

Aim → Implementation of Network Topologies using Cisco Packet Tracer

Objective 1 → An overview on network topologies (i.e. Star, Bus, Ring and Mesh)

i) Star Topology → a) Structure → All nodes connect to a central hub

b) Pros → Easy to manage, node failures don't affect others.

c) Cons → Hub failure brings down the network; more cabling required.

ii) Bus Topology →

a) Structure → Devices share a single communication line.

b) Pros → Cost-effective, simple setup

c) Cons → Network failure if the main line breaks; limited scalability

iii) Ring Topology →

a) Structure → Devices form a closed loop, data flows in one direction

b) Pros → Predictable data flow, easy setup

c) Cons → One failure can disrupt the entire network

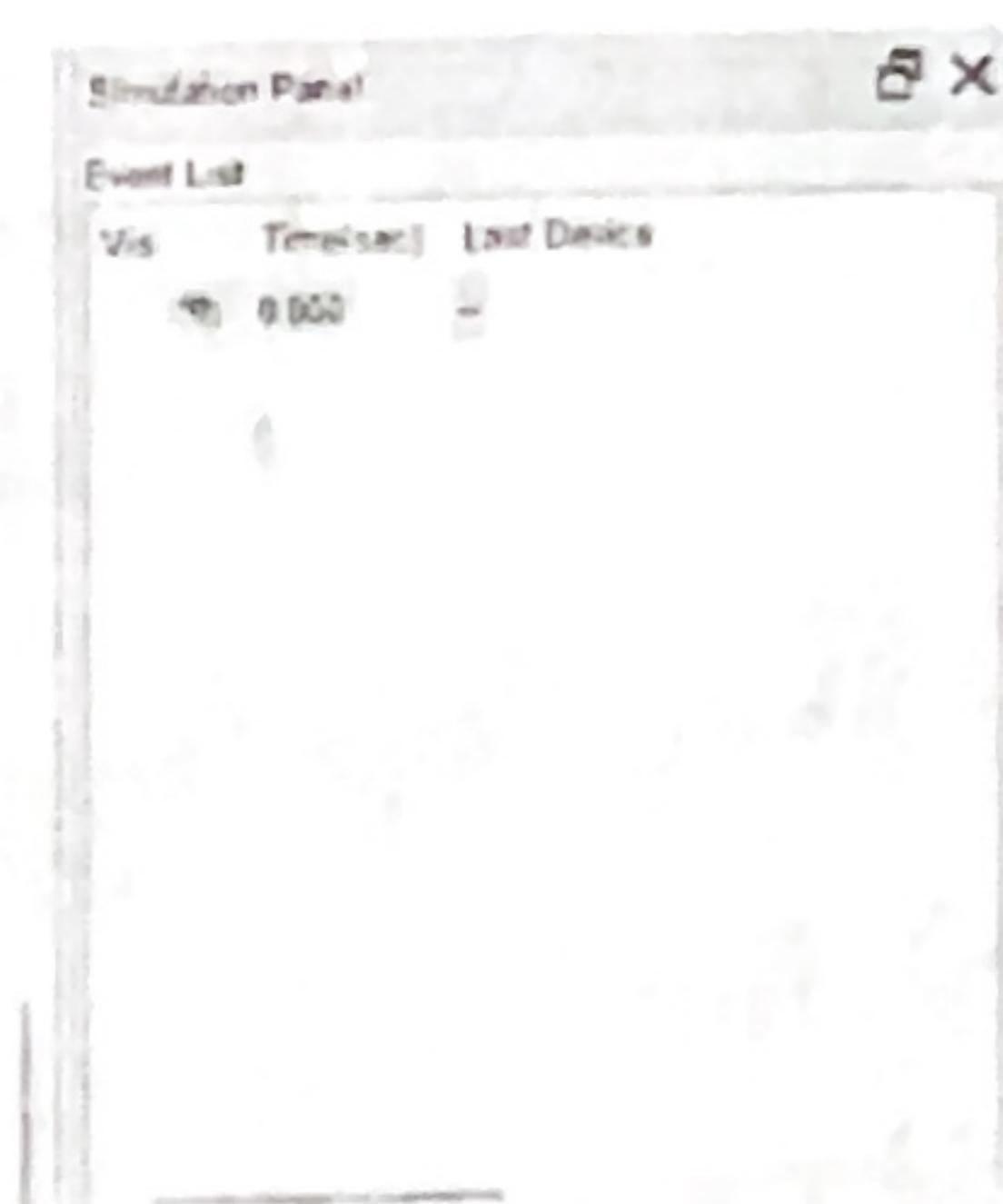
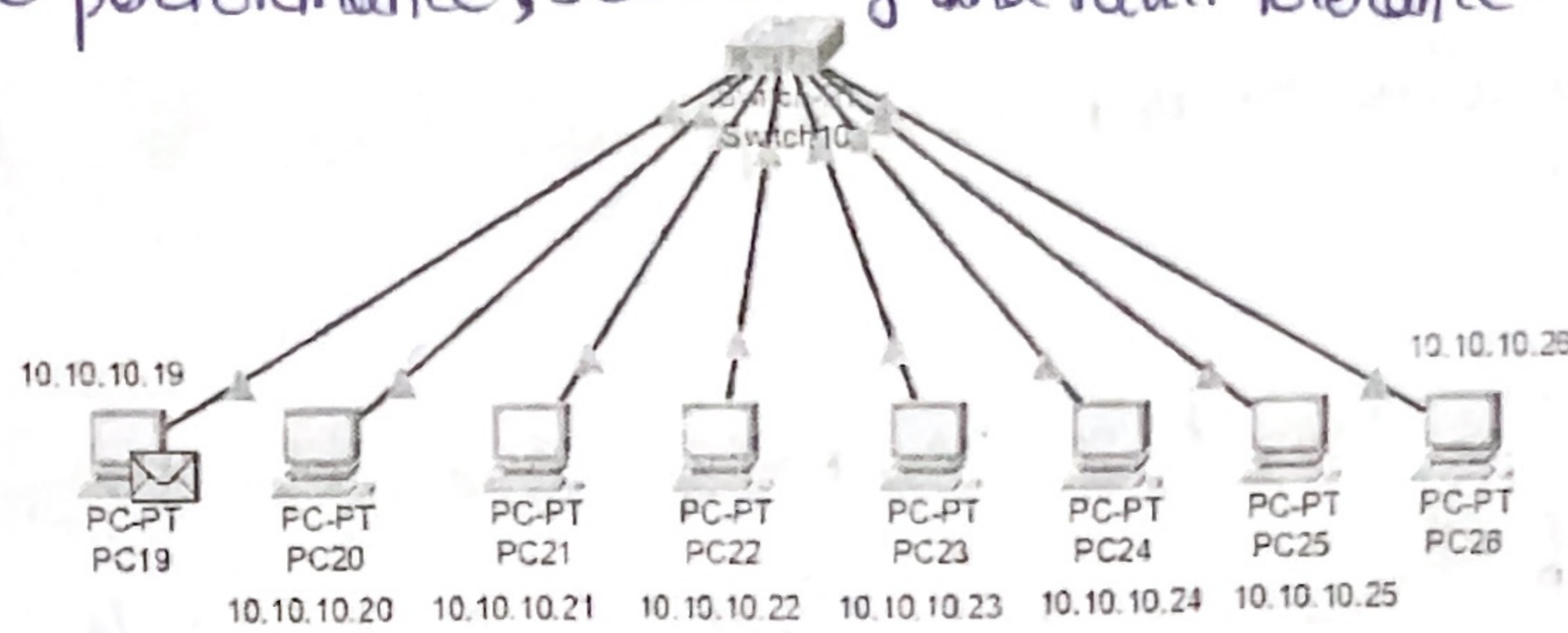
iv) Mesh Topology →

a) Structure → Devices are interconnected

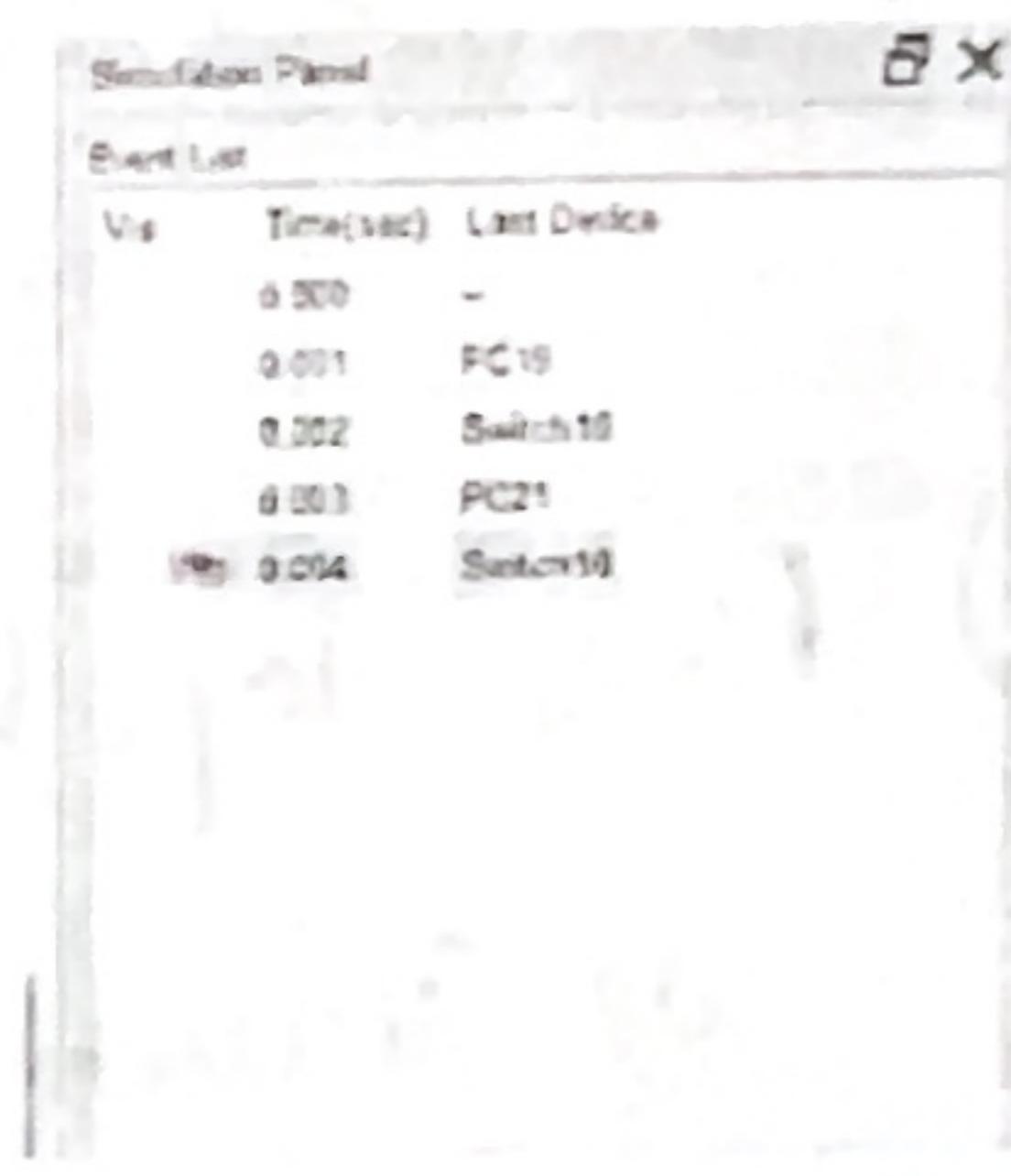
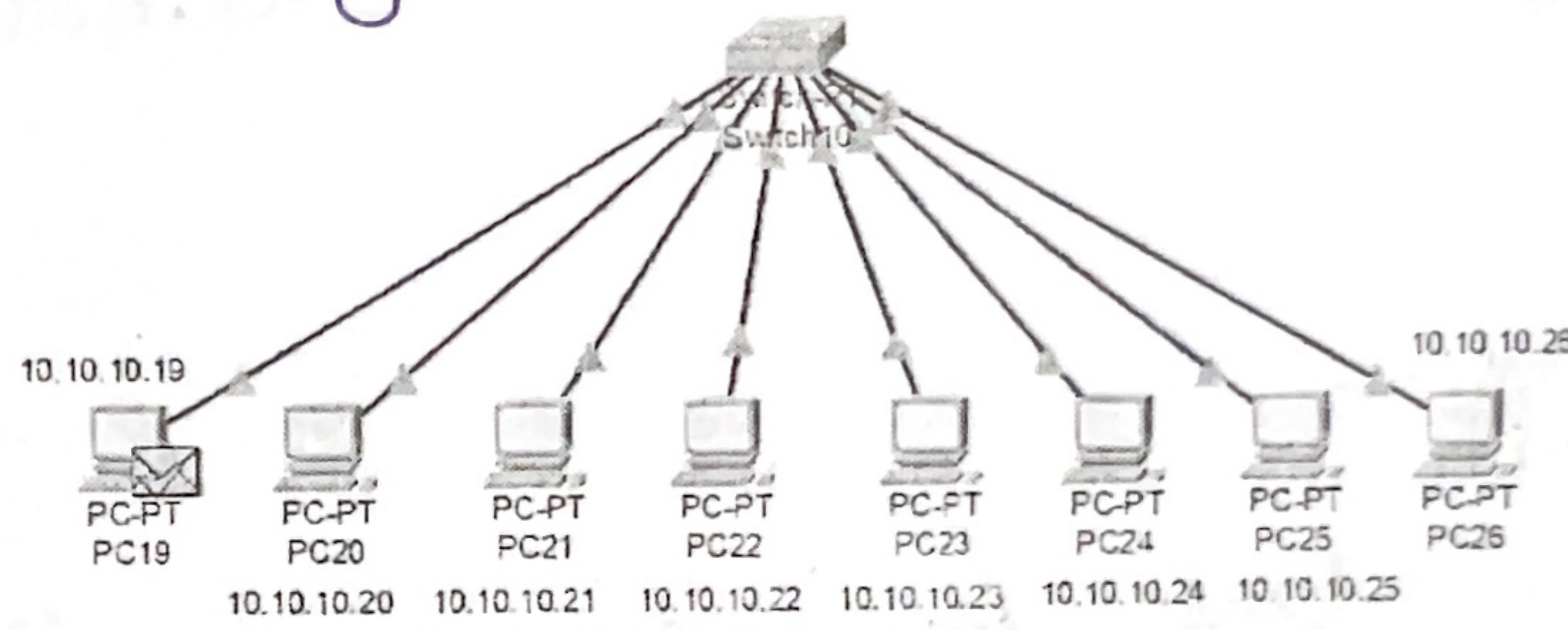
b) Pros → Highly reliable, redundancy built-in

c) Cons → Complex and expensive to implement.

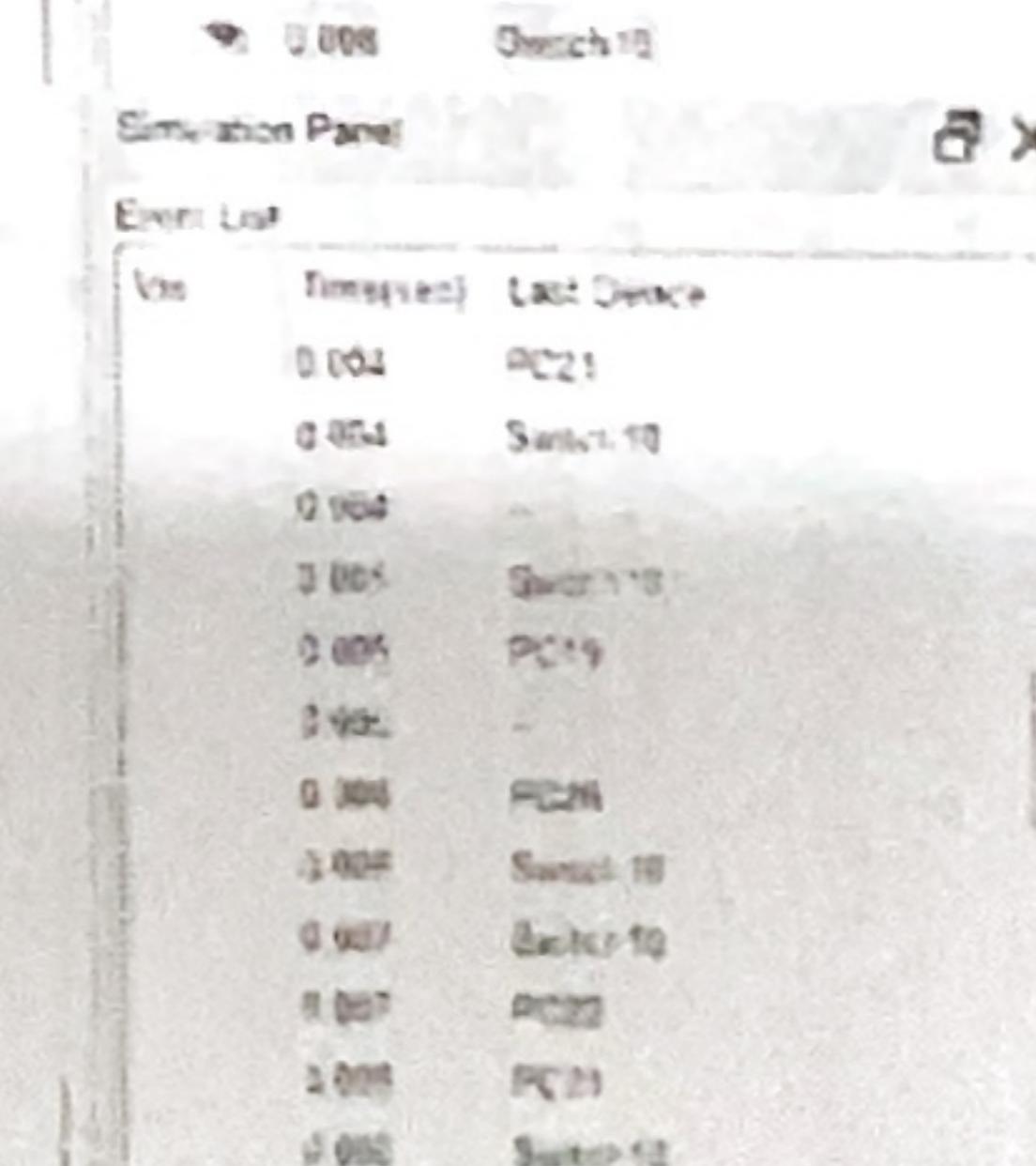
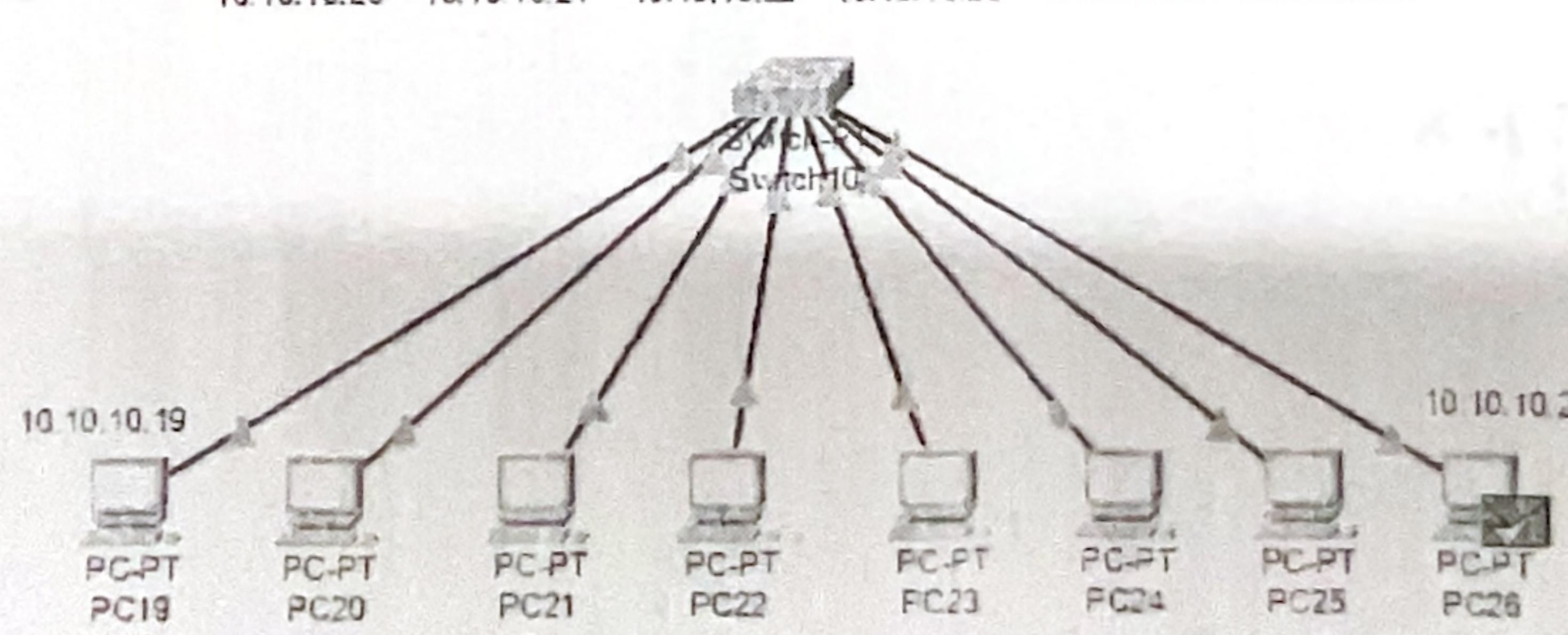
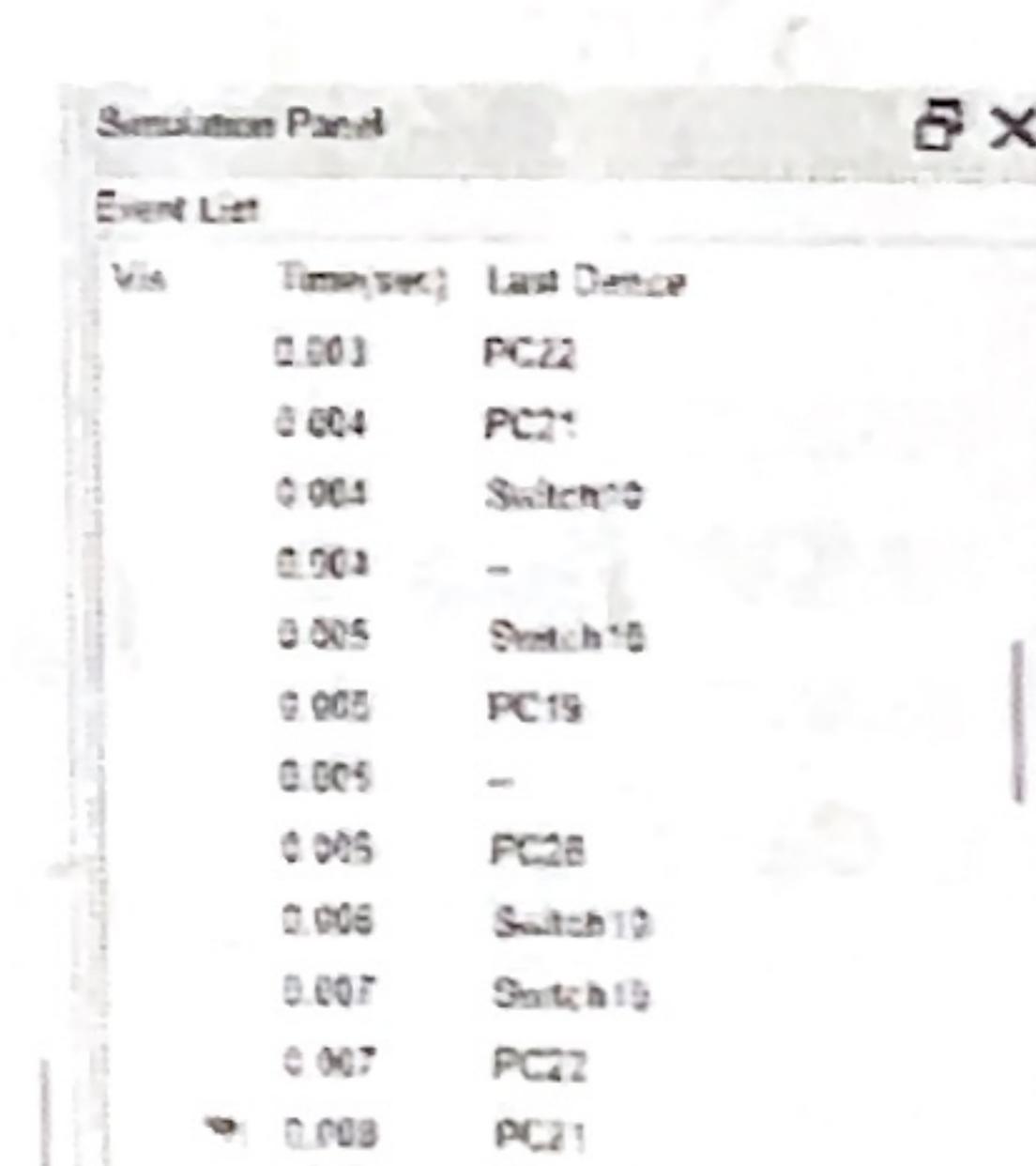
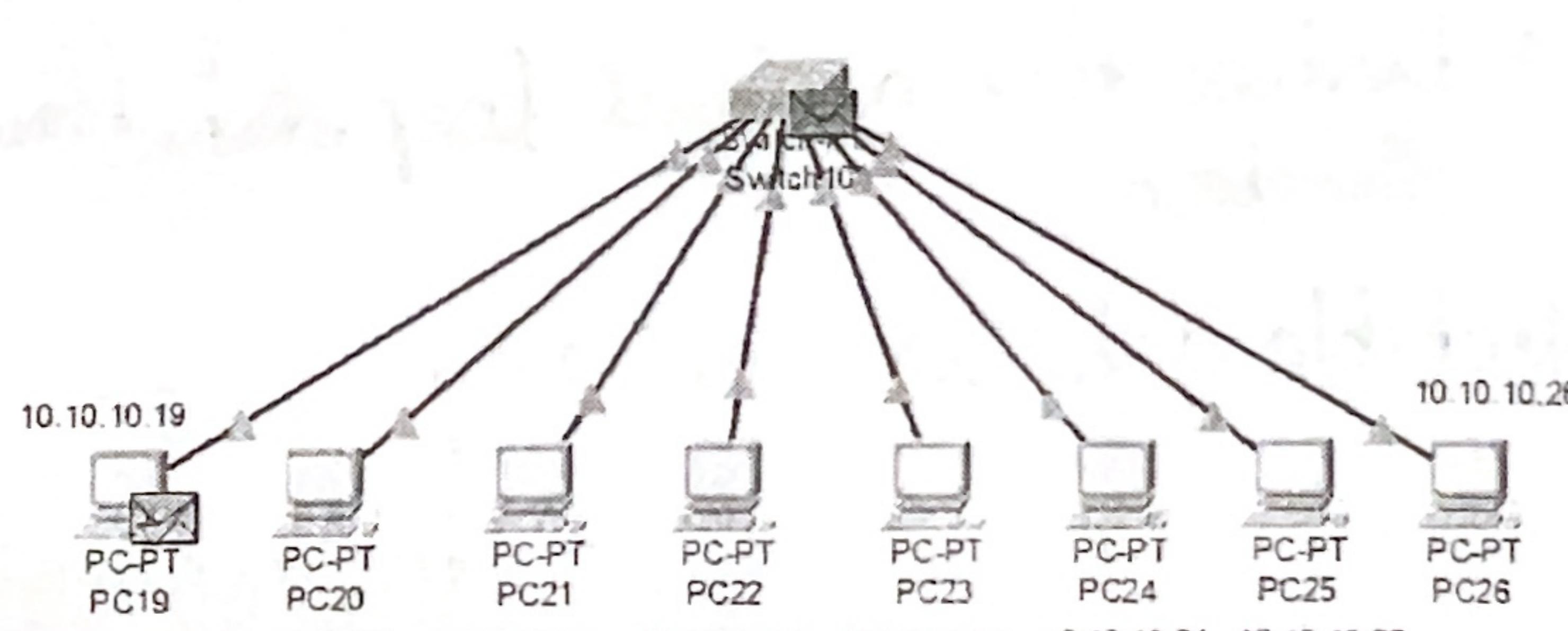
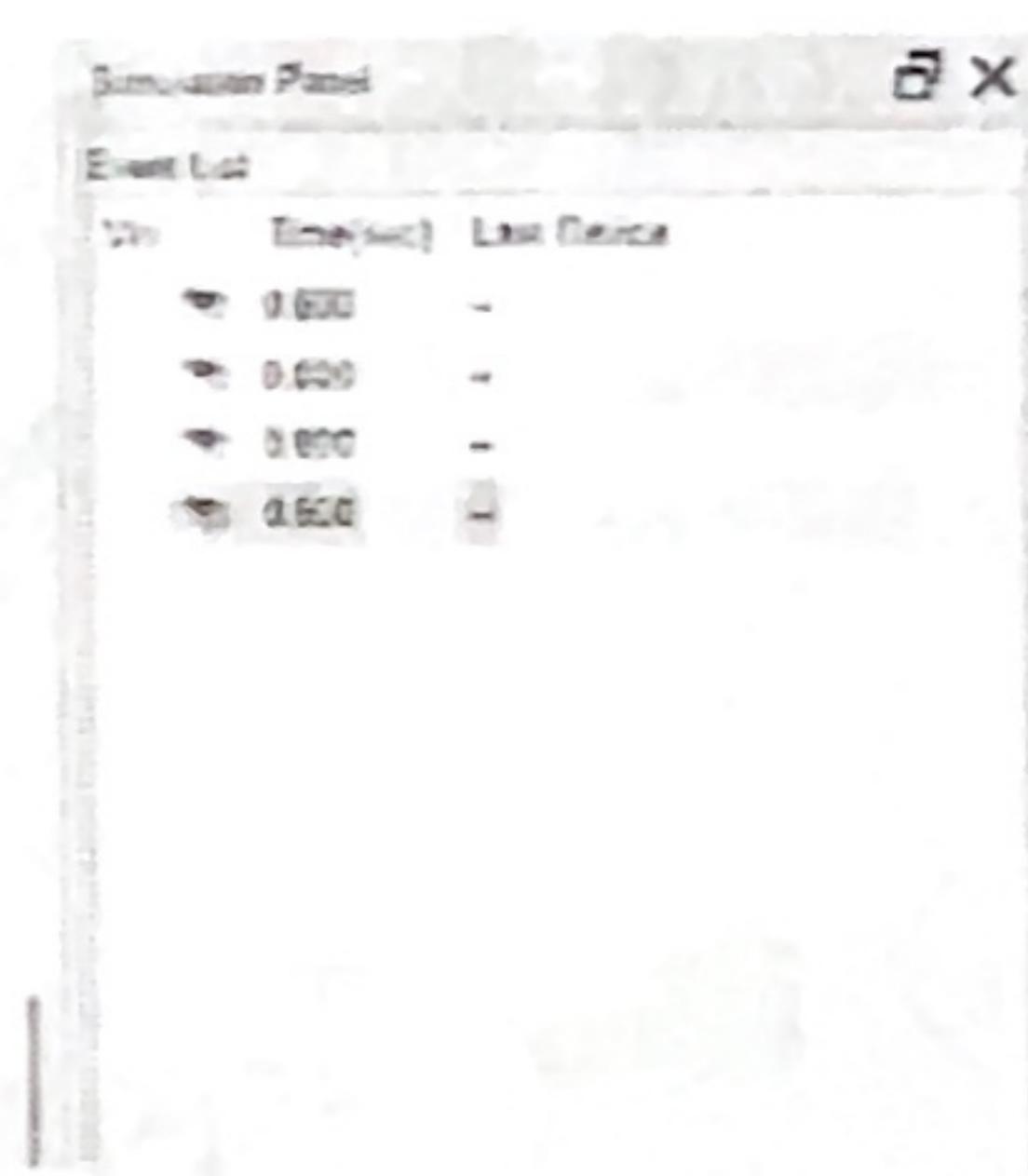
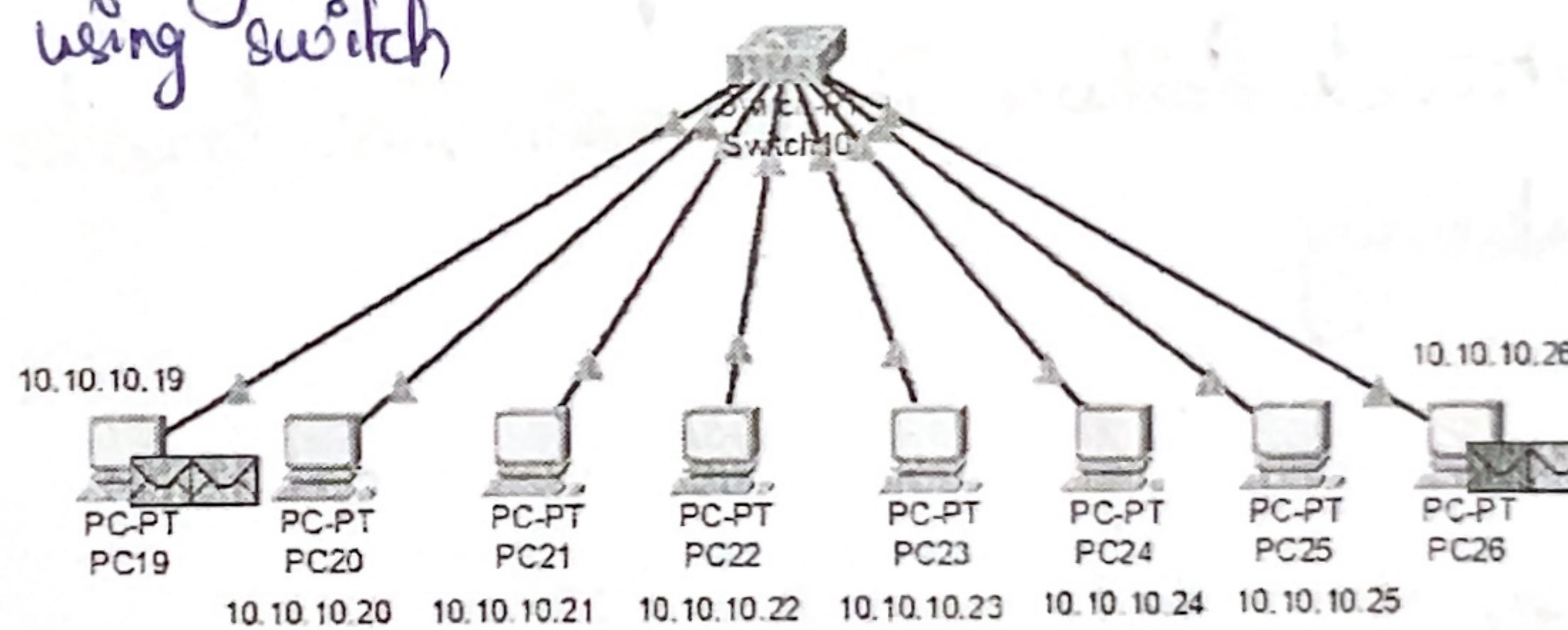
Objective 2 → Constructing and simulating a network based on star topology to analyse the performance, scalability and fault tolerance.



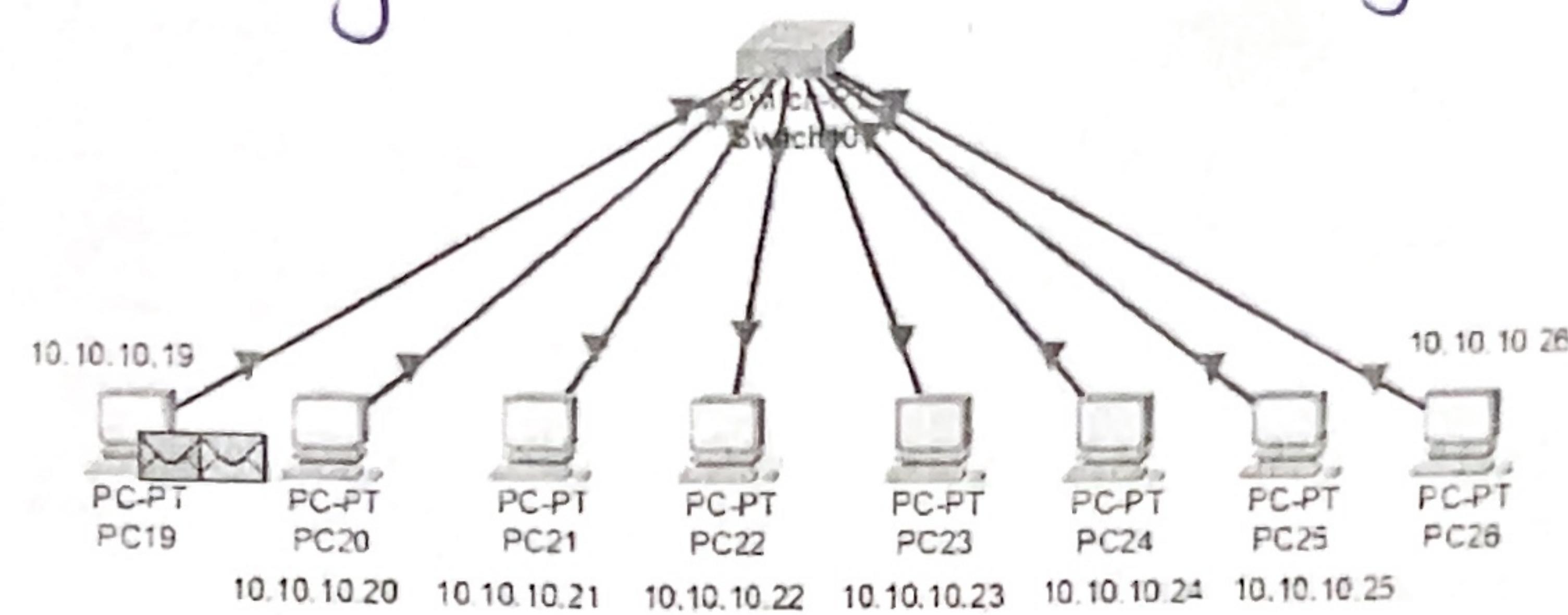
a) Sending and receiving message from PC19 to PC22 using switch.



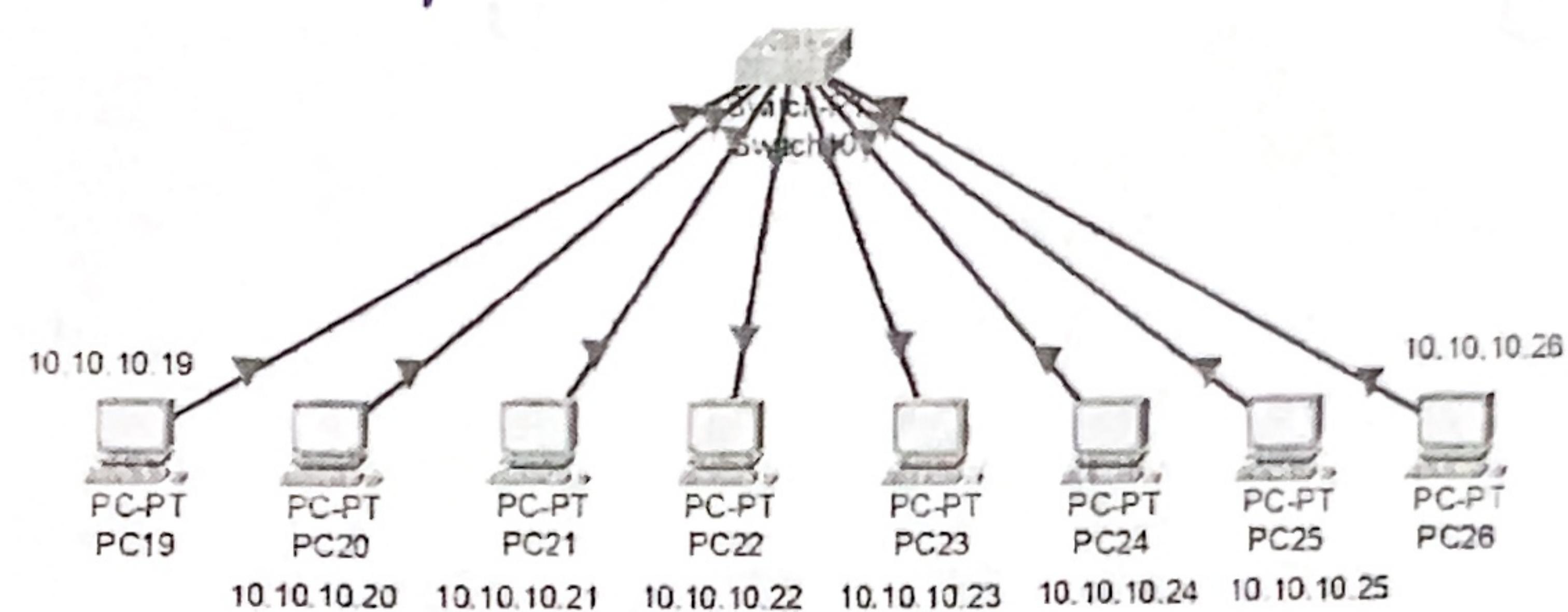
b) Sending and receiving messages from PC19 to PC22 and PC26 to PC21 using switch



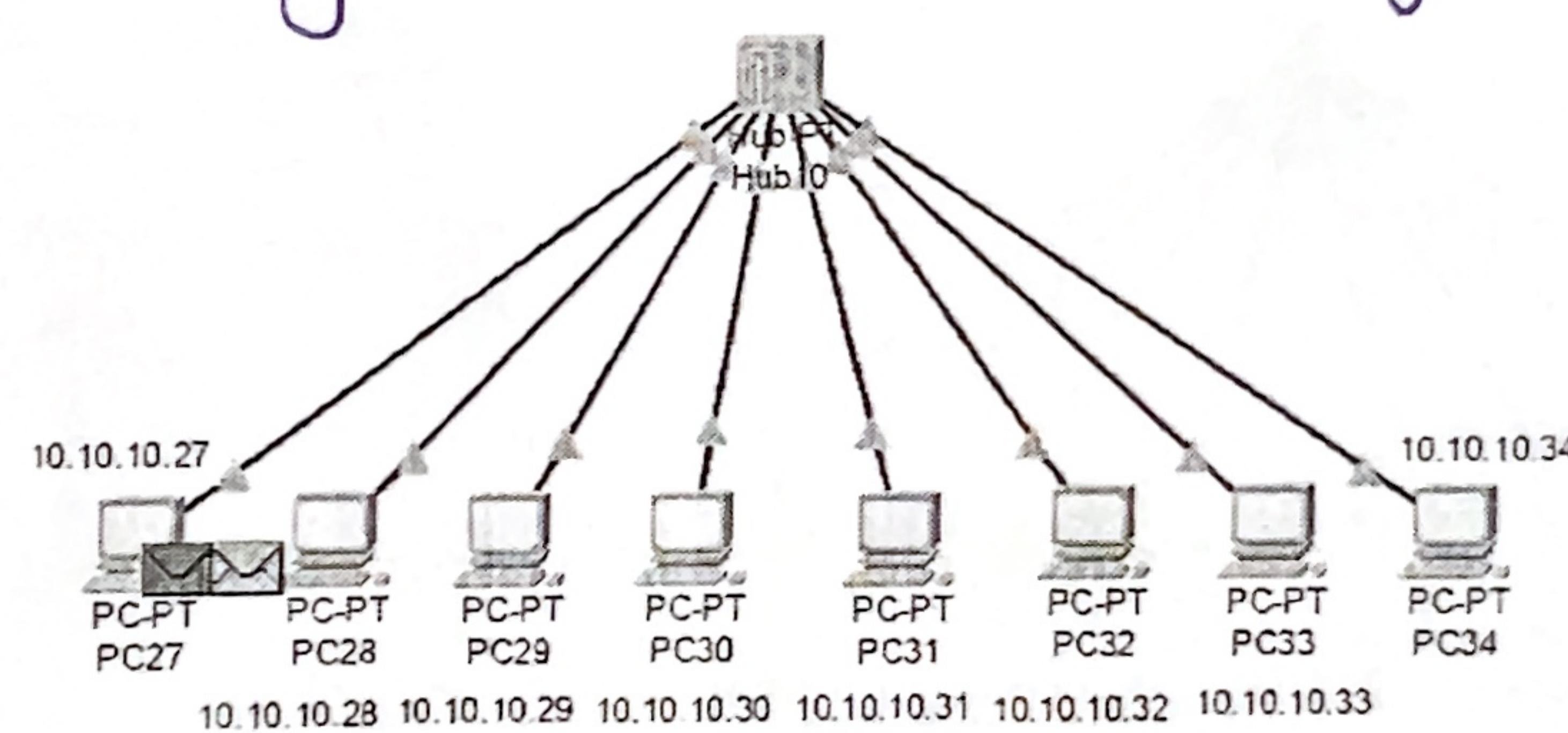
c) Switching off the switch and sending message from PC 19 to PC 25



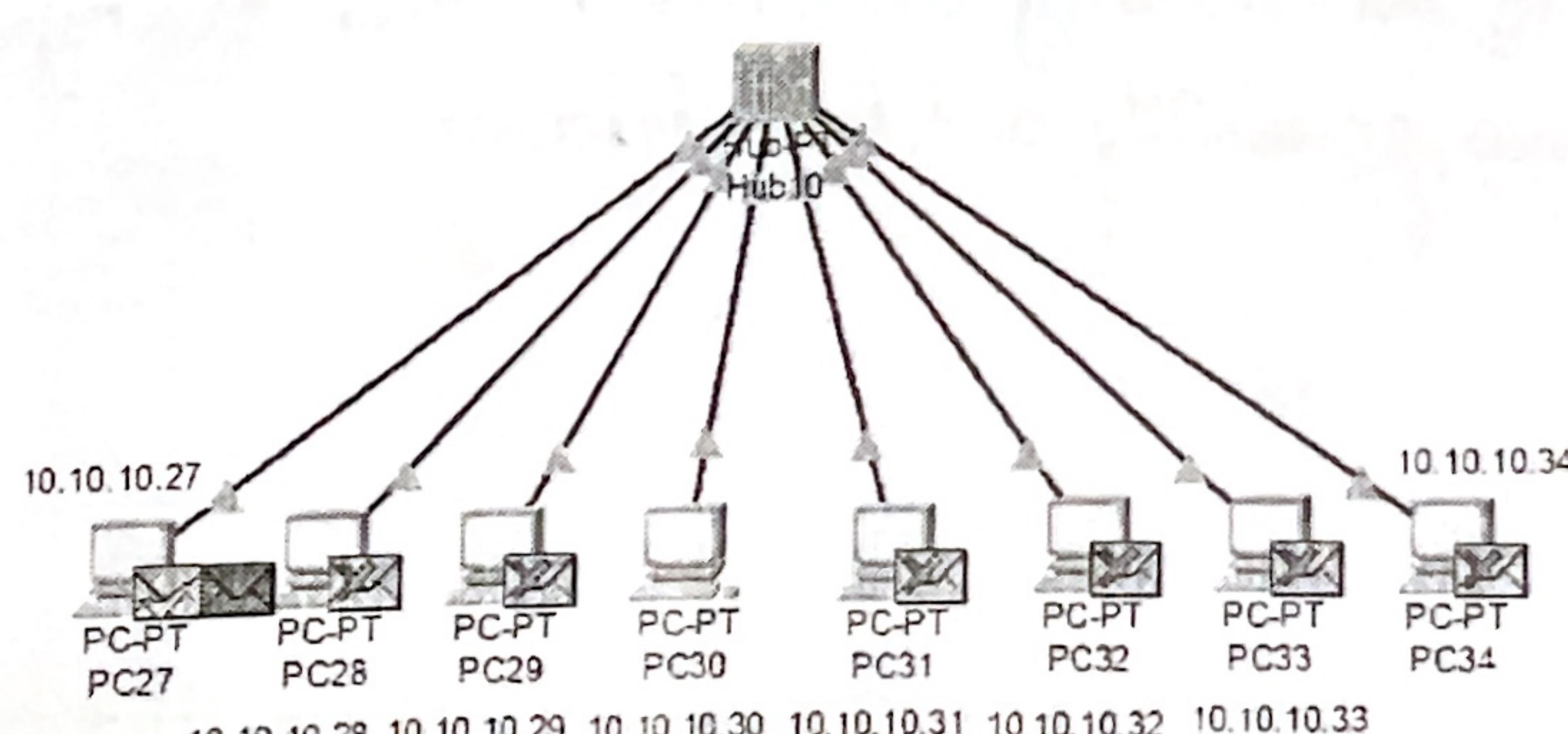
Reception didn't work because of network failure.



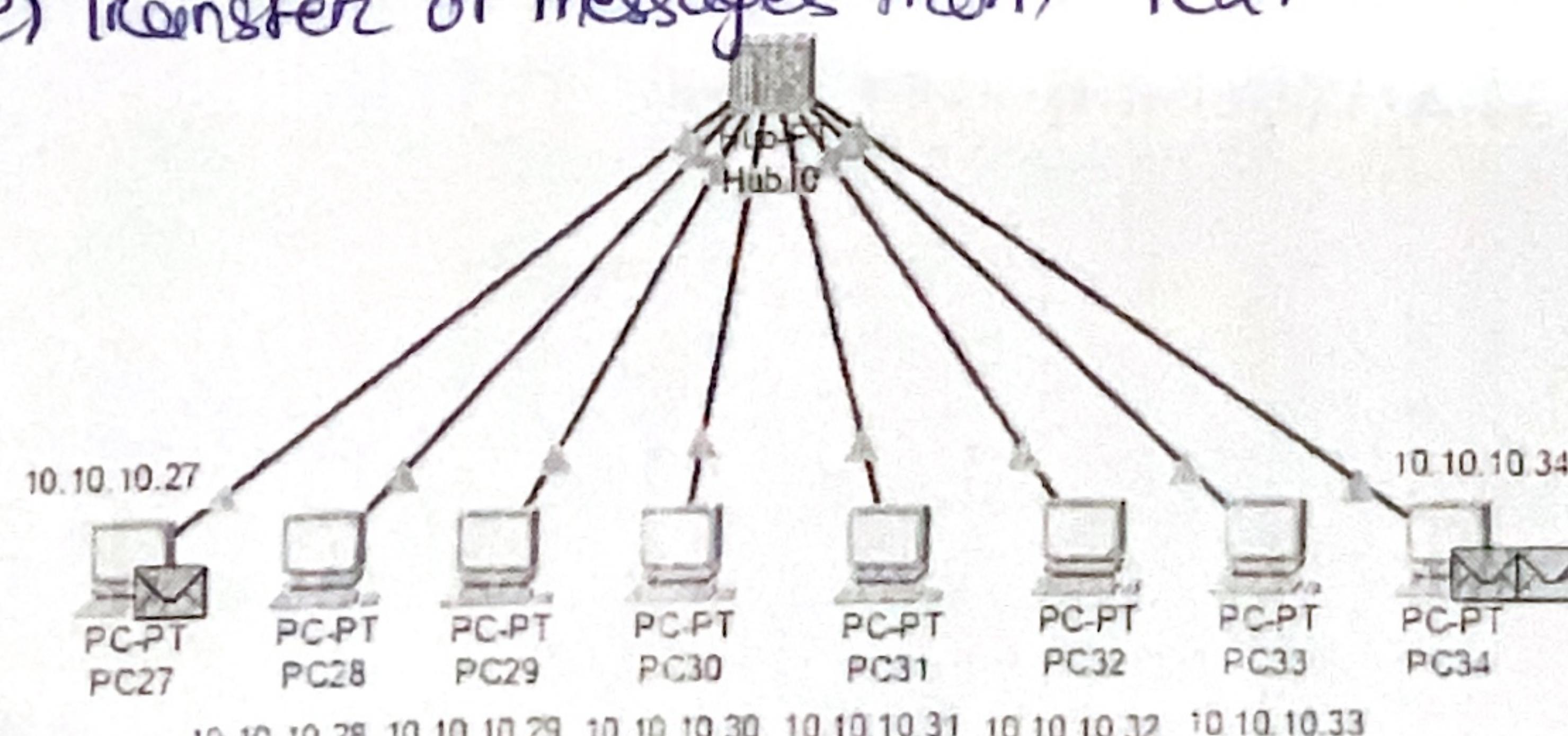
(d) Using hub for transfer of message from PC<sub>27</sub> to PC<sub>30</sub>



Event List	Timestamp	Last Event ID
0	0 000	-
1	0 000	-



e) Transfer of messages from PC27 to PC30 & PC34 to PC29

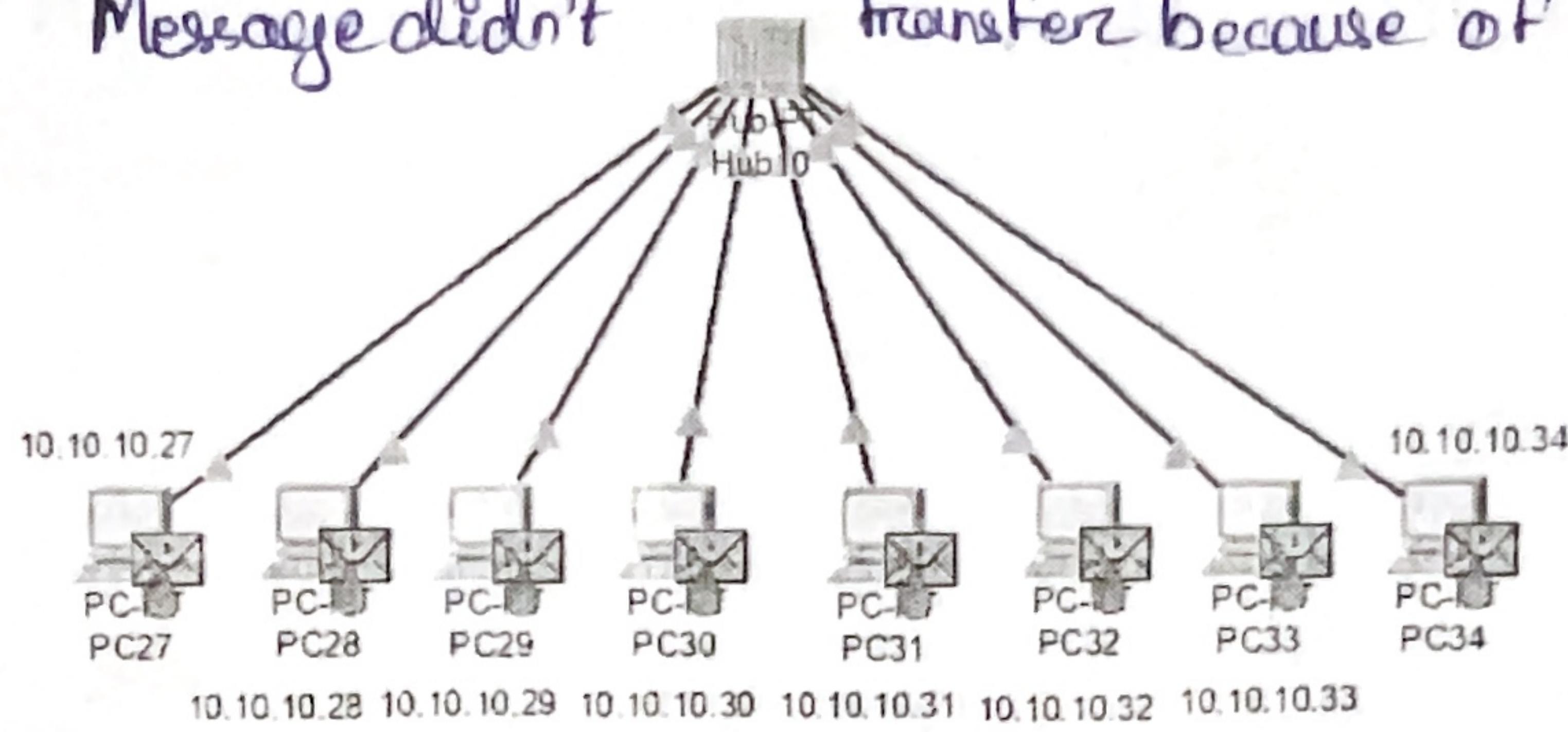


Time (hrs)	Last Dance
0.392	-
0.360	-
0.060	-

Name: \_\_\_\_\_

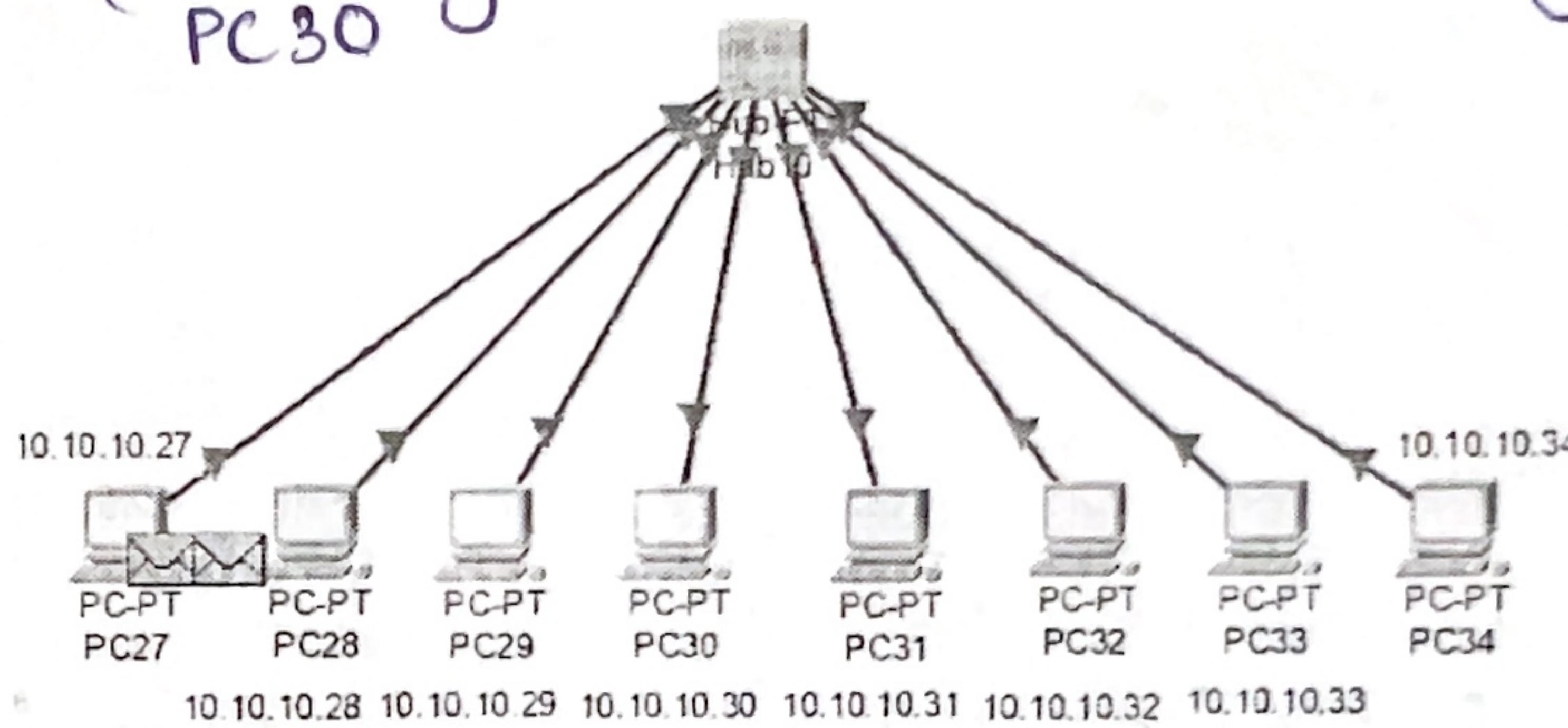
Regd No.: \_\_\_\_\_

Message didn't transfer because of collision

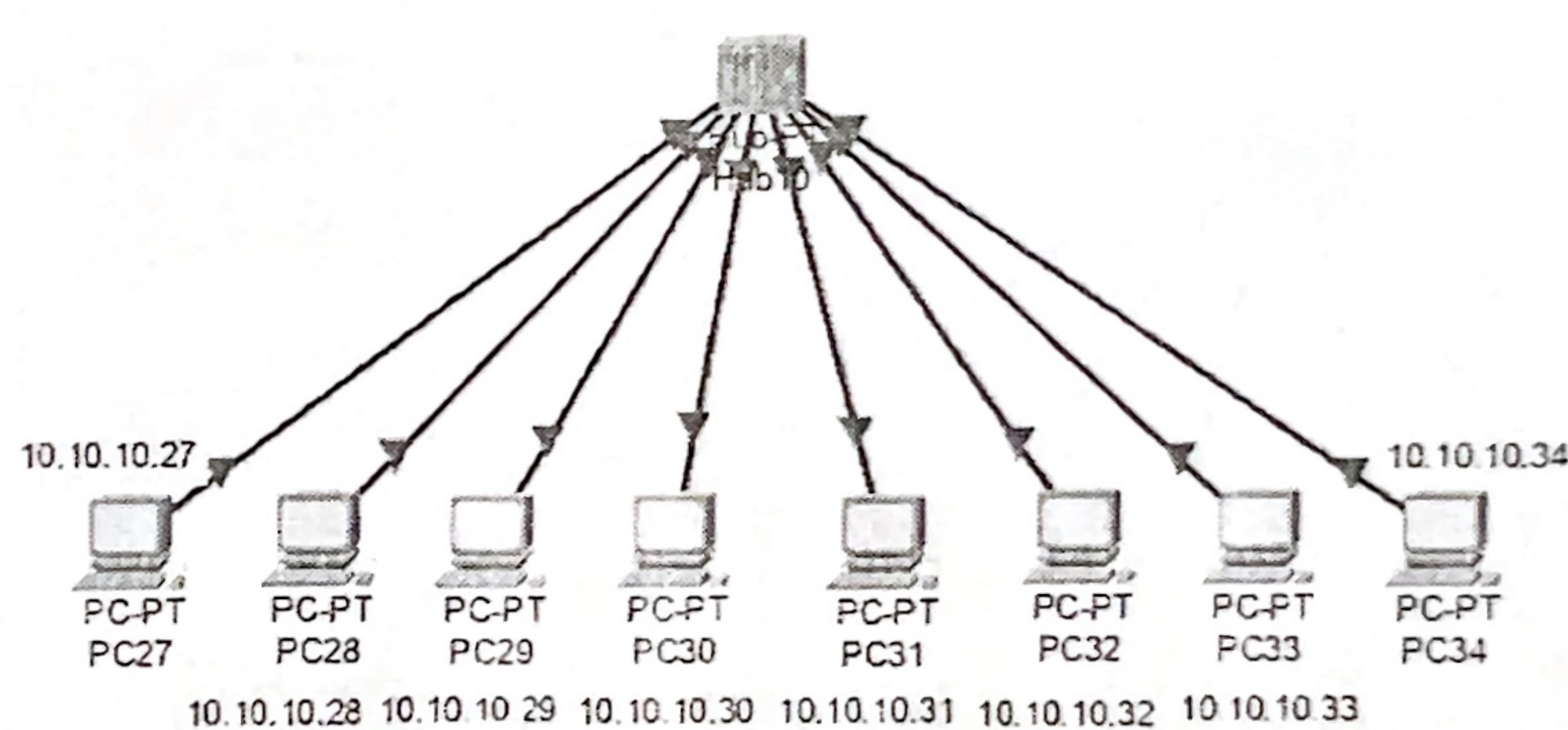


Event List	VIS	Time(sec)	Last Device
0.000	-	-	-
0.000	-	-	-
0.000	-	-	-
0.001	PC27	0.001	-
0.001	PC34	0.001	-
0.002	Hub10	0.002	-
0.002	Hub10	0.002	-
0.002	Hub10	0.002	-
0.002	Hub10	0.002	-
0.002	Hub10	0.002	-
0.002	Hub10	0.002	-
0.002	Hub10	0.002	-
0.002	Hub10	0.002	-

f) Switching off the hub, and then sending message from PC27 to PC30

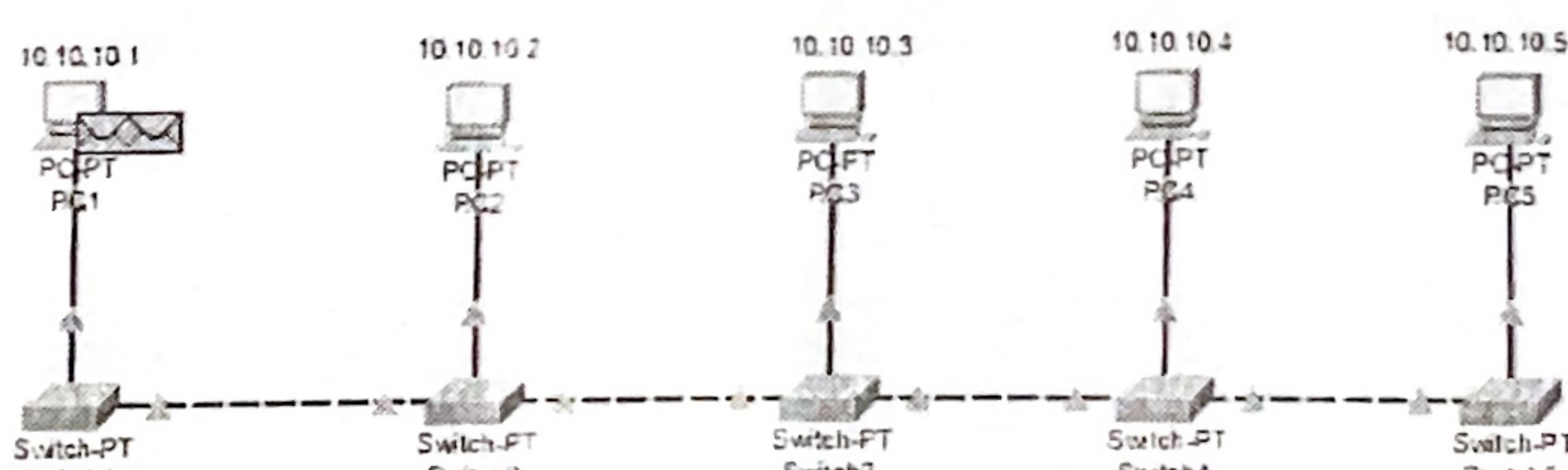


Simulation Panel	Event List	VIS	Time(sec)	Last Device
0.000	-	-	-	-
0.000	-	-	-	-



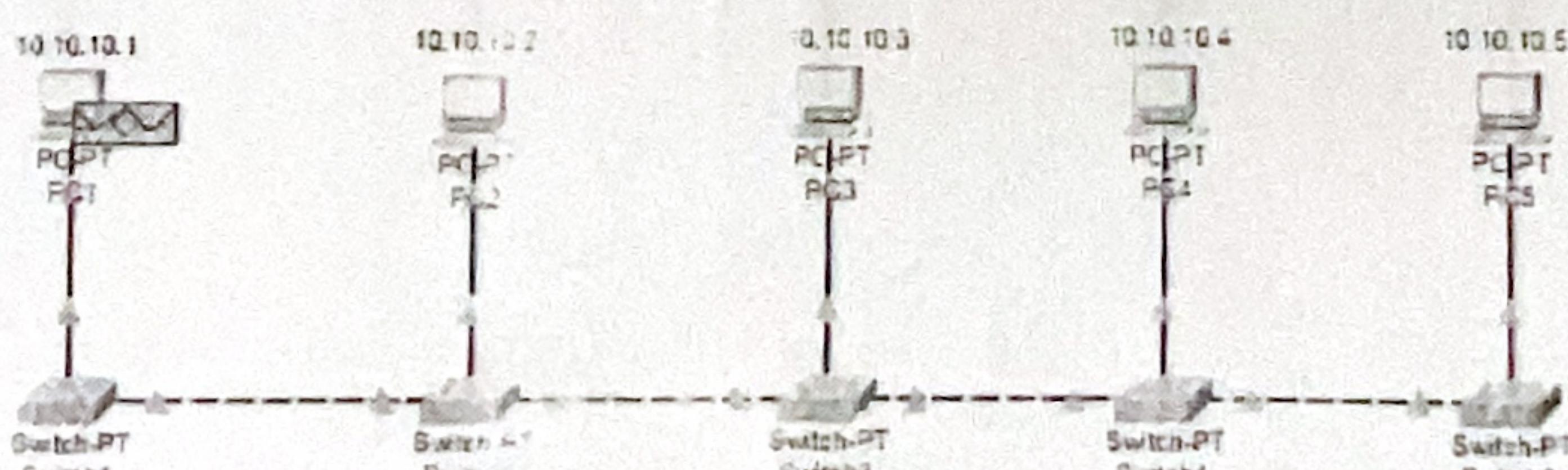
Simulation Panel	Event List	VIS	Time(sec)	Last Device
0.000	-	-	-	-
0.000	-	-	0.042	-

Objective 3 → Constructing and simulating a network based on bus topology to analyse the performance, scalability and fault tolerance.



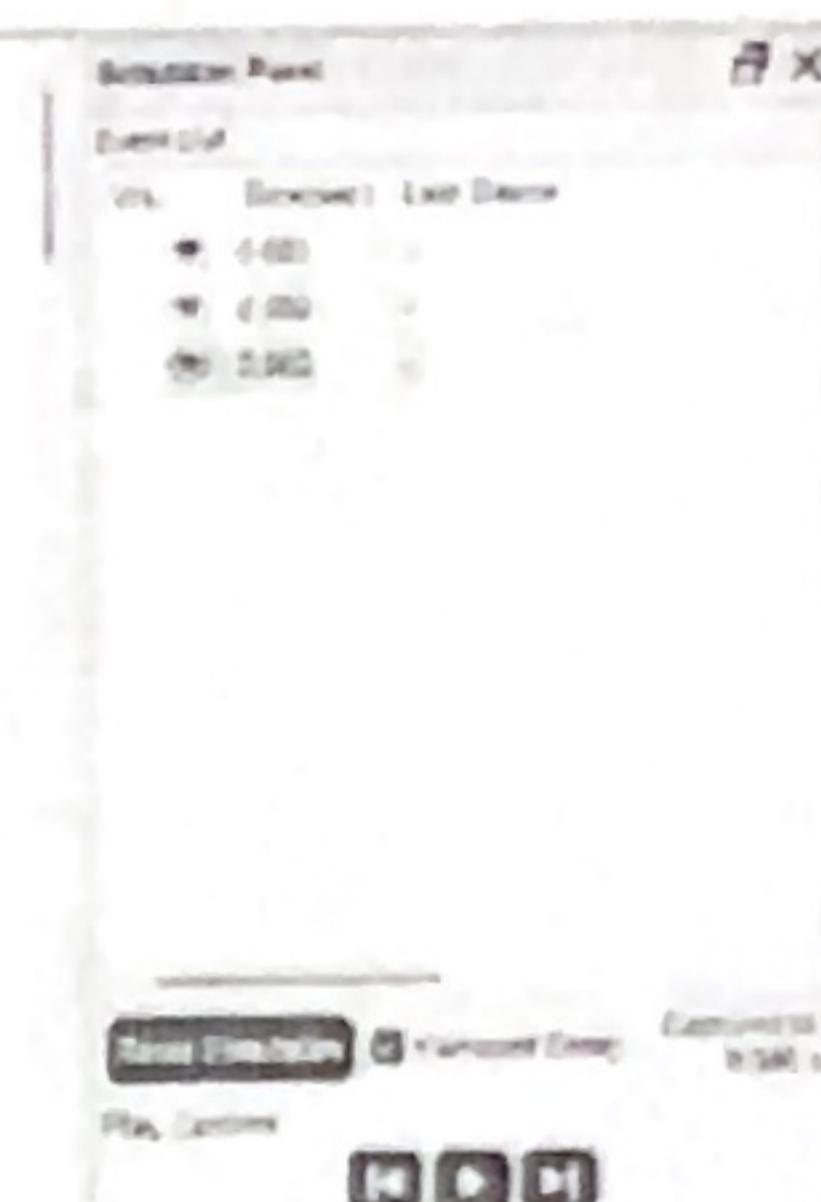
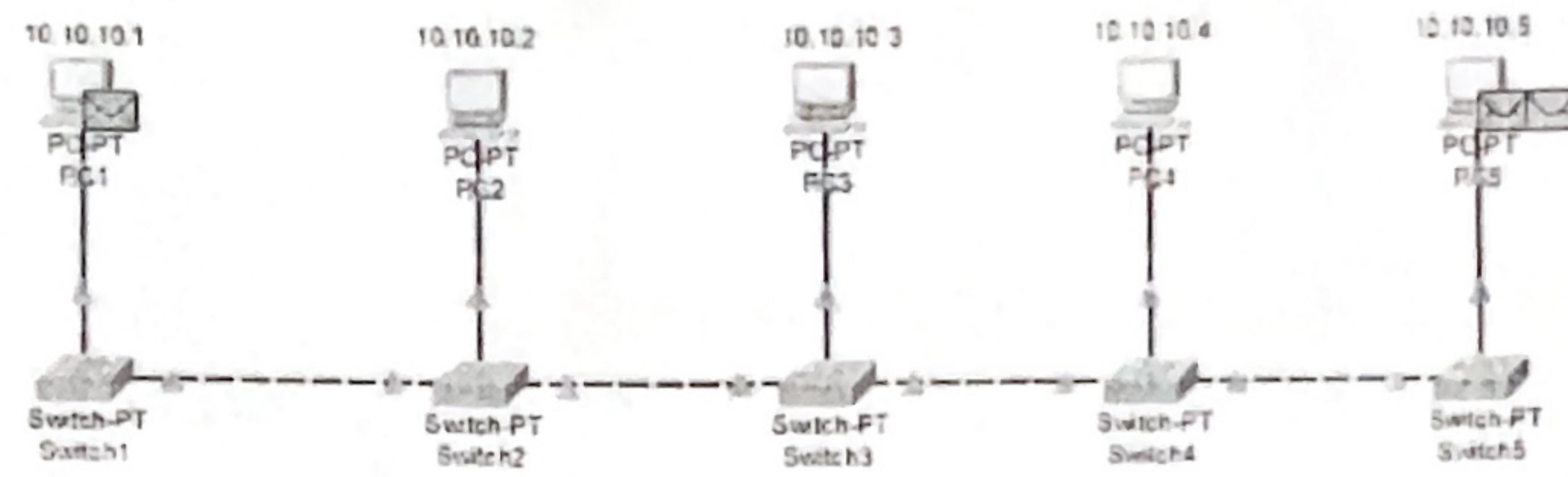
Simulation Panel	Event List	VIS	Time(sec)	Last Device
0.000	-	-	-	-
0.000	-	-	-	-

a) Sending message from PC1 to PC4 using switch and receiving back the same at PC1

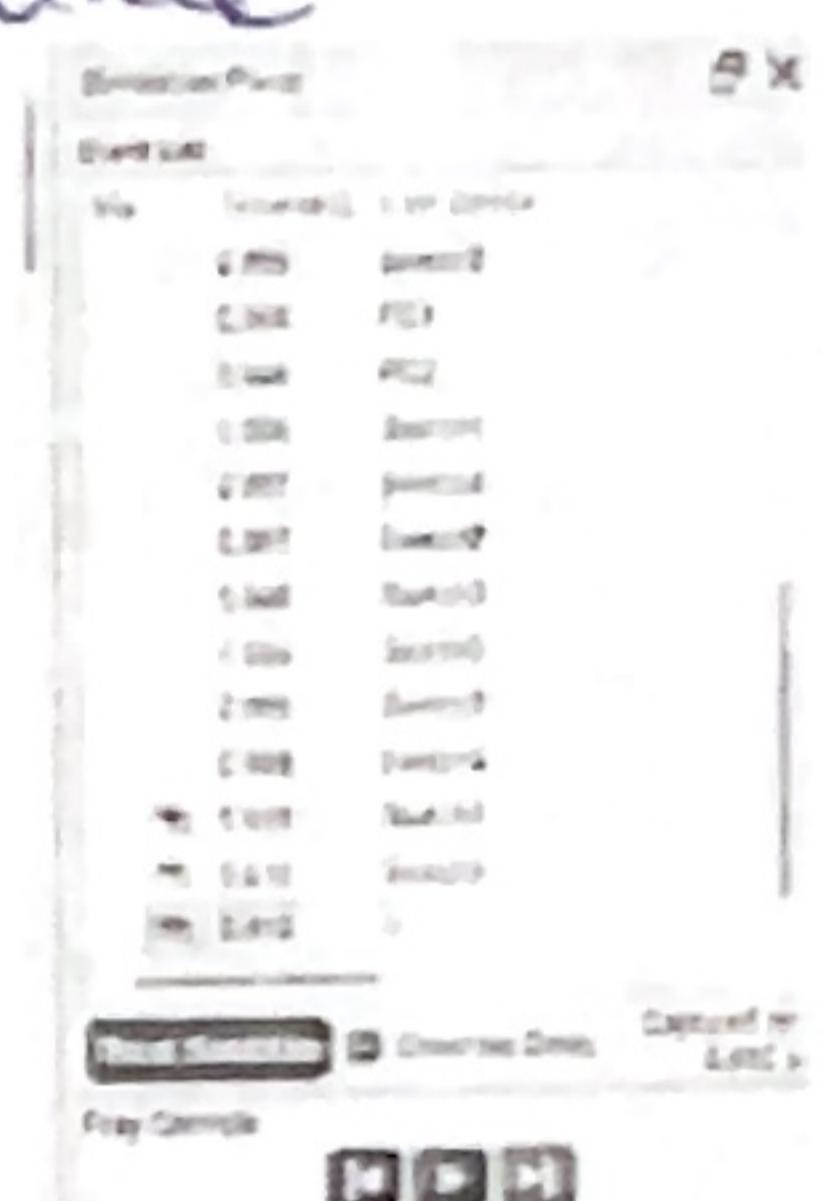
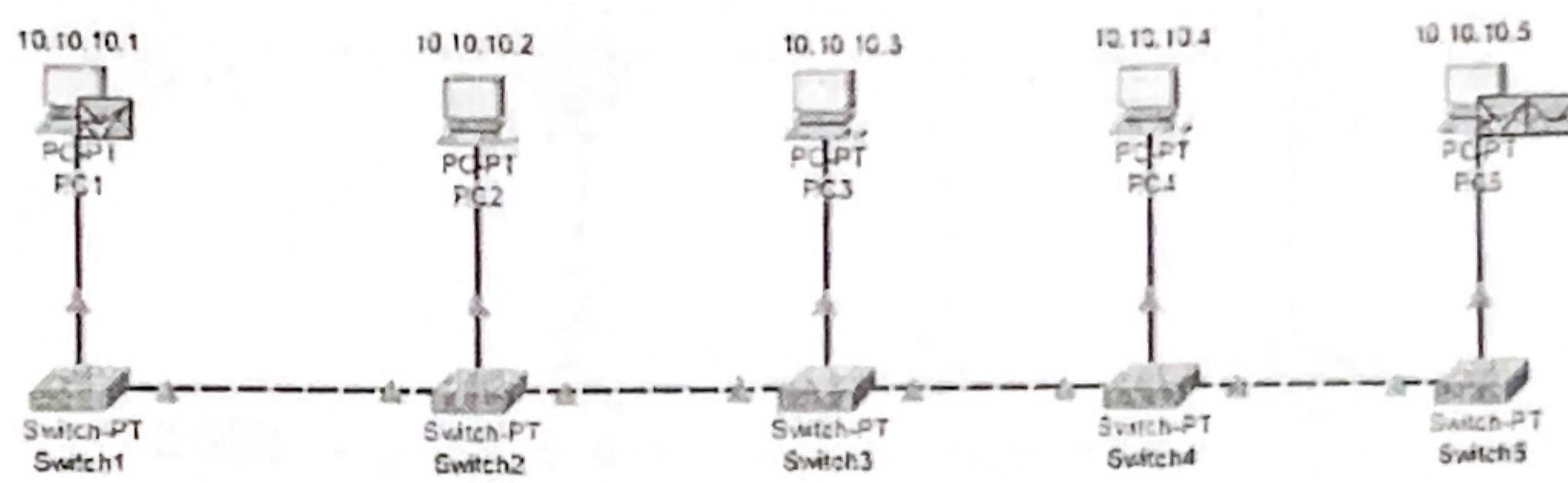


Simulation Panel	Event List	VIS	Time(sec)	Last Device
0.000	Switch1	0.000	-	-
0.000	Switch2	0.000	-	-
0.000	Switch3	0.000	-	-
0.000	Switch4	0.000	-	-
0.000	Switch5	0.000	-	-
0.001	Switch1	0.001	-	-
0.001	Switch2	0.001	-	-
0.001	Switch3	0.001	-	-
0.001	Switch4	0.001	-	-
0.001	Switch5	0.001	-	-
0.002	Switch1	0.002	-	-
0.002	Switch2	0.002	-	-
0.002	Switch3	0.002	-	-
0.002	Switch4	0.002	-	-
0.002	Switch5	0.002	-	-
0.003	Switch1	0.003	-	-
0.003	Switch2	0.003	-	-
0.003	Switch3	0.003	-	-
0.003	Switch4	0.003	-	-
0.003	Switch5	0.003	-	-
0.004	Switch1	0.004	-	-
0.004	Switch2	0.004	-	-
0.004	Switch3	0.004	-	-
0.004	Switch4	0.004	-	-
0.004	Switch5	0.004	-	-
0.005	Switch1	0.005	-	-
0.005	Switch2	0.005	-	-
0.005	Switch3	0.005	-	-
0.005	Switch4	0.005	-	-
0.005	Switch5	0.005	-	-
0.006	Switch1	0.006	-	-
0.006	Switch2	0.006	-	-
0.006	Switch3	0.006	-	-
0.006	Switch4	0.006	-	-
0.006	Switch5	0.006	-	-
0.007	Switch1	0.007	-	-
0.007	Switch2	0.007	-	-
0.007	Switch3	0.007	-	-
0.007	Switch4	0.007	-	-
0.007	Switch5	0.007	-	-
0.008	Switch1	0.008	-	-
0.008	Switch2	0.008	-	-
0.008	Switch3	0.008	-	-
0.008	Switch4	0.008	-	-
0.008	Switch5	0.008	-	-
0.009	Switch1	0.009	-	-
0.009	Switch2	0.009	-	-
0.009	Switch3	0.009	-	-
0.009	Switch4	0.009	-	-
0.009	Switch5	0.009	-	-
0.010	Switch1	0.010	-	-
0.010	Switch2	0.010	-	-
0.010	Switch3	0.010	-	-
0.010	Switch4	0.010	-	-
0.010	Switch5	0.010	-	-
0.011	Switch1	0.011	-	-
0.011	Switch2	0.011	-	-
0.011	Switch3	0.011	-	-
0.011	Switch4	0.011	-	-
0.011	Switch5	0.011	-	-
0.012	Switch1	0.012	-	-
0.012	Switch2	0.012	-	-
0.012	Switch3	0.012	-	-
0.012	Switch4	0.012	-	-
0.012	Switch5	0.012	-	-
0.013	Switch1	0.013	-	-
0.013	Switch2	0.013	-	-
0.013	Switch3	0.013	-	-
0.013	Switch4	0.013	-	-
0.013	Switch5	0.013	-	-
0.014	Switch1	0.014	-	-
0.014	Switch2	0.014	-	-
0.014	Switch3	0.014	-	-
0.014	Switch4	0.014	-	-
0.014	Switch5	0.014	-	-
0.015	Switch1	0.015	-	-
0.015	Switch2	0.015	-	-
0.015	Switch3	0.015	-	-
0.015	Switch4	0.015	-	-
0.015	Switch5	0.015	-	-
0.016	Switch1	0.016	-	-
0.016	Switch2	0.016	-	-
0.016	Switch3	0.016	-	-
0.016	Switch4	0.016	-	-
0.016	Switch5	0.016	-	-
0.017	Switch1	0.017	-	-
0.017	Switch2	0.017	-	-
0.017	Switch3	0.017	-	-
0.017	Switch4	0.017	-	-
0.017	Switch5	0.017	-	-
0.018	Switch1	0.018	-	-
0.018	Switch2	0.018	-	-
0.018	Switch3	0.018	-	-
0.018	Switch4	0.018	-	-
0.018	Switch5	0.018	-	-
0.019	Switch1	0.019	-	-
0.019	Switch2	0.019	-	-
0.019	Switch3	0.019	-	-
0.019	Switch4	0.019	-	-
0.019	Switch5	0.019	-	-
0.020	Switch1	0.020	-	-
0.020	Switch2	0.020	-	-
0.020	Switch3	0.020	-	-
0.020	Switch4	0.020	-	-
0.020	Switch5	0.020	-	-
0.021	Switch1	0.021	-	-
0.021	Switch2	0.021	-	-
0.021	Switch3	0.021	-	-
0.021	Switch4	0.021	-	-
0.021	Switch5	0.021	-	-

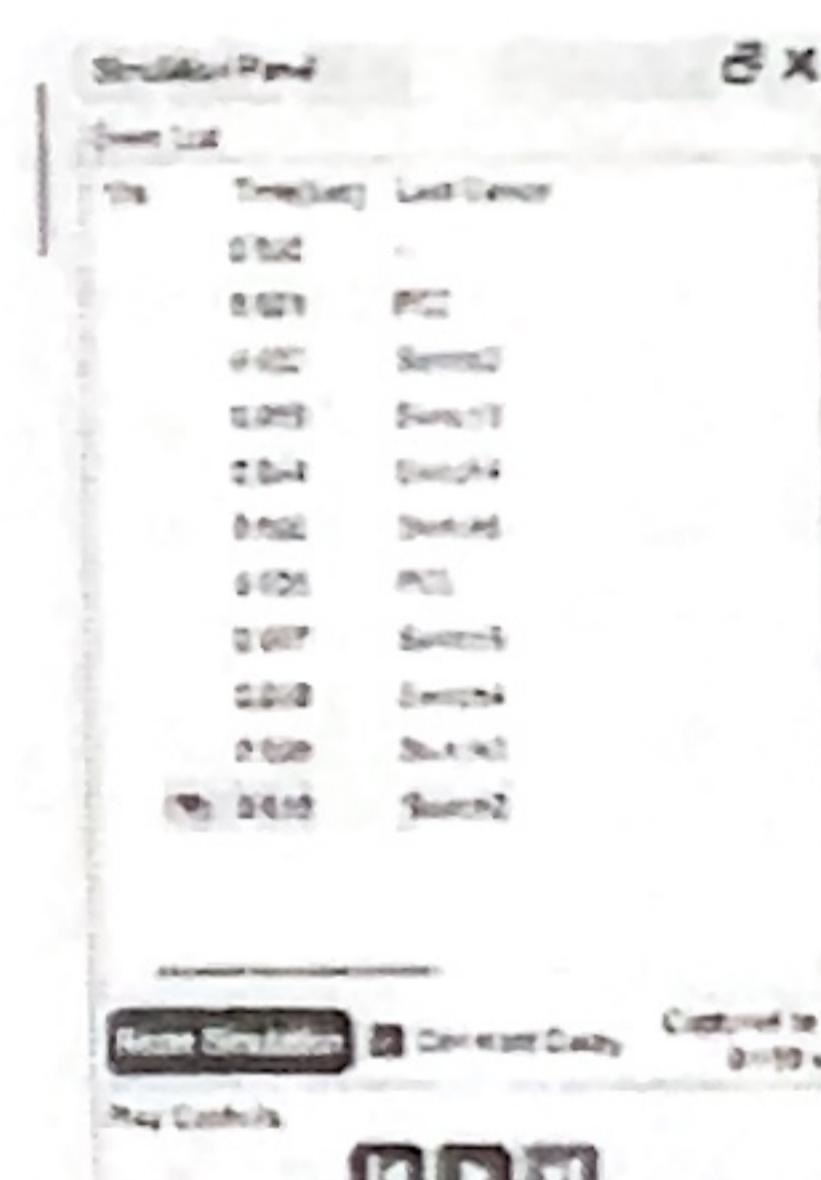
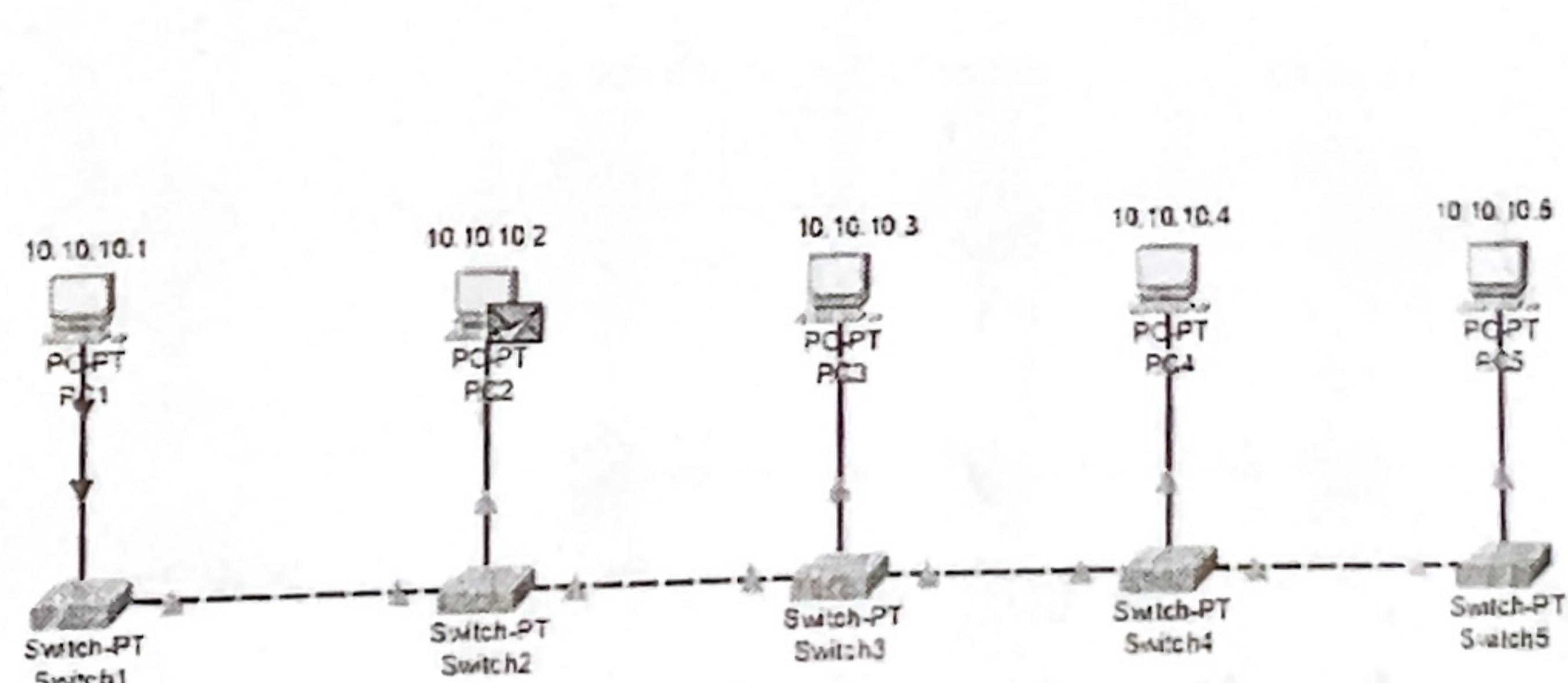
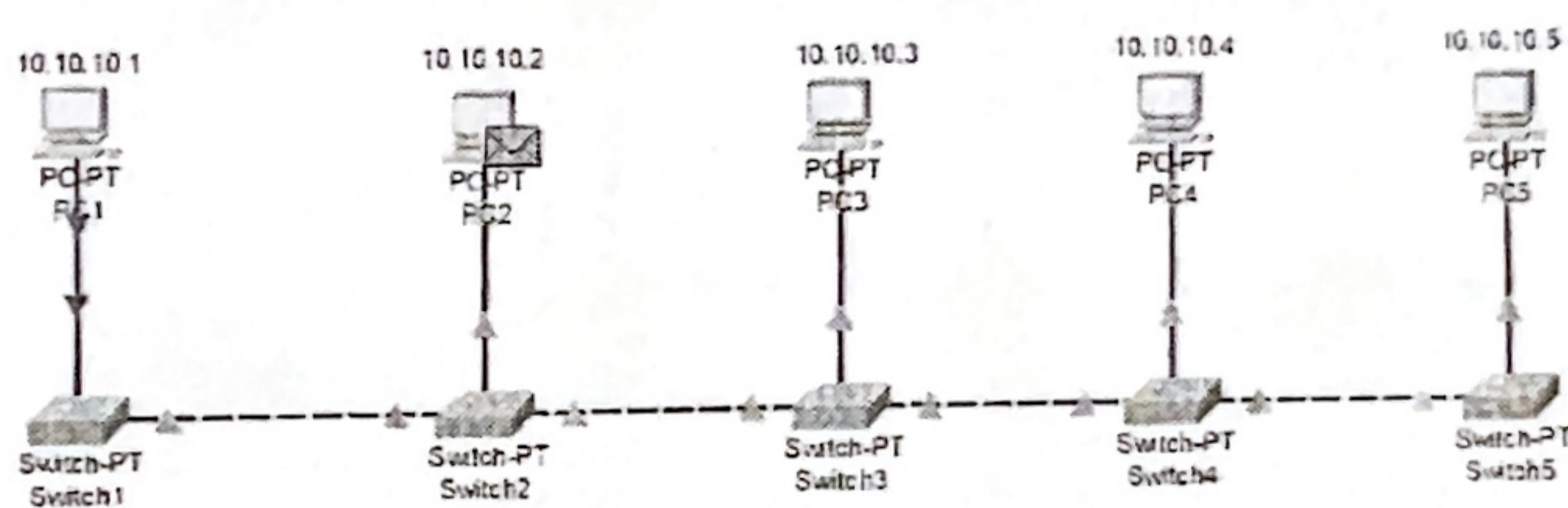
b) Transferring message from PC1 to PC4 and PC5 to PC2



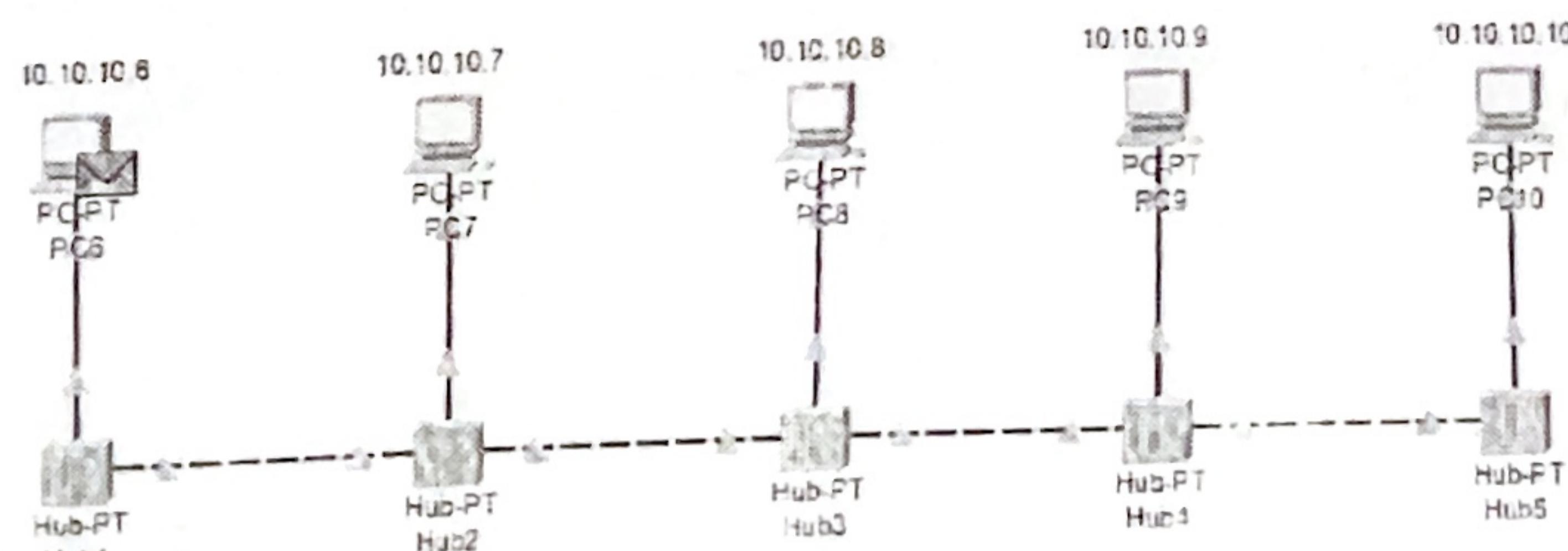
Receiving the same back at respective source



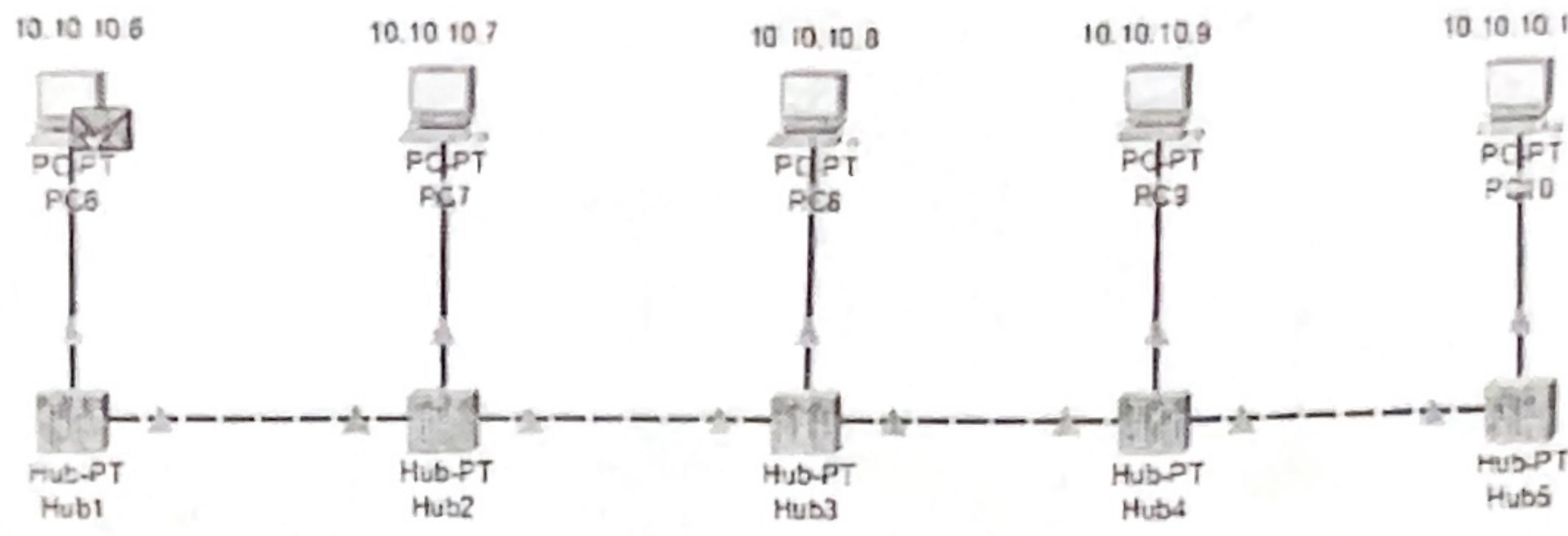
c) Switching off the ~~switch~~<sup>PC1</sup>, then transferring message from PC2 to PC5



d) Now, using hub for transferring message from PC6 to PC10

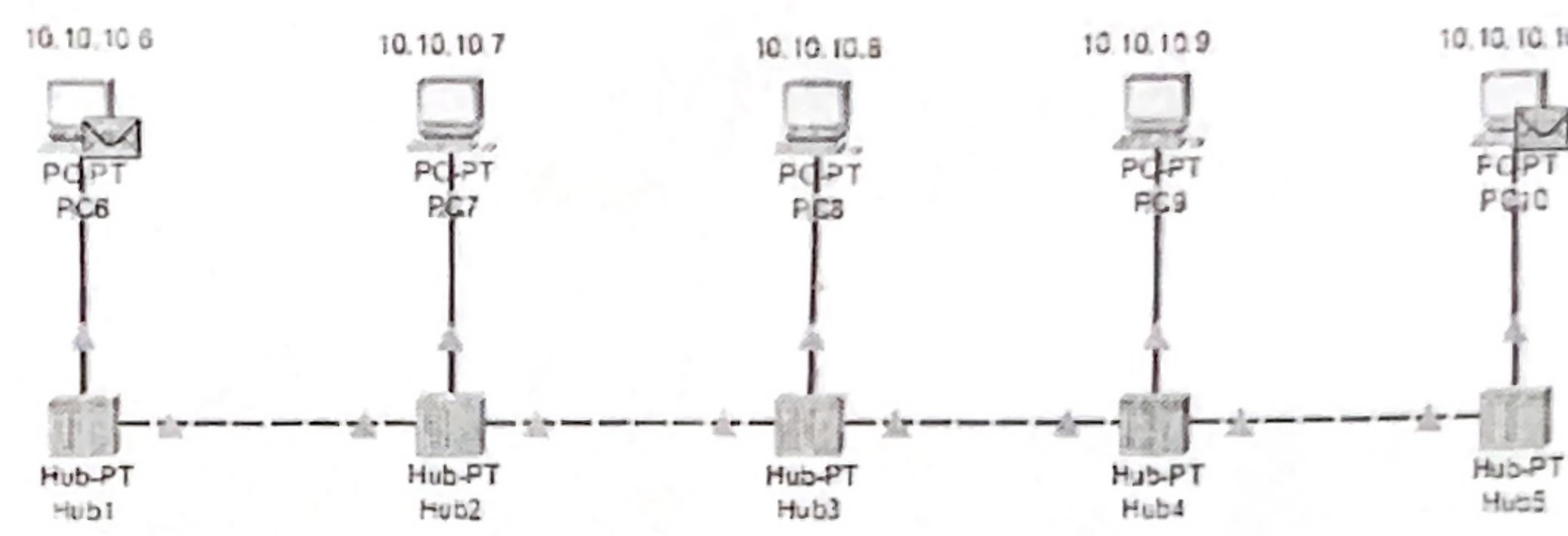


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Faculty of Engineering & Technology (ITER)



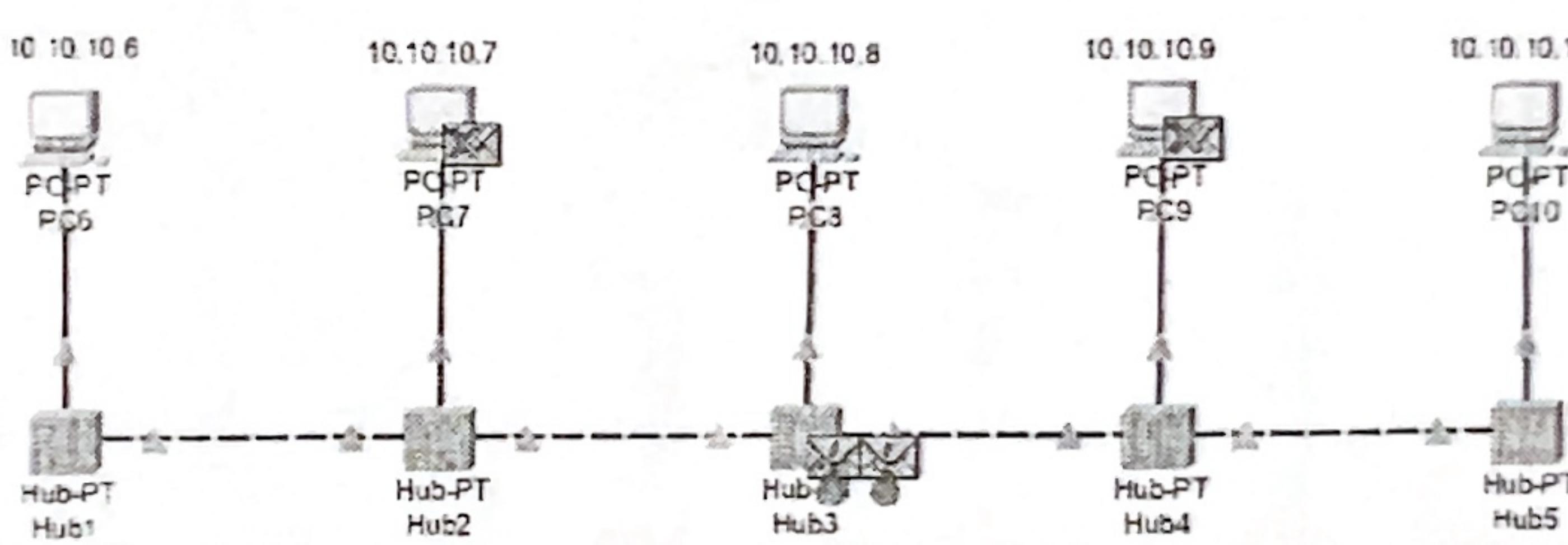
Collision Filter		
Idx	Transmitter	Last Device
1	PC6	Hub5
2	PC6	Hub4
3	PC6	Hub3
4	PC6	Hub2
5	PC6	Hub1
6	PC7	Hub5
7	PC7	Hub4
8	PC7	Hub3
9	PC7	Hub2
10	PC7	Hub1
11	PC8	Hub5
12	PC8	Hub4
13	PC8	Hub3
14	PC8	Hub2
15	PC8	Hub1
16	PC9	Hub5
17	PC9	Hub4
18	PC9	Hub3
19	PC9	Hub2
20	PC9	Hub1
21	PC10	Hub5
22	PC10	Hub4
23	PC10	Hub3
24	PC10	Hub2
25	PC10	Hub1

e) Transfer of message from PC6 to PC9 and PC10 to PC7

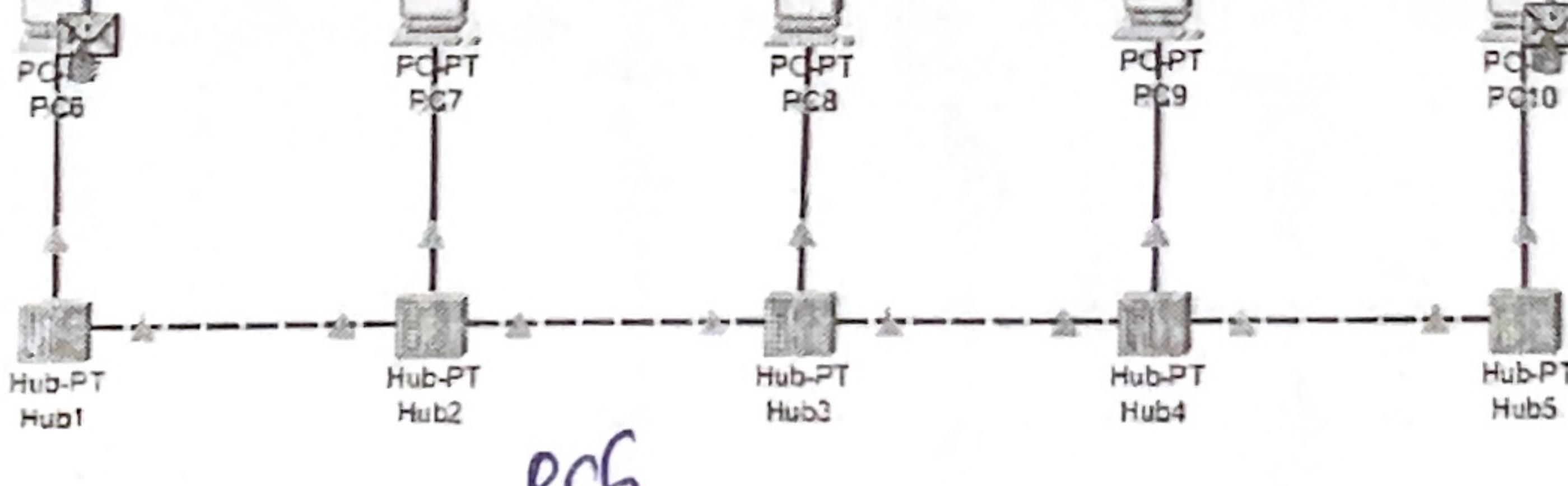


Collision Filter		
Idx	Transmitter	Last Device
1	PC6	-
2	PC6	-
3	PC6	-
4	PC6	-
5	PC6	-
6	PC7	-
7	PC7	-
8	PC7	-
9	PC7	-
10	PC7	-
11	PC8	-
12	PC8	-
13	PC8	-
14	PC8	-
15	PC8	-
16	PC9	-
17	PC9	-
18	PC9	-
19	PC9	-
20	PC9	-
21	PC10	-
22	PC10	-
23	PC10	-
24	PC10	-
25	PC10	-

Transfer of message didn't happen due to collision

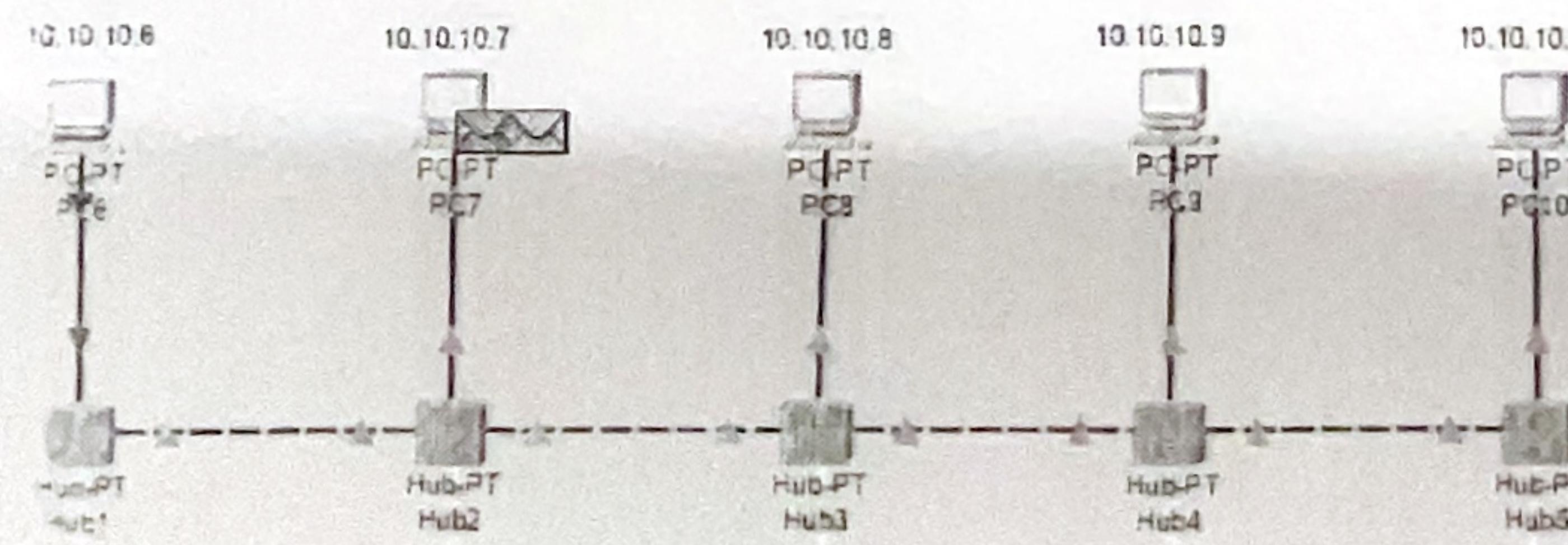


Collision Filter		
Idx	Transmitter	Last Device
1	PC6	-
2	PC6	-
3	PC6	-
4	PC6	-
5	PC6	-
6	PC7	-
7	PC7	-
8	PC7	-
9	PC7	-
10	PC7	-
11	PC8	-
12	PC8	-
13	PC8	-
14	PC8	-
15	PC8	-
16	PC9	-
17	PC9	-
18	PC9	-
19	PC9	-
20	PC9	-
21	PC10	-
22	PC10	-
23	PC10	-
24	PC10	-
25	PC10	-



Collision Filter		
Idx	Transmitter	Last Device
1	PC6	Hub2
2	PC6	Hub3
3	PC6	Hub4
4	PC6	Hub5
5	PC7	Hub2
6	PC7	Hub3
7	PC7	Hub4
8	PC7	Hub5
9	PC8	Hub2
10	PC8	Hub3
11	PC8	Hub4
12	PC8	Hub5
13	PC9	Hub2
14	PC9	Hub3
15	PC9	Hub4
16	PC9	Hub5
17	PC10	Hub2
18	PC10	Hub3
19	PC10	Hub4
20	PC10	Hub5

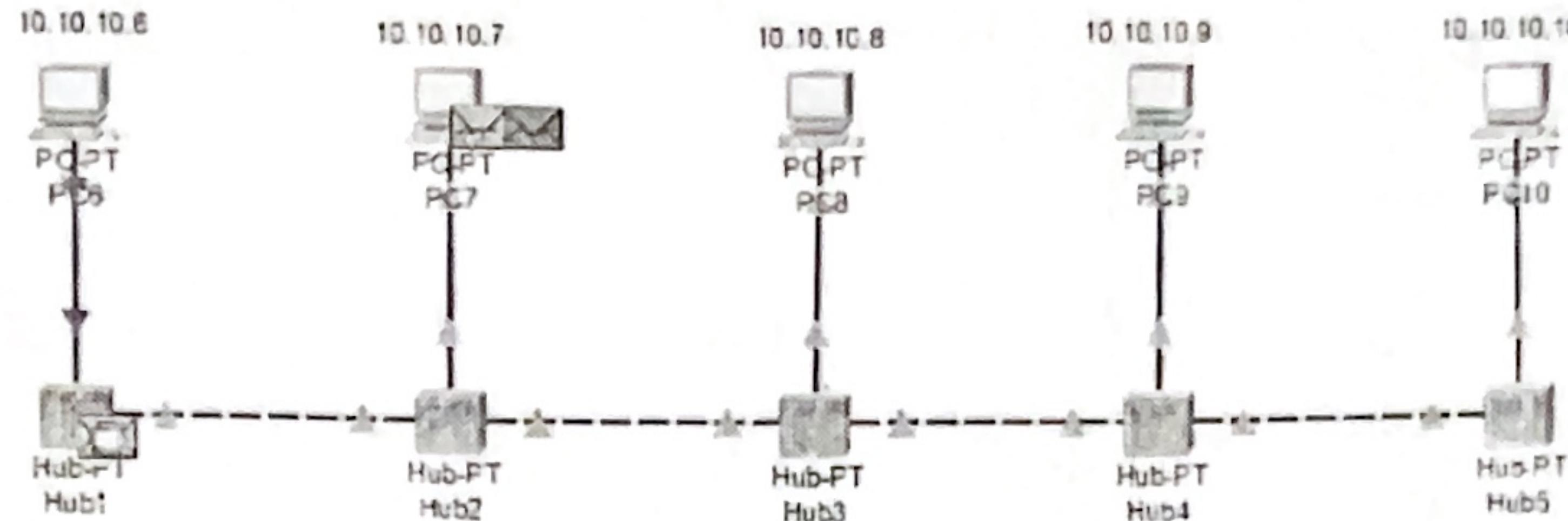
A) Switching the hub off, then transferring message PC7 to PC10



Collision Filter		
Idx	Transmitter	Last Device
1	PC6	Hub2
2	PC6	Hub3
3	PC6	Hub4
4	PC6	Hub5
5	PC7	Hub2
6	PC7	Hub3
7	PC7	Hub4
8	PC7	Hub5
9	PC8	Hub2
10	PC8	Hub3
11	PC8	Hub4
12	PC8	Hub5
13	PC9	Hub2
14	PC9	Hub3
15	PC9	Hub4
16	PC9	Hub5
17	PC10	Hub2
18	PC10	Hub3
19	PC10	Hub4
20	PC10	Hub5

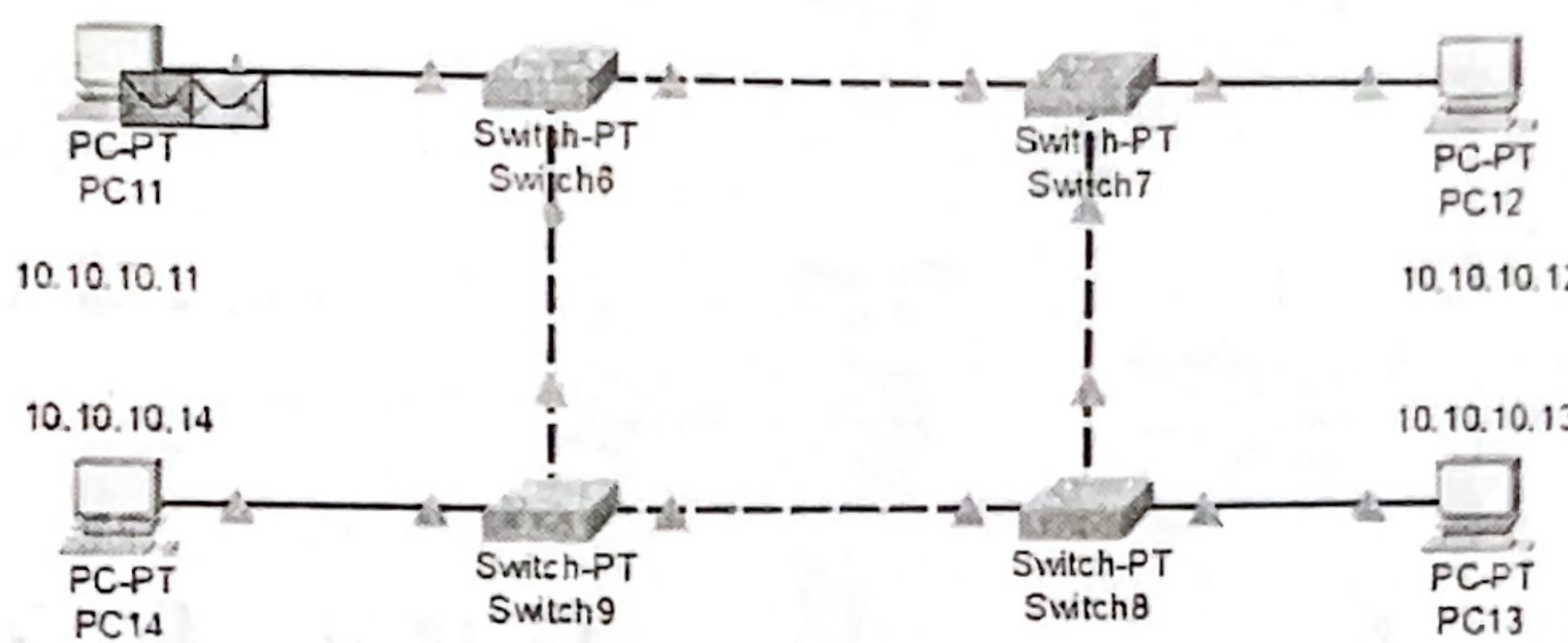
Name: \_\_\_\_\_

Regd No.: \_\_\_\_\_



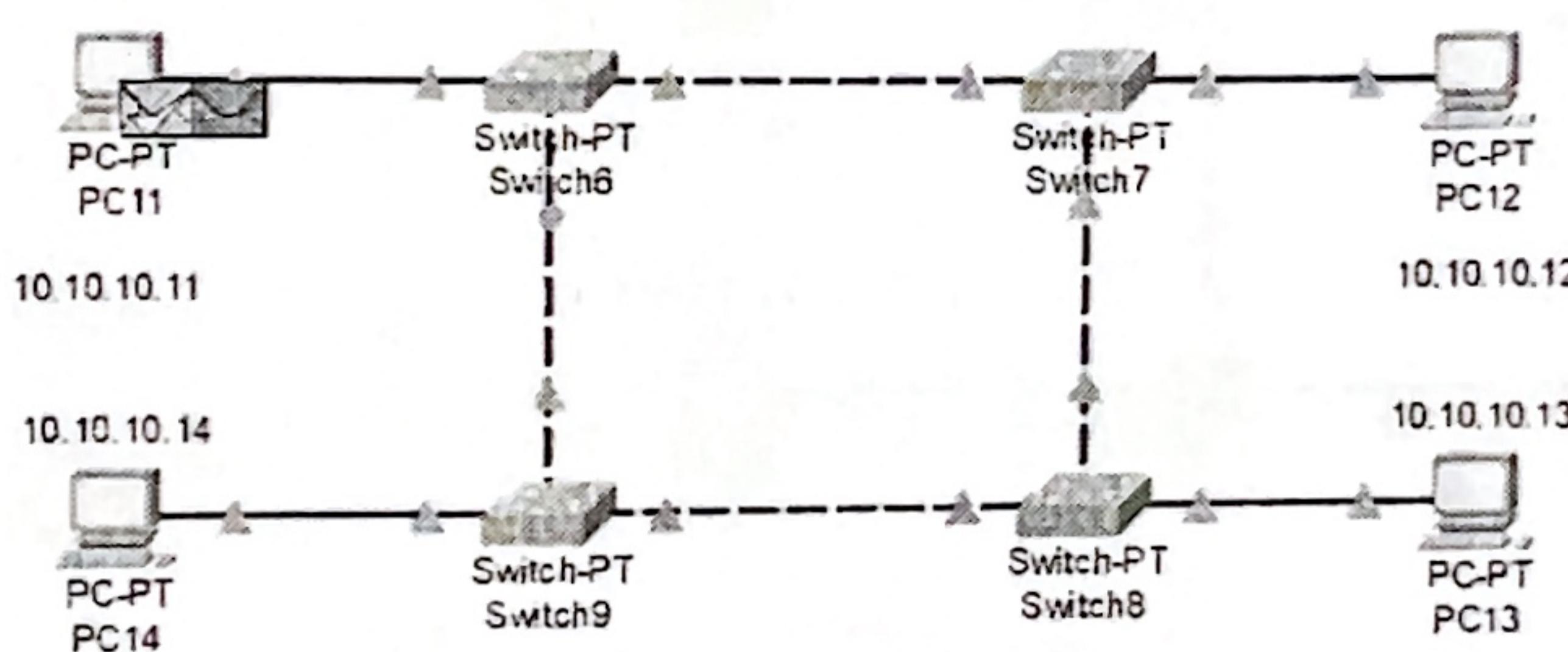
Simulation Panel		
Via	Time(sec)	Last Device
0.000	0.000	Hub1
0.001	0.000	Hub2
0.002	0.000	Hub3
0.003	0.000	Hub4
0.004	0.000	Hub5
0.005	0.000	-
0.006	0.000	-
0.007	0.000	-
0.008	0.000	-
0.009	0.000	-
0.010	0.000	-

Objective 4 → Constructing and simulating a network based on ring topology to analyse the performance, scalability and fault tolerance.

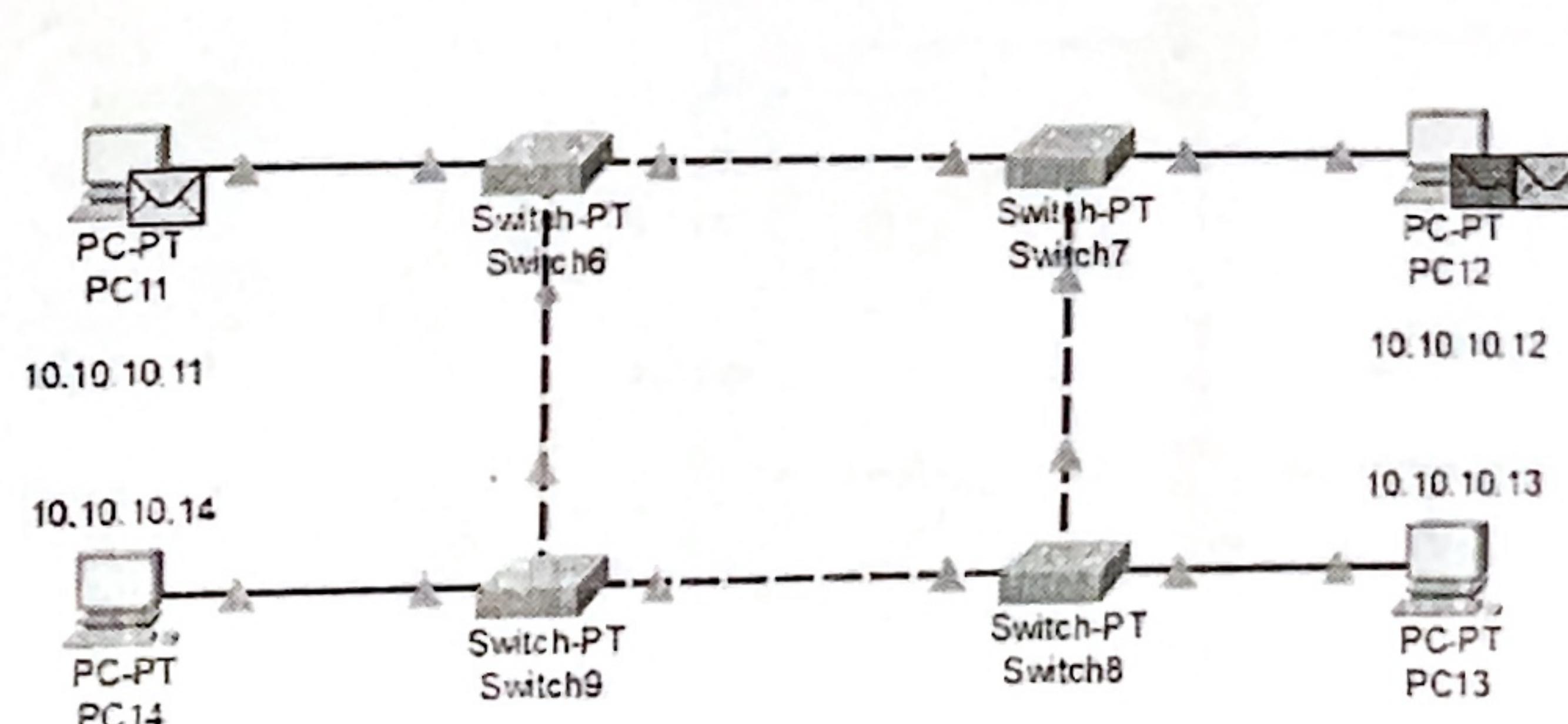


Simulation Panel		
Via	Time(sec)	Last Device
0.000	0.000	-
0.001	0.000	-

a) Transfer of message from PC11 to PC13

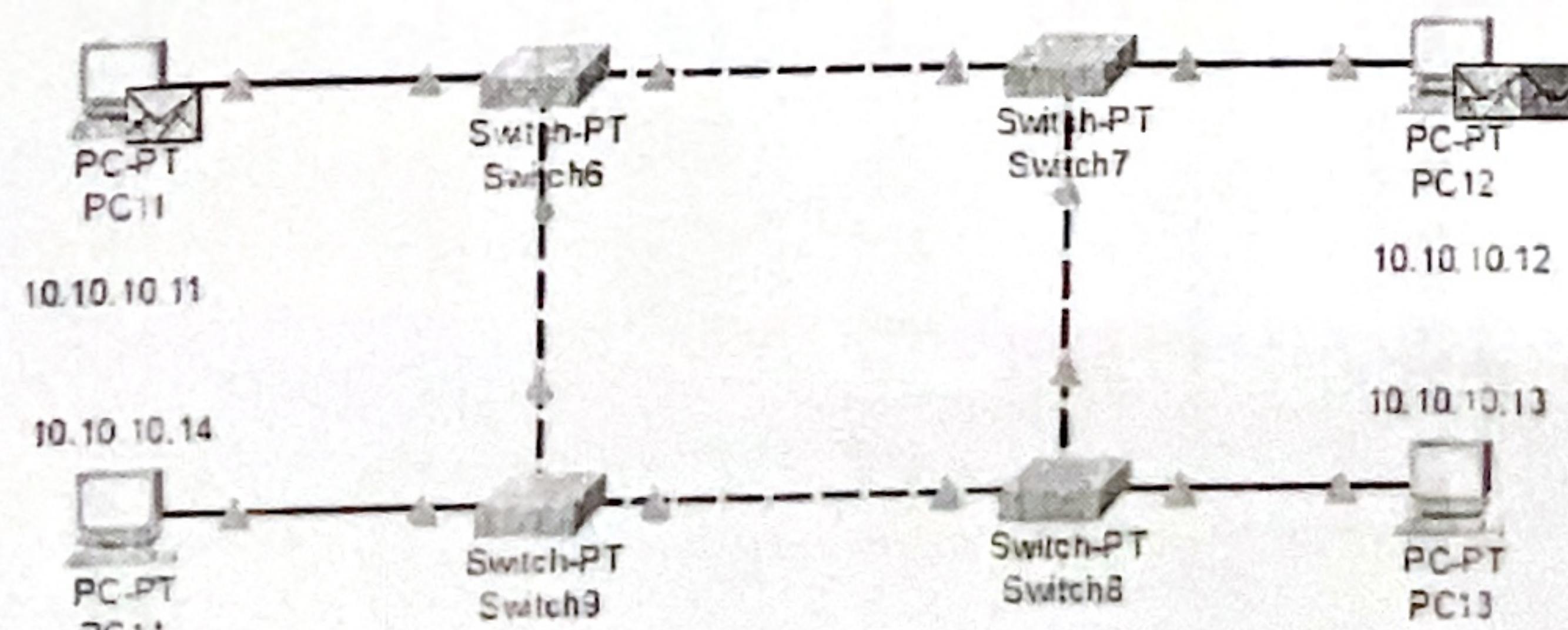


Simulation Panel		
Via	Time(sec)	Last Device
0.001	0.000	PC11
0.002	0.000	Switch6
0.003	0.000	Switch7
0.004	0.000	Switch8
0.005	0.000	PC13
0.006	0.000	-
0.007	0.000	-
0.008	0.000	-
0.009	0.000	-



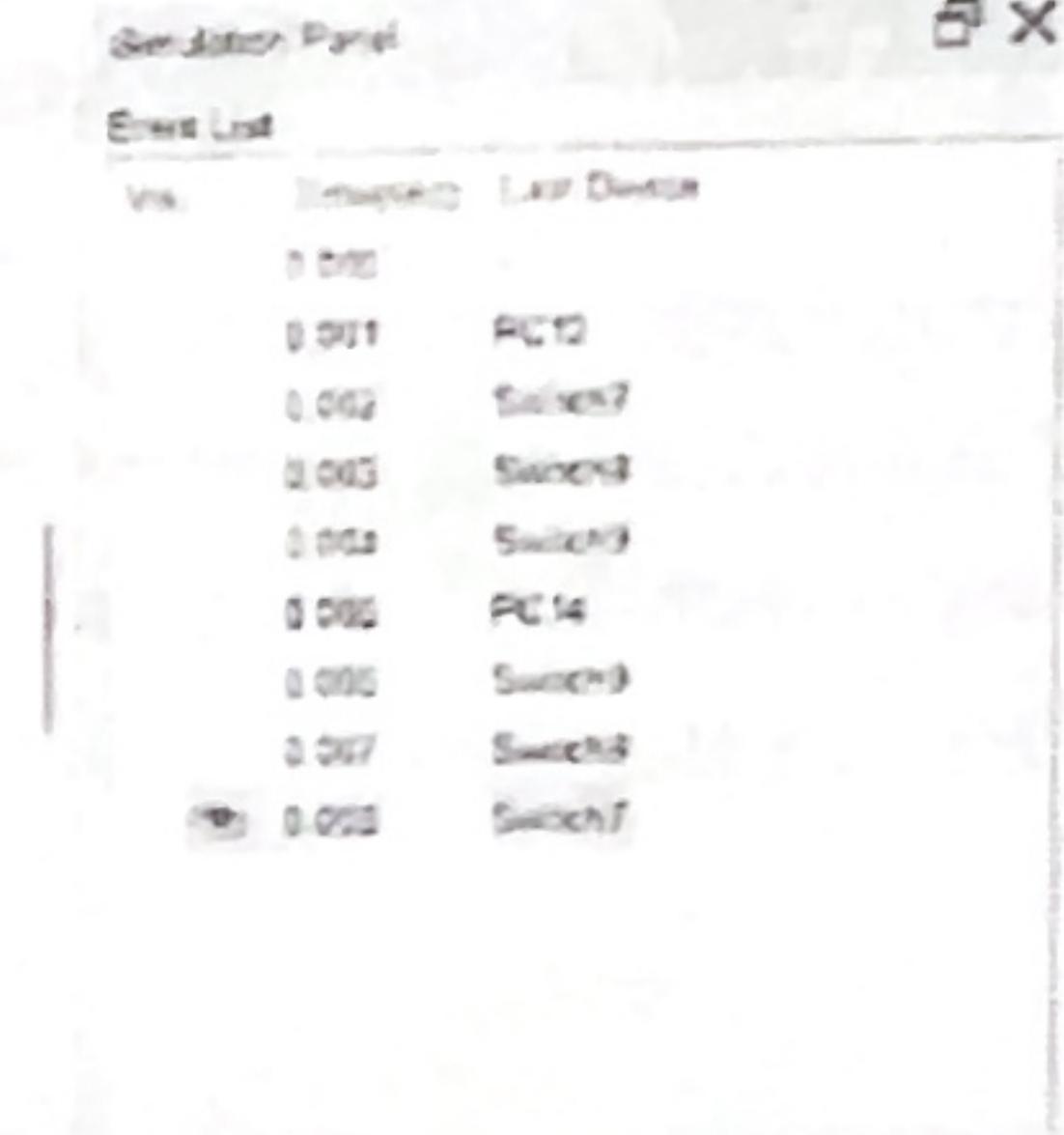
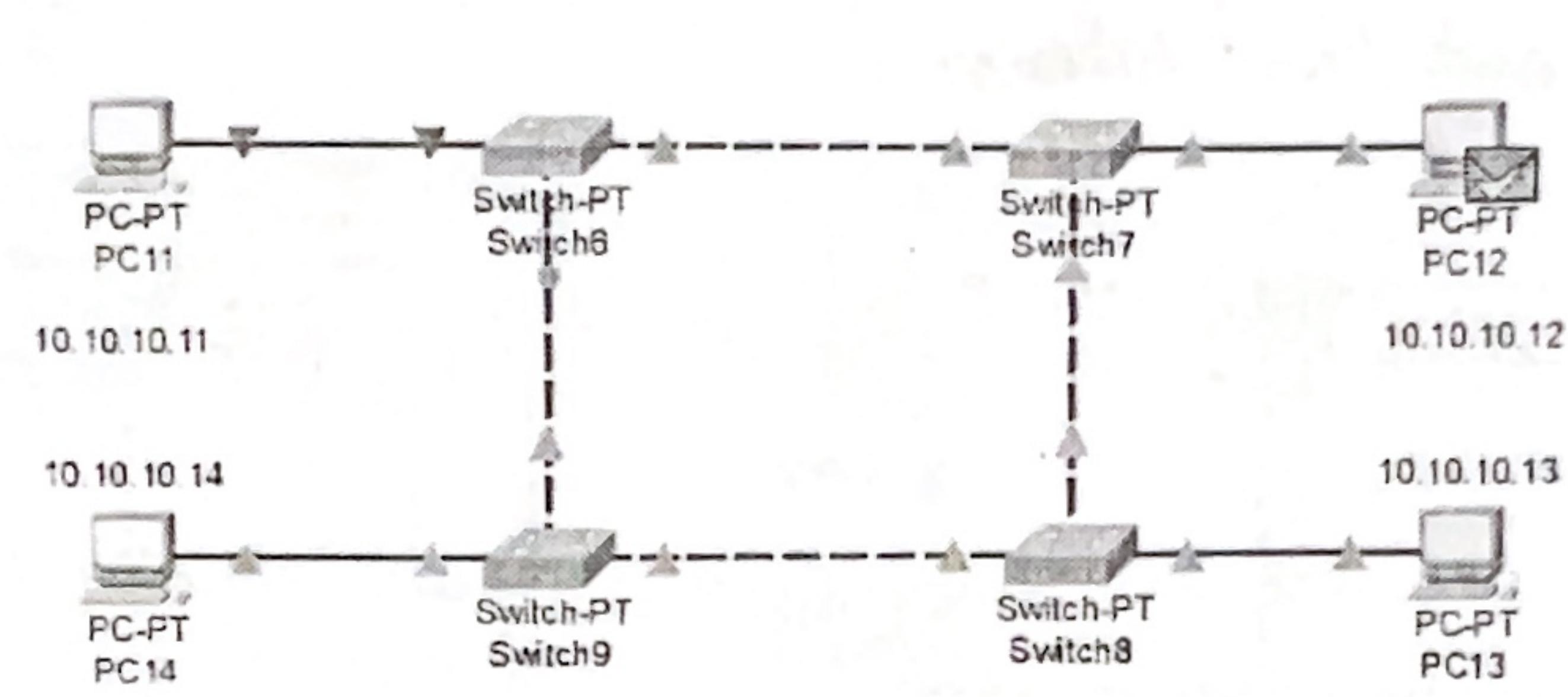
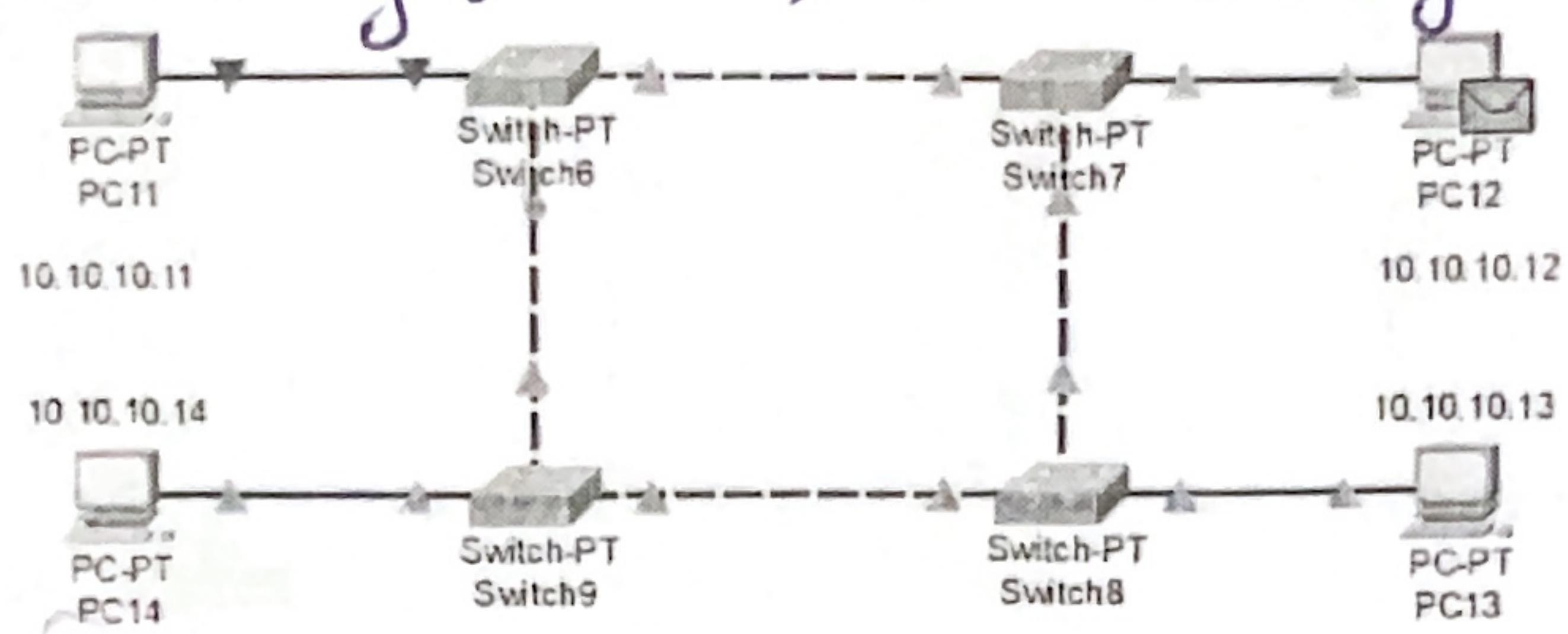
Simulation Panel		
Via	Time(sec)	Last Device
0.000	0.000	-
0.001	0.000	-
0.002	0.000	-

b) Transfer of message from PC11 to PC13 and PC12 to PC14

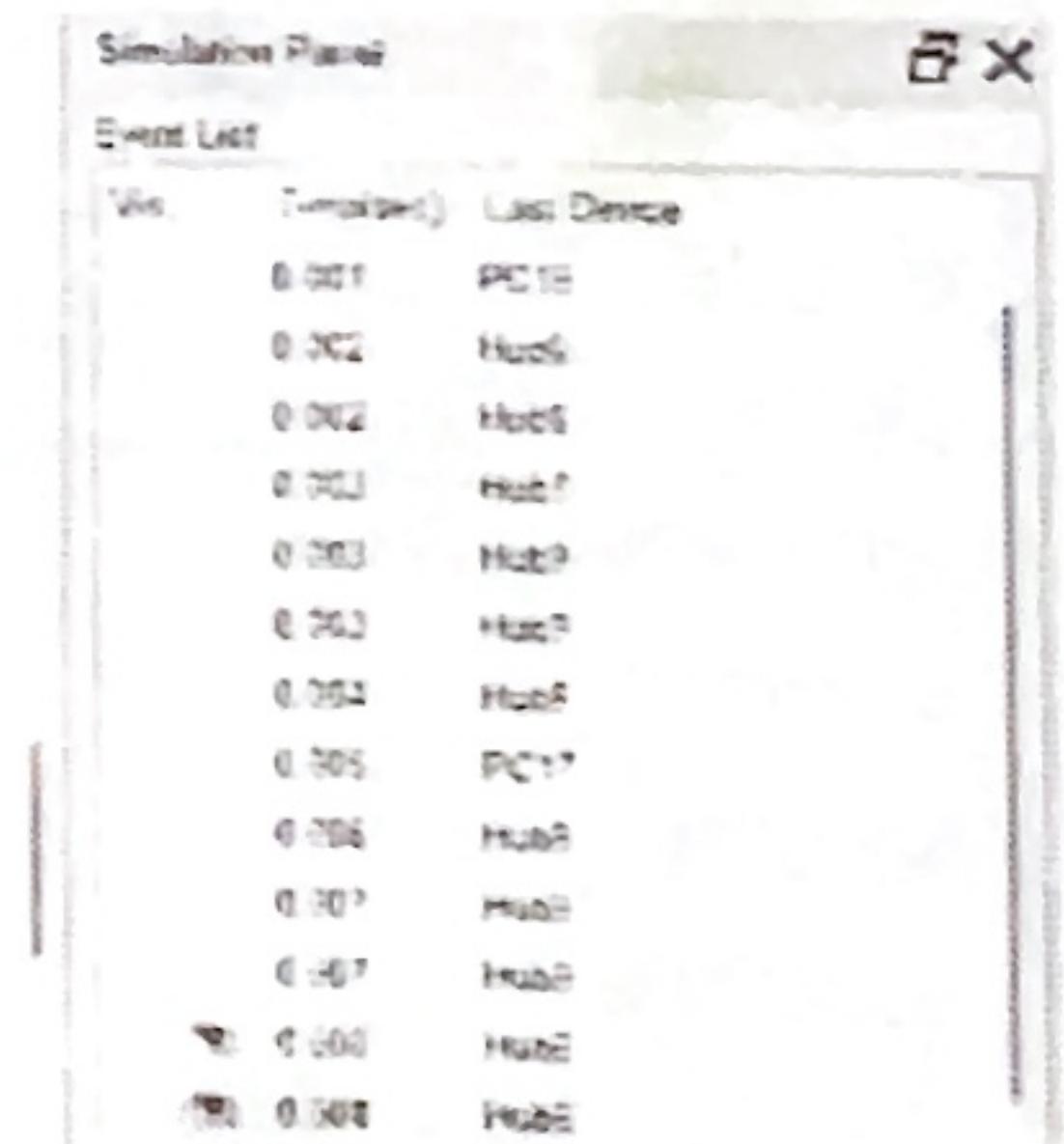
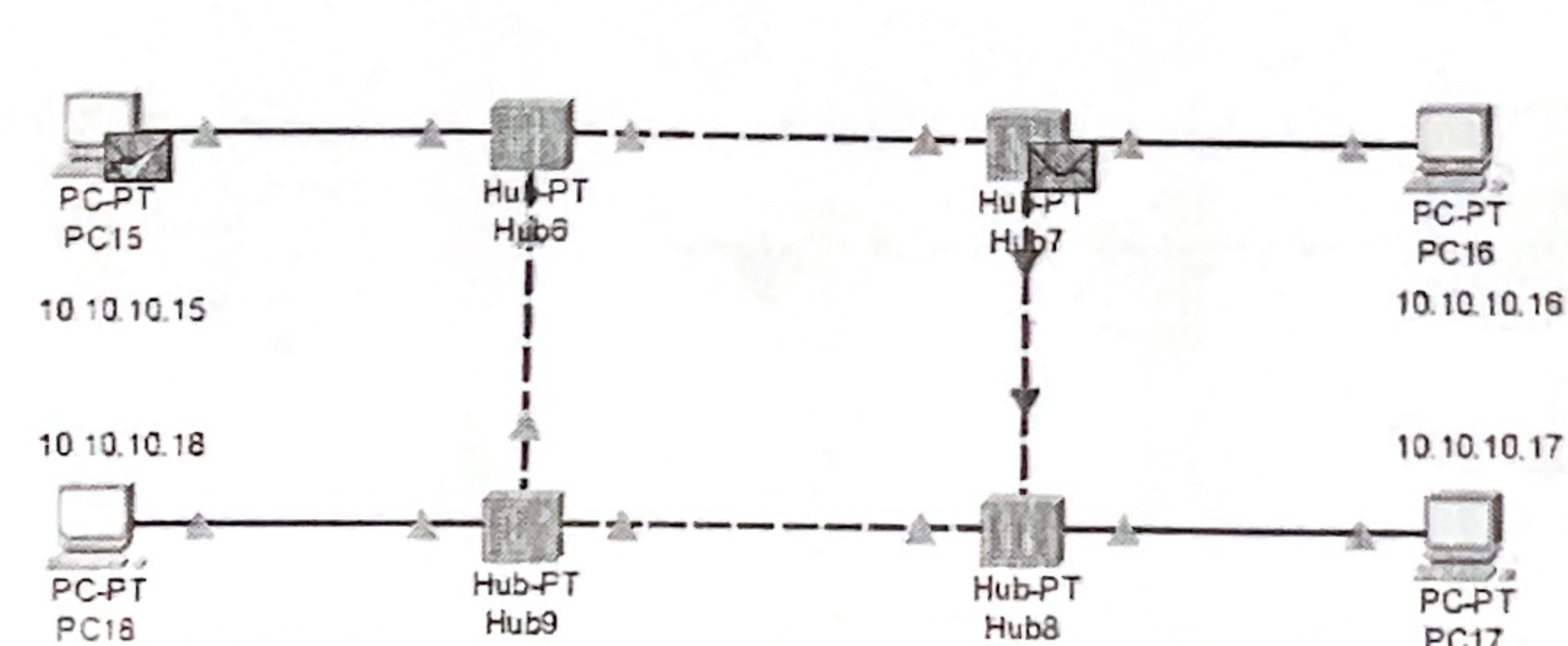
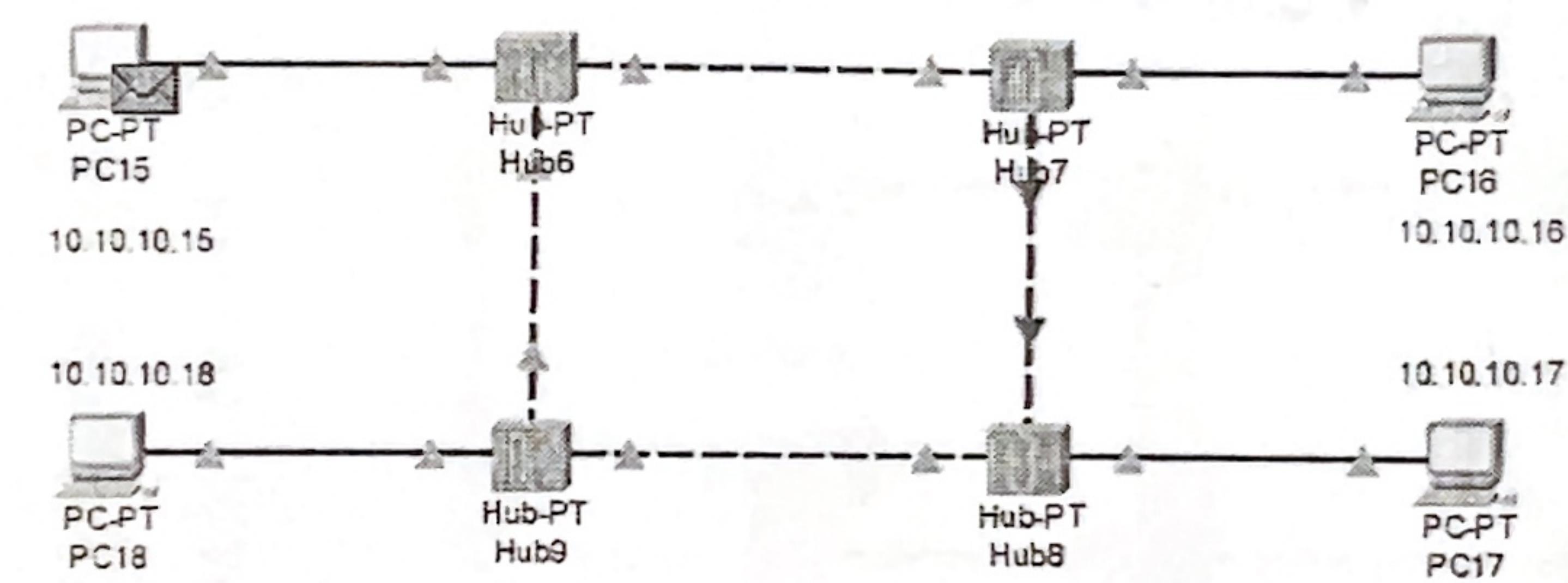


Simulation Panel		
Via	Time(sec)	Last Device
0.003	0.000	Switch6
0.004	0.000	Switch8
0.004	0.000	Switch9
0.005	0.000	PC13
0.005	0.000	PC14
0.006	0.000	Switch6
0.006	0.000	Switch8
0.007	0.000	Switch9
0.007	0.000	PC12
0.008	0.000	Switch6
0.008	0.000	Switch8
0.009	0.000	Switch9
0.009	0.000	PC14

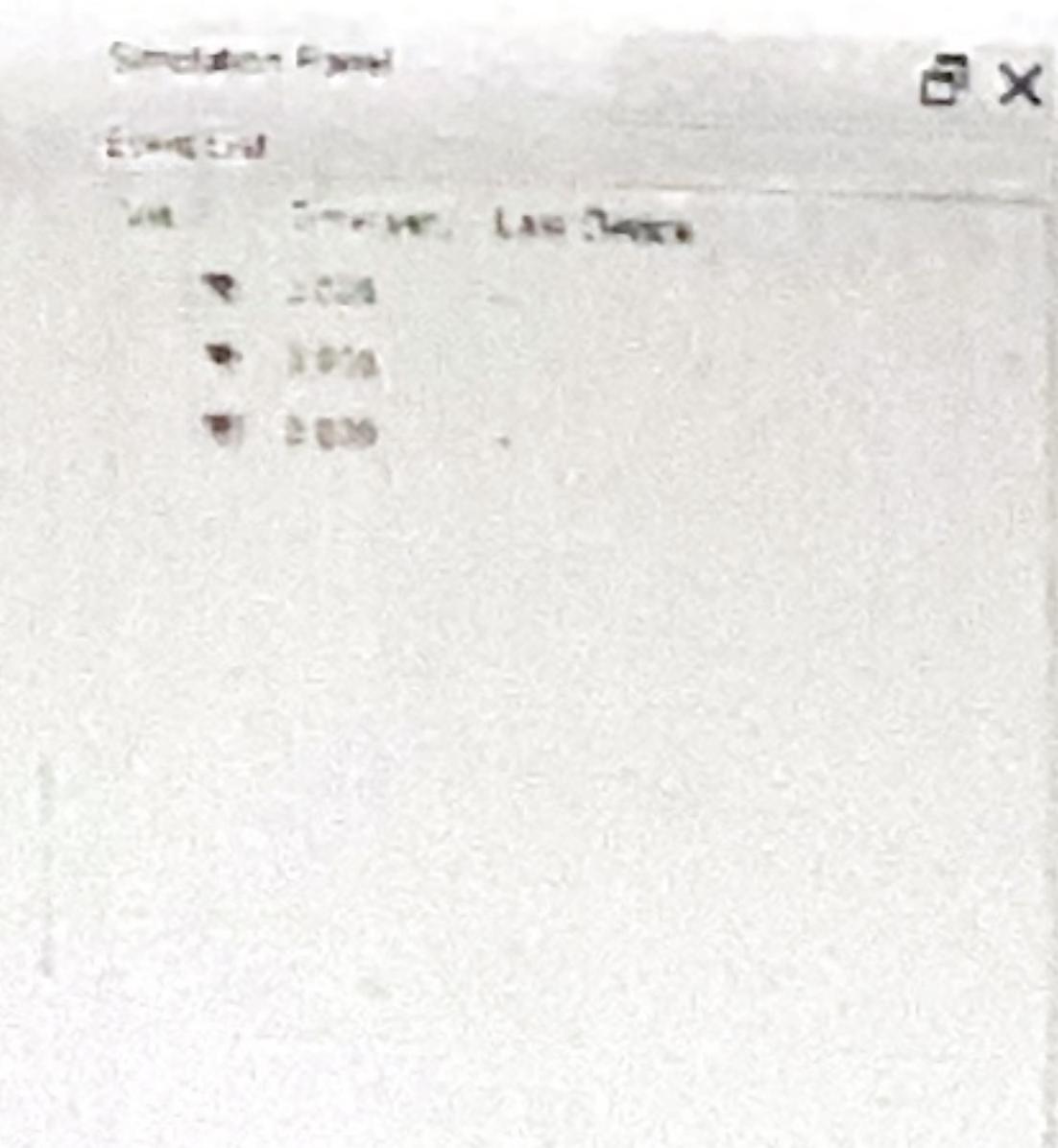
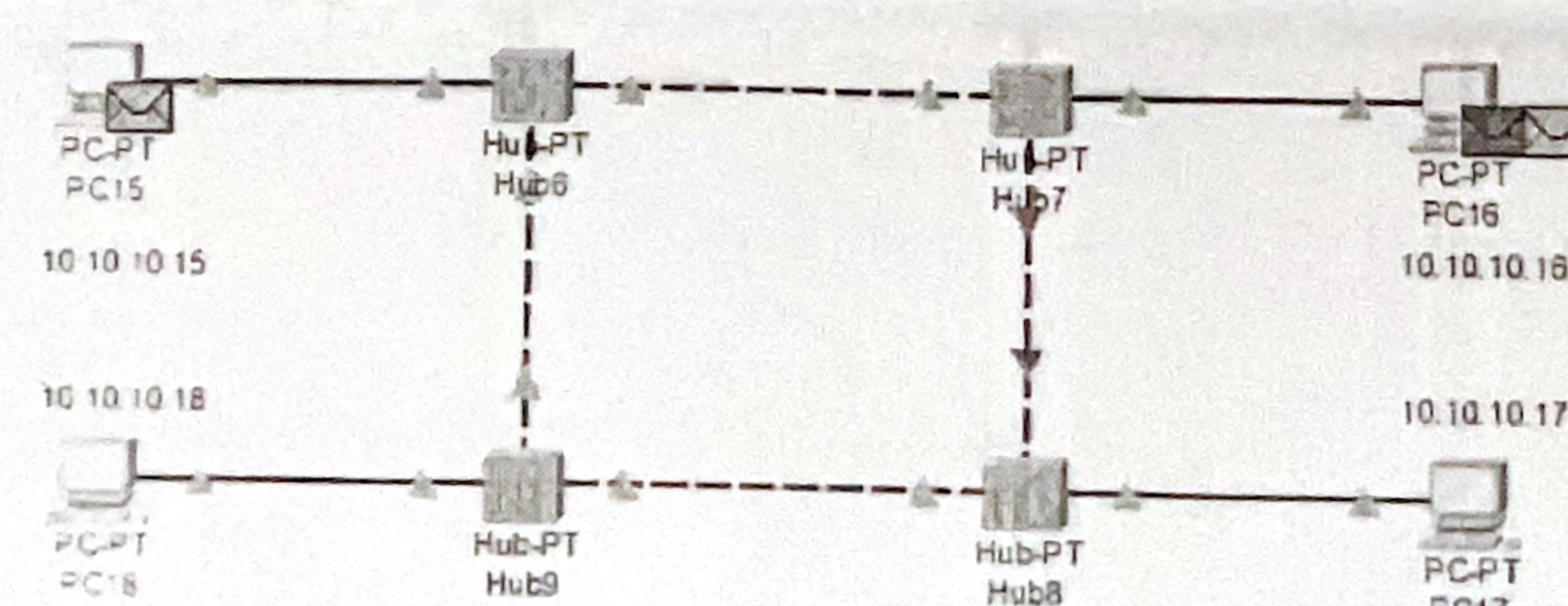
c) Switching off PC11, then transferring message from PC12 to PC14



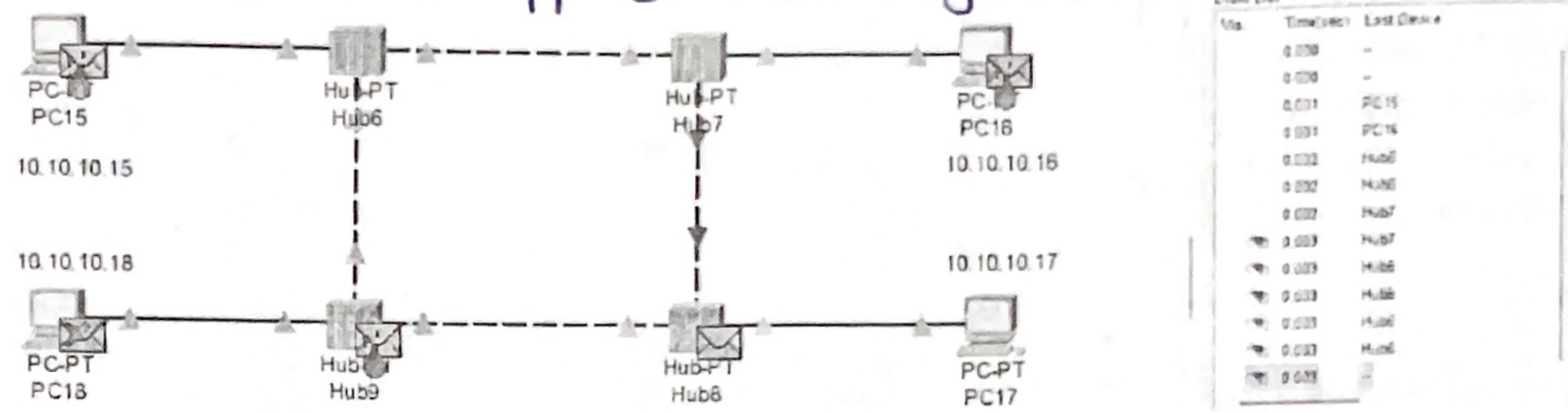
d) Now using hub, to transfer message from PC15 to PC17



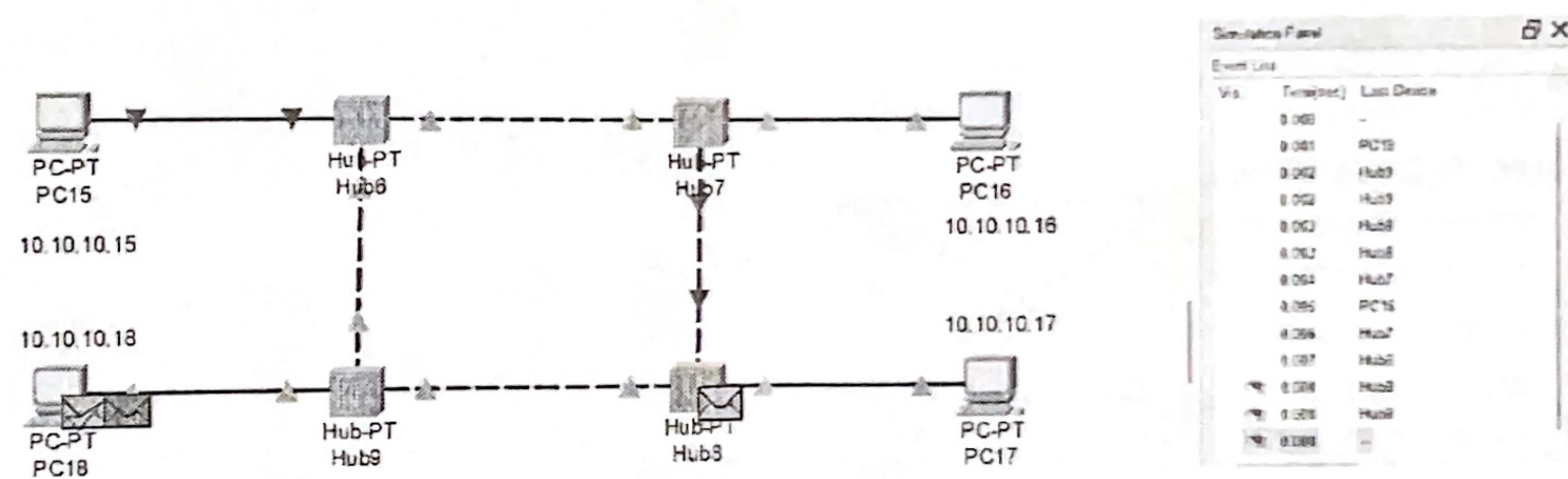
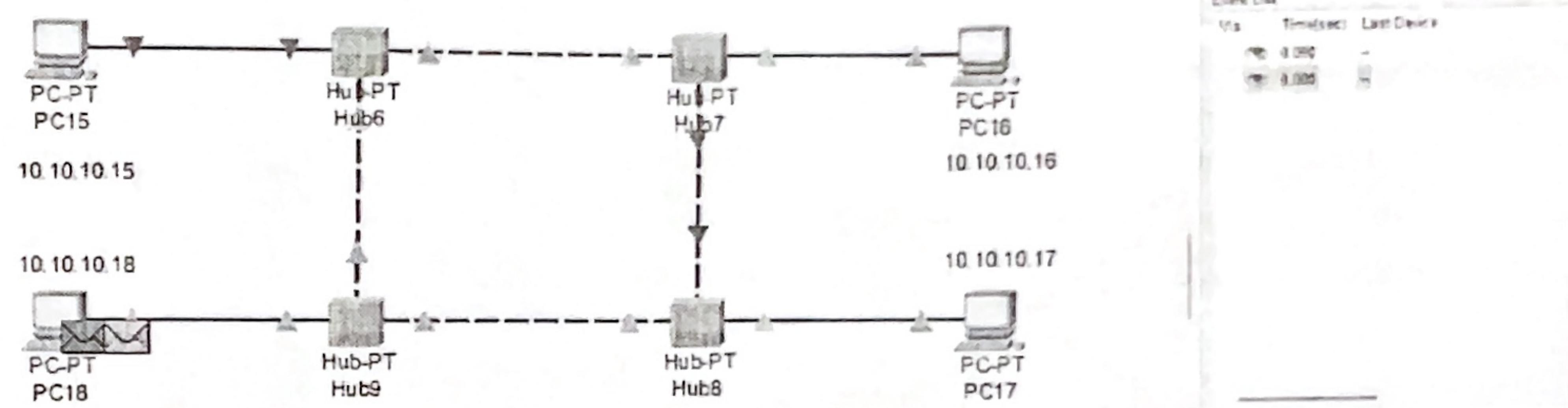
e) Transferring message from PC15 to PC17 and PC16 to PC18



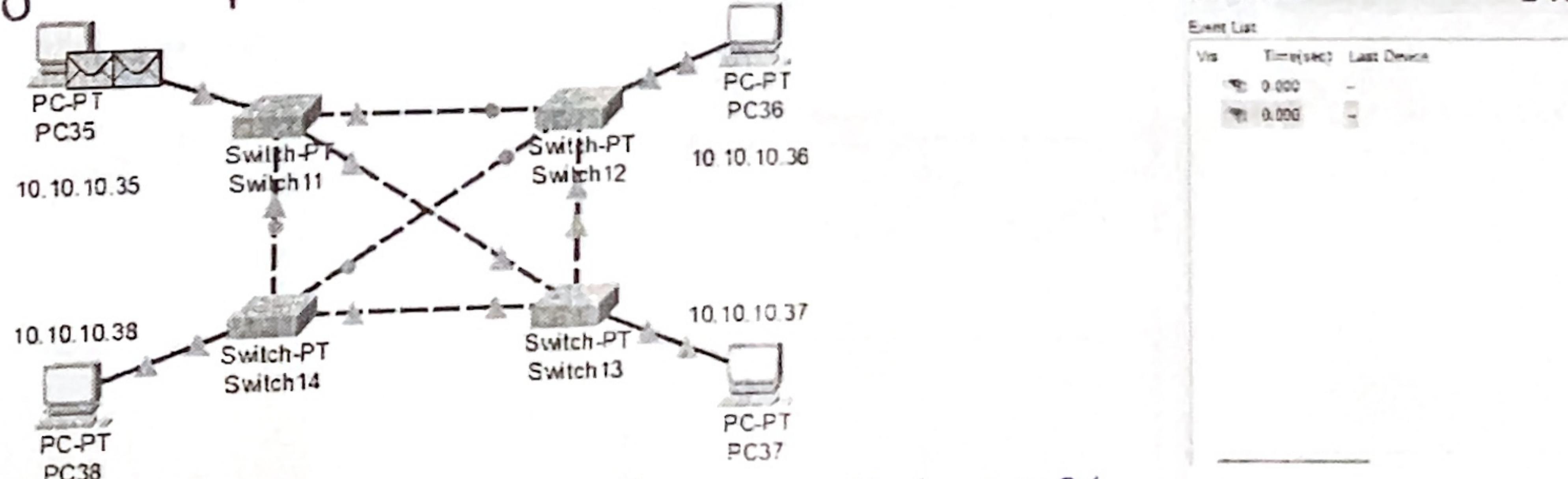
*Collision happened and message didn't happen*



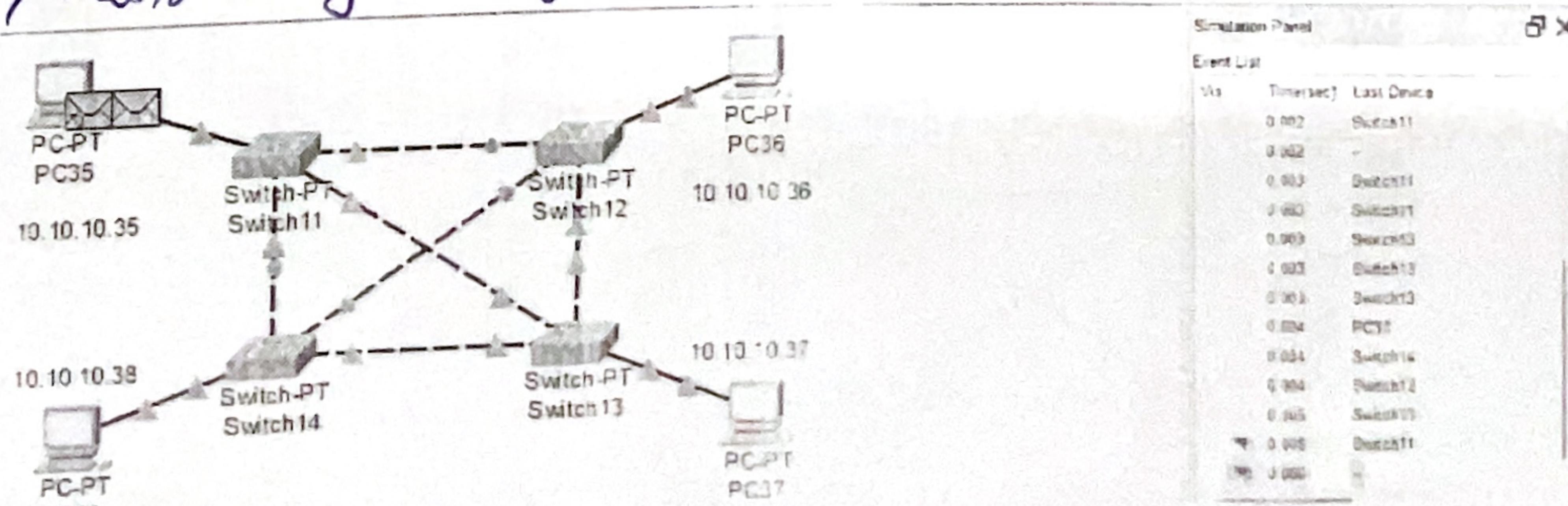
f) PC15 turned off; then transfer of message from PC18 to PC16



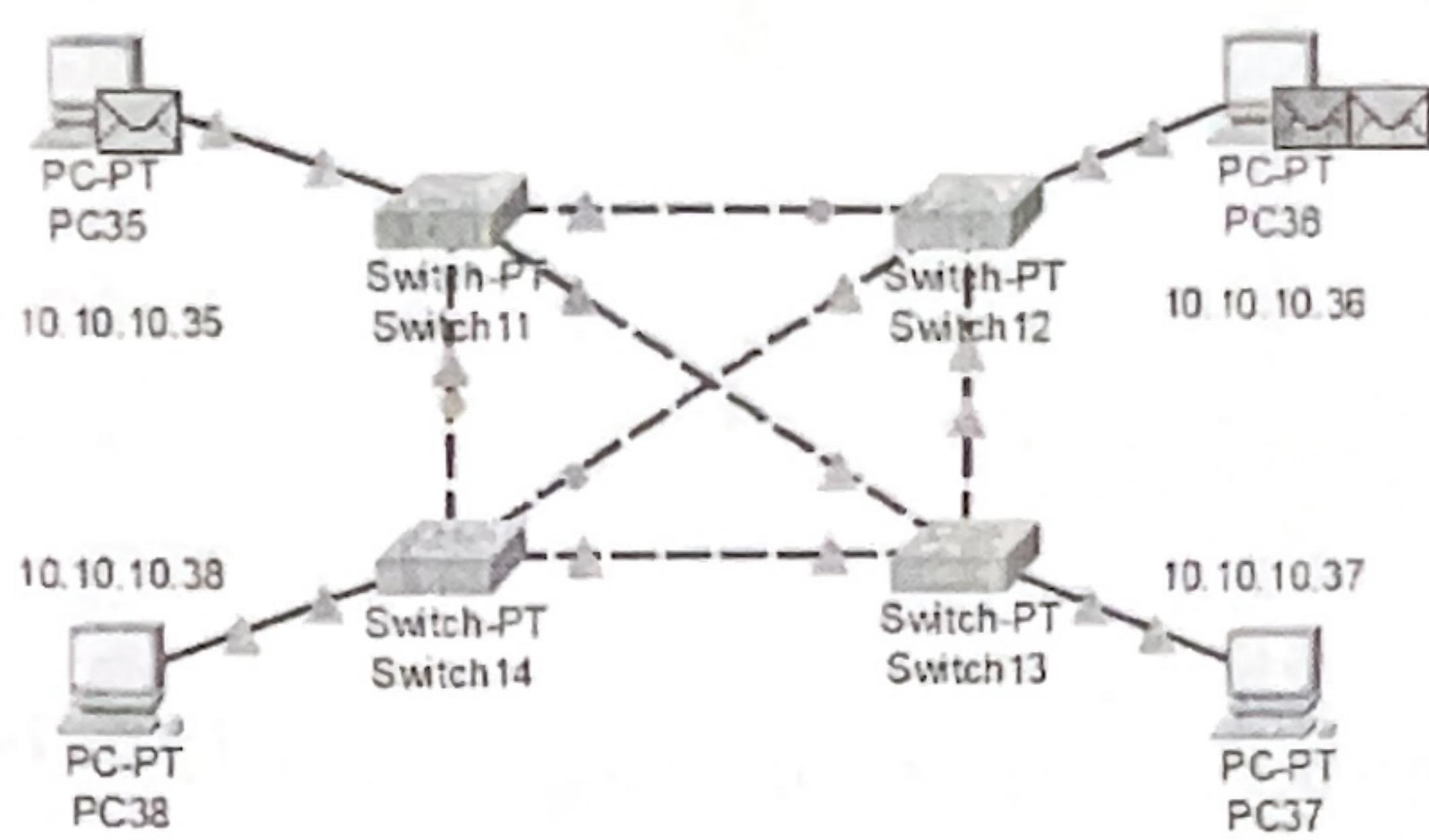
Objective 5 → Constructing and simulating a network based on mesh topology to analyse the performance, scalability and fault tolerance.



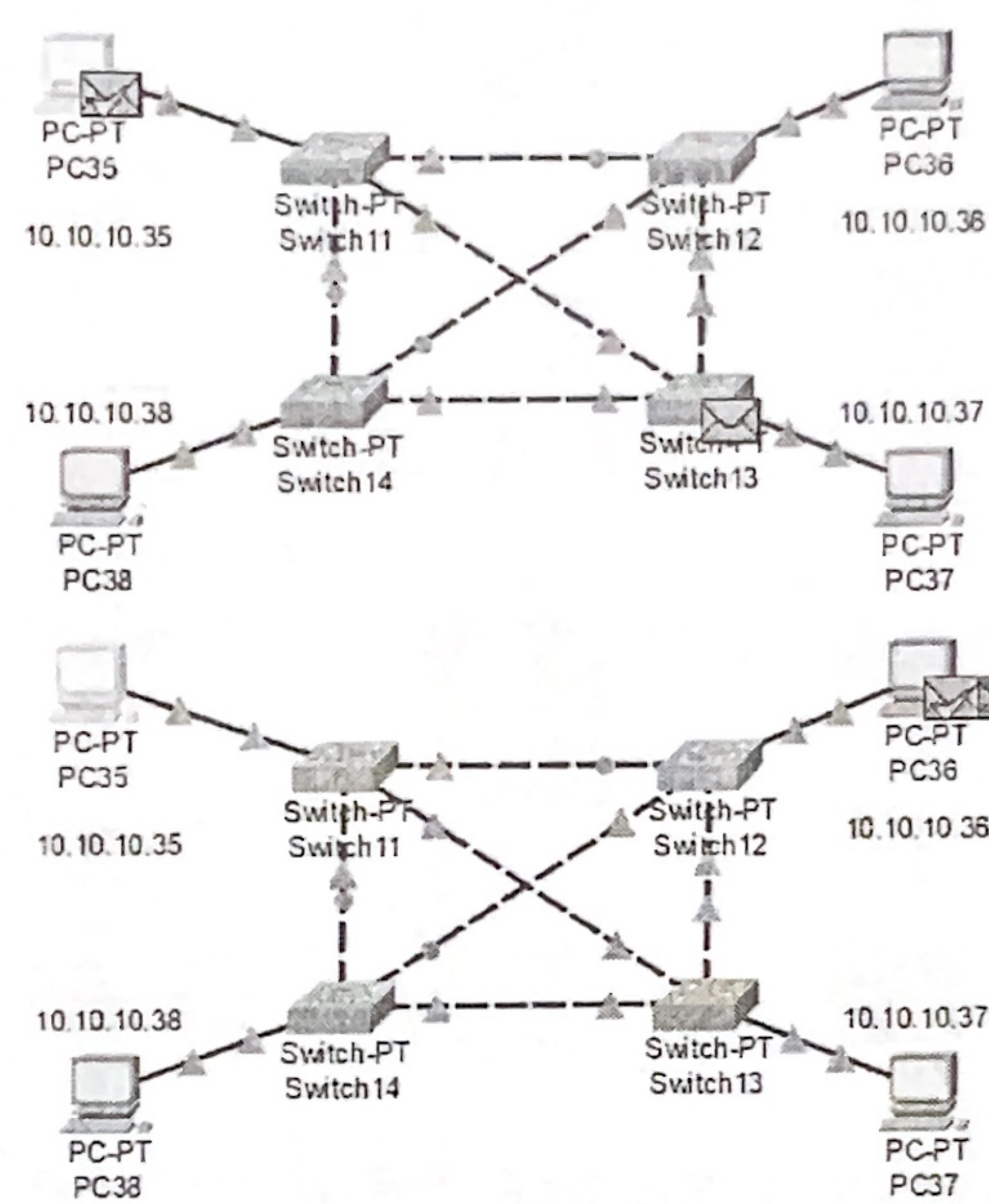
a) Transferring message from PC35 to PC38



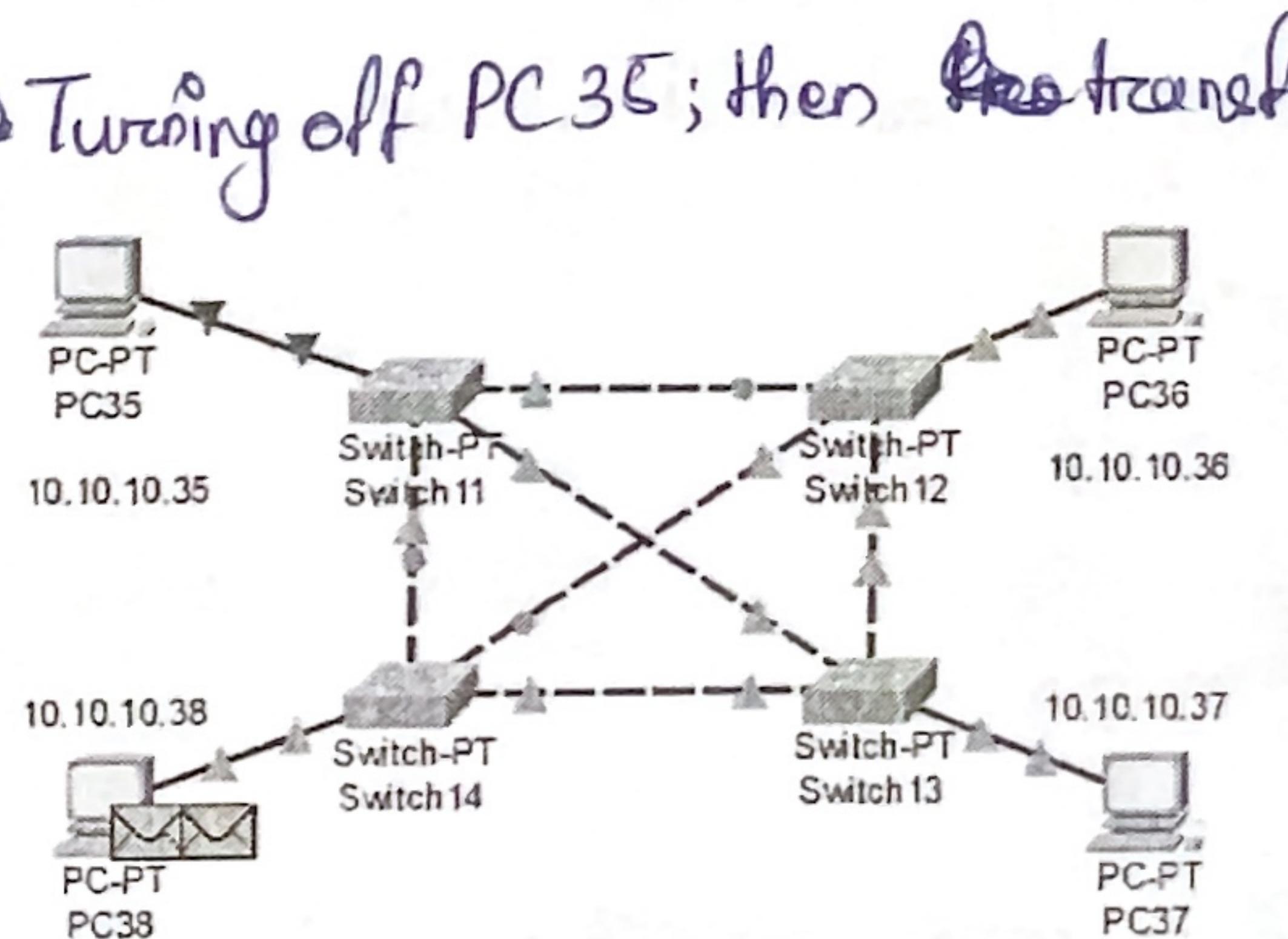
b) Transferring message from PC35 to PC37 and PC36 to PC38 →



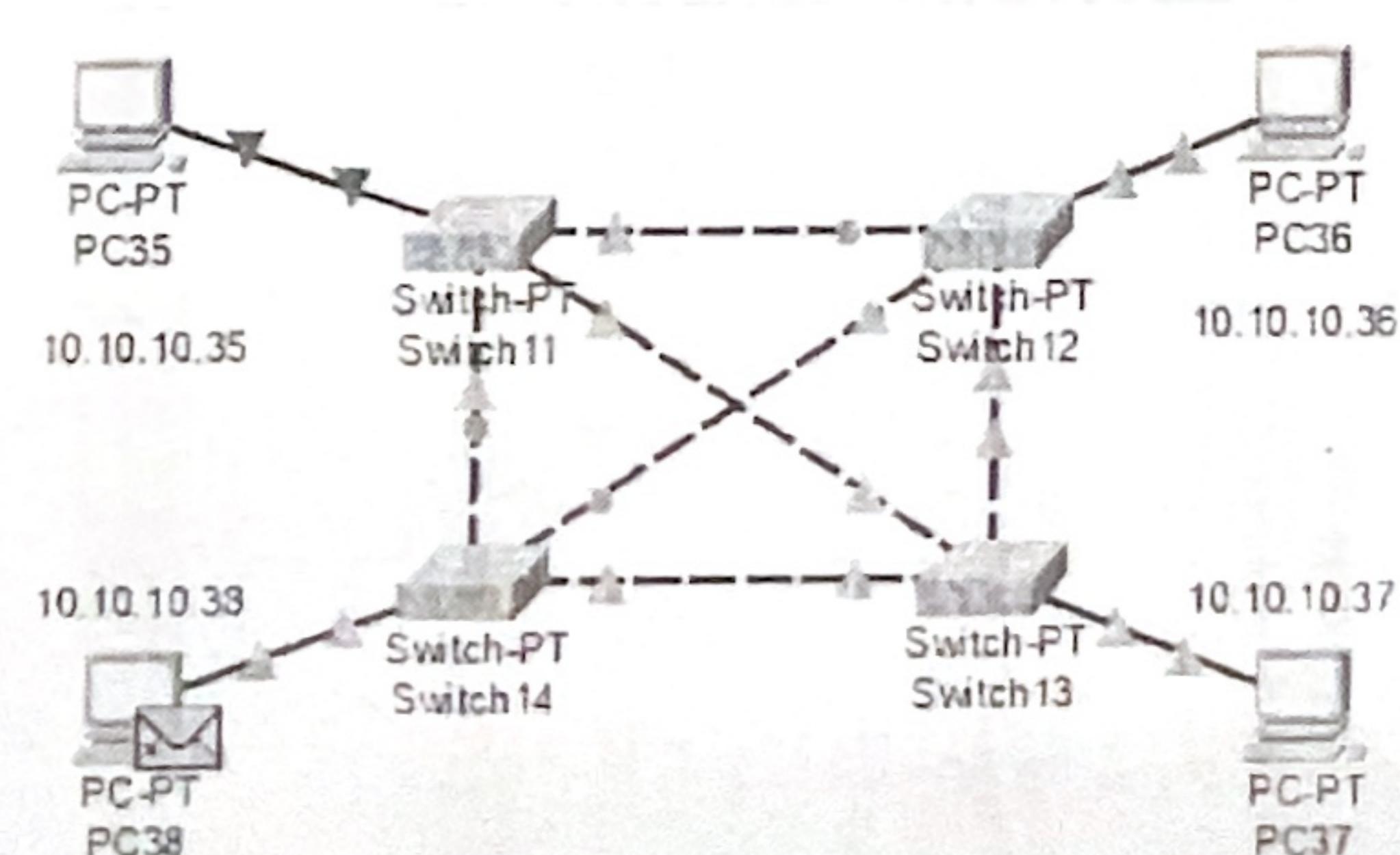
Simulation Panel		
Via	Time(sec)	Last Device
V1	0.000	-
V2	0.000	-
V3	0.000	-



Simulation Panel		
Via	Time(sec)	Last Device
V1	0.003	Switch13
V2	0.003	Switch13
V3	0.003	-
V4	0.004	Switch13
V5	0.004	PC37
V6	0.004	Switch14
V7	0.004	Switch11
V8	0.004	Switch11
V9	0.005	Switch13
V10	0.005	PC38
V11	0.005	Switch11
V12	0.006	Switch14
V13	0.006	Switch11
V14	0.006	Switch11
V15	0.006	Switch13
V16	0.006	PC38
V17	0.006	Switch11
V18	0.006	Switch14
V19	0.007	Switch13
V20	0.007	Switch12
V21	0.008	-

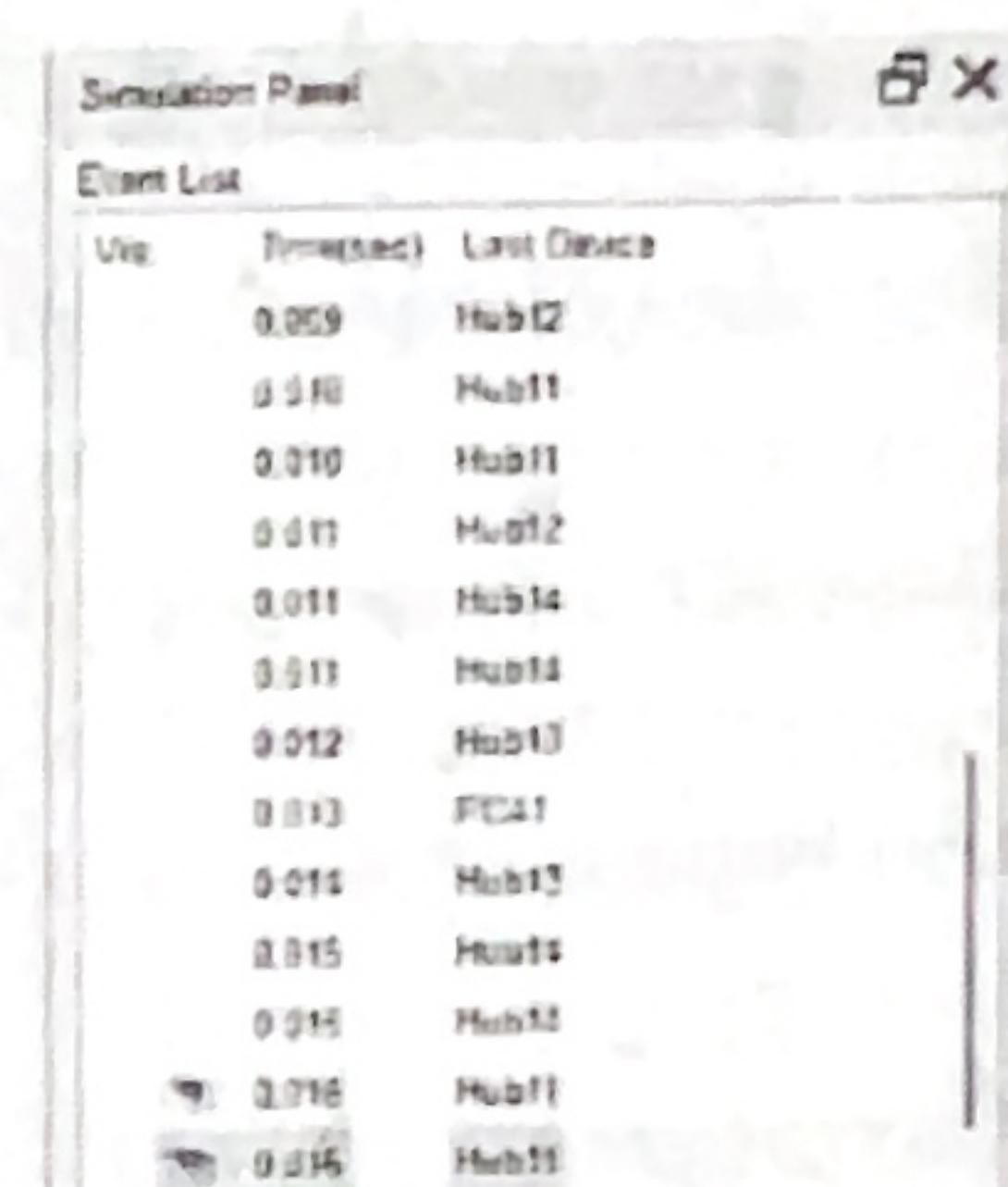
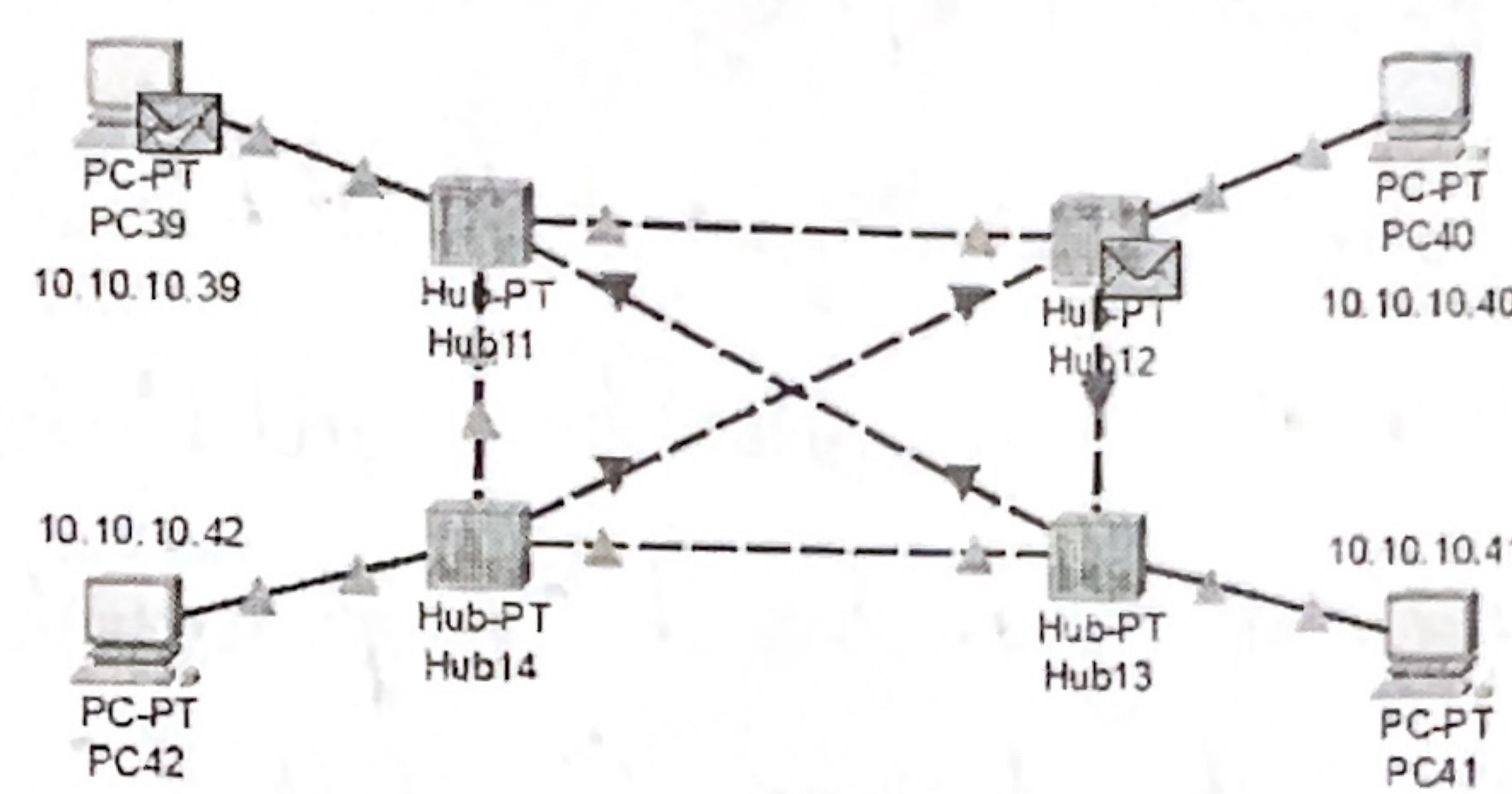
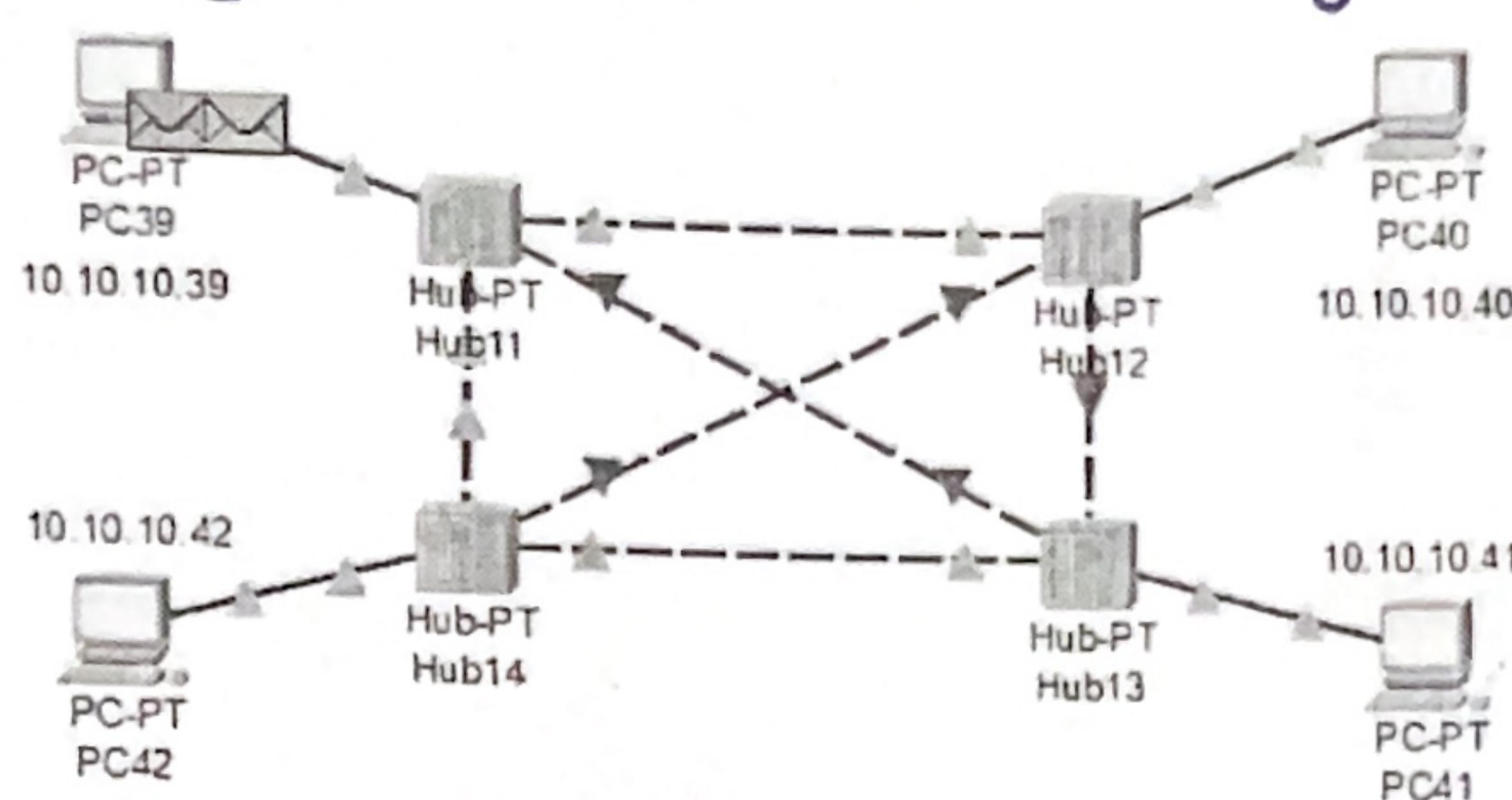


Simulation Panel		
Via	Time(sec)	Last Device
V1	0.000	-
V2	0.000	-

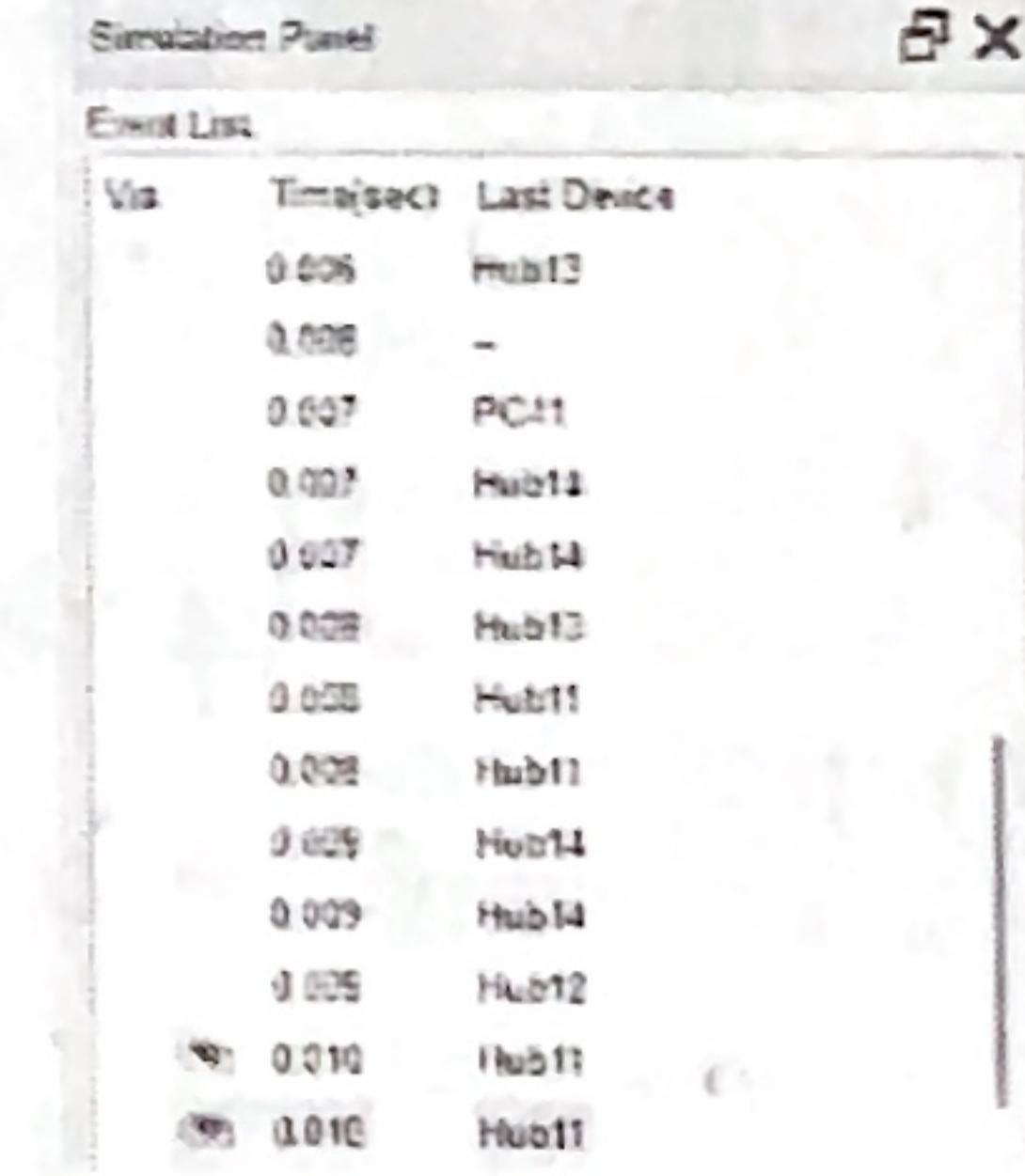
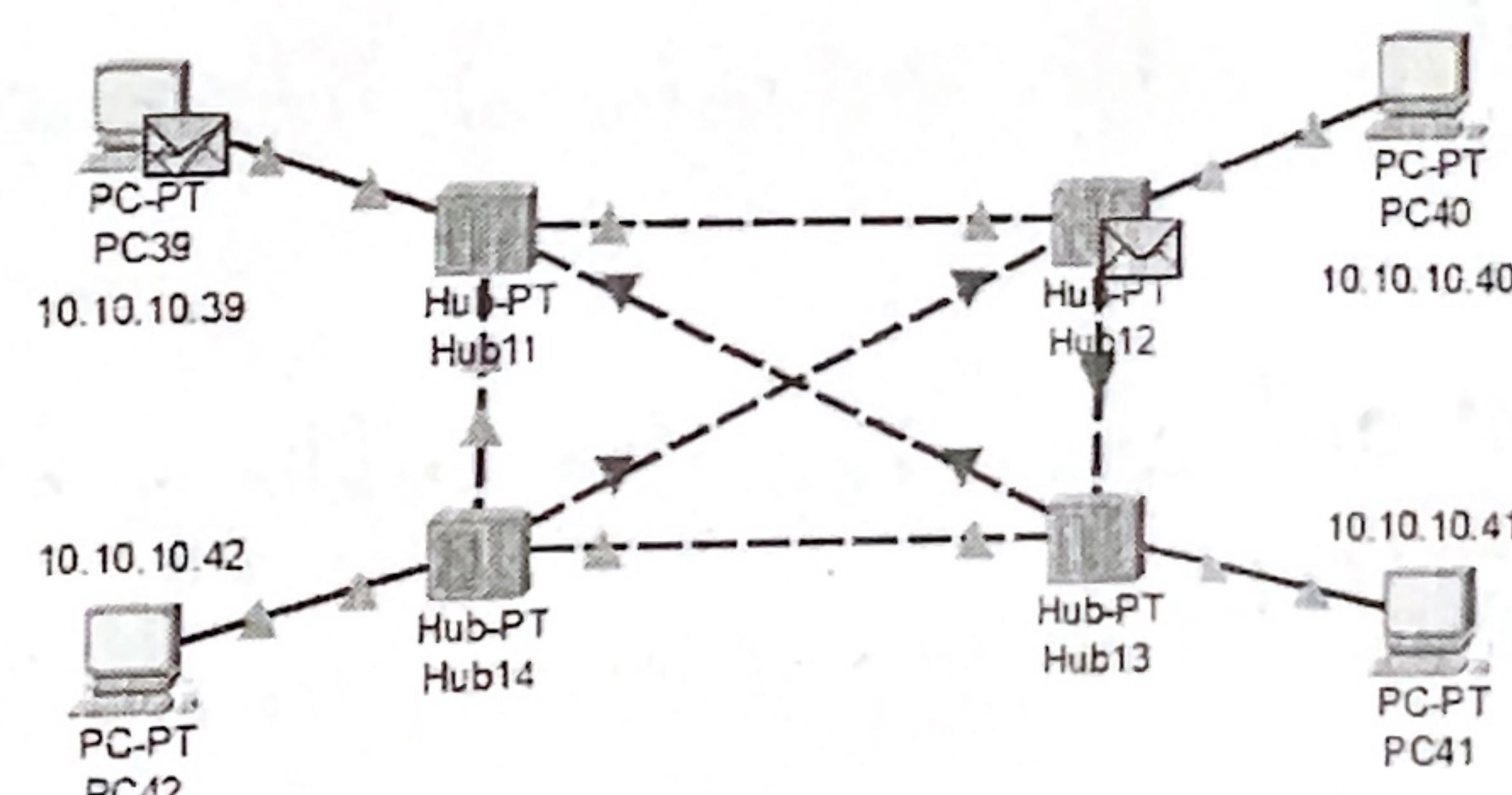
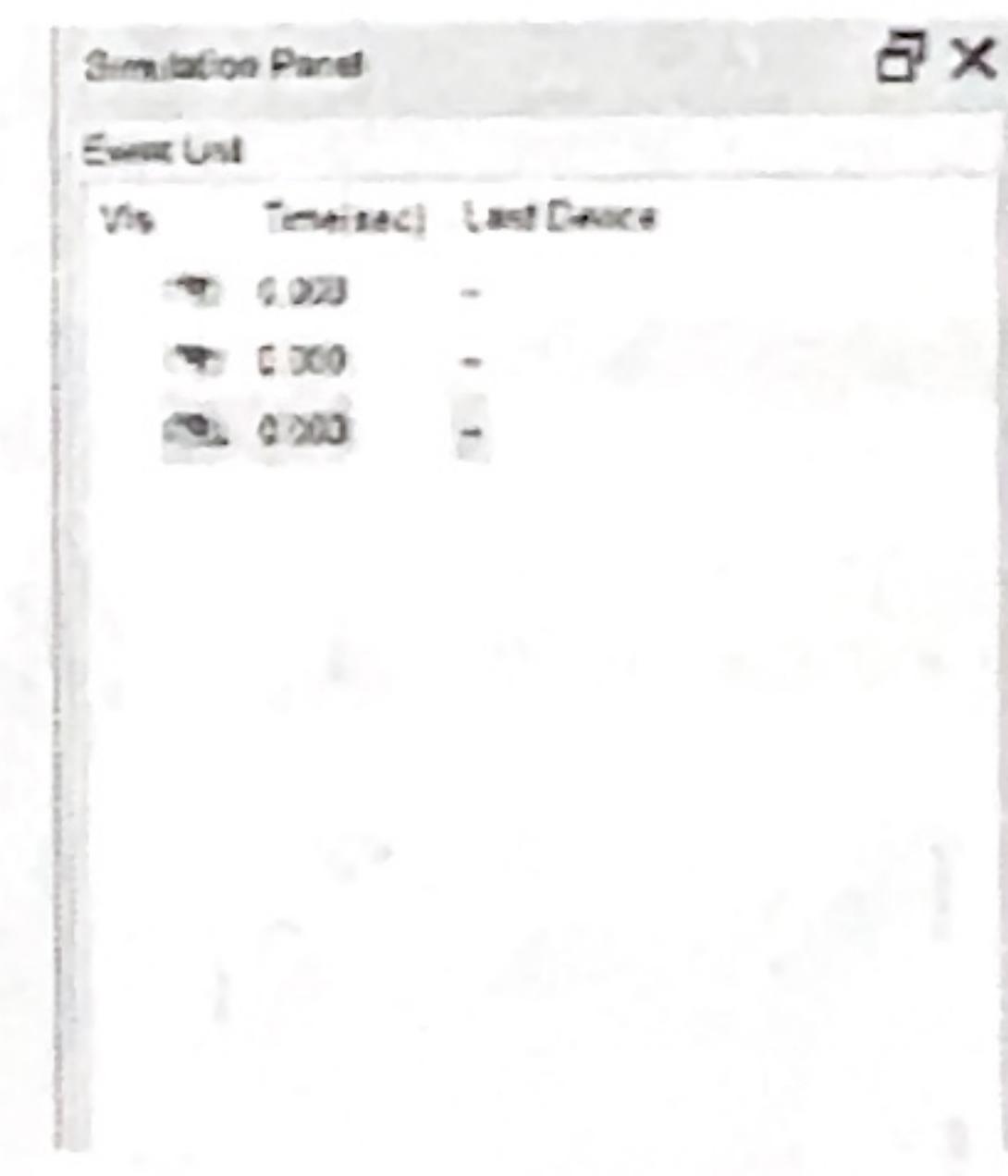
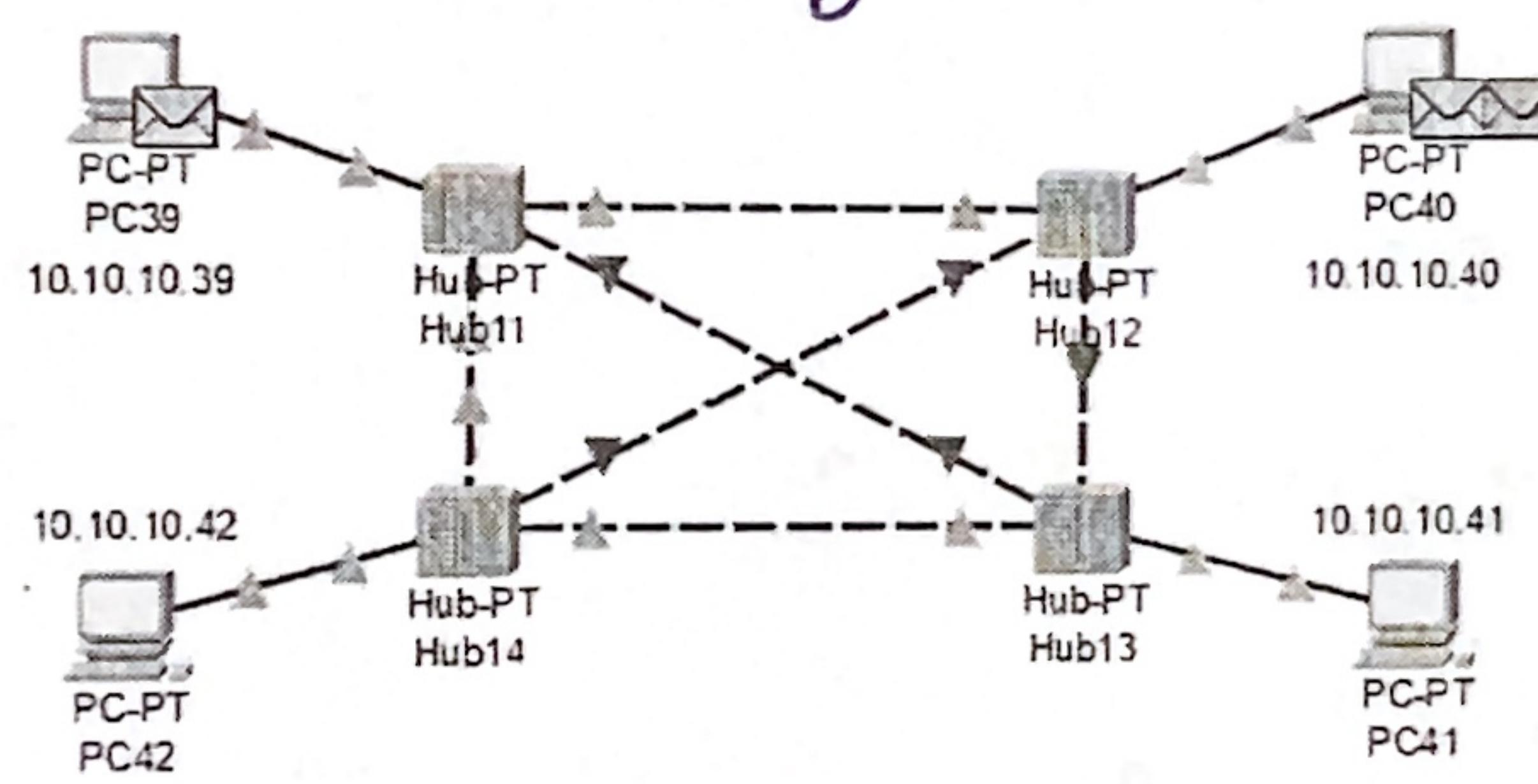


Simulation Panel		
Via	Time(sec)	Last Device
V1	0.004	Switch12
V2	0.004	Switch12
V3	0.004	Switch11
V4	0.004	Switch11
V5	0.005	Switch13
V6	0.005	Switch14
V7	0.005	-
V8	0.006	PC38
V9	0.006	Switch14
V10	0.006	Switch13
V11	0.006	PC37
V12	0.006	Switch13
V13	0.006	Switch14
V14	0.007	-
V15	0.008	PC38
V16	0.008	Switch14
V17	0.008	Switch11
V18	0.008	Switch11
V19	0.009	Switch13
V20	0.009	PC37
V21	0.010	PC37
V22	0.011	Switch13
V23	0.012	Switch14

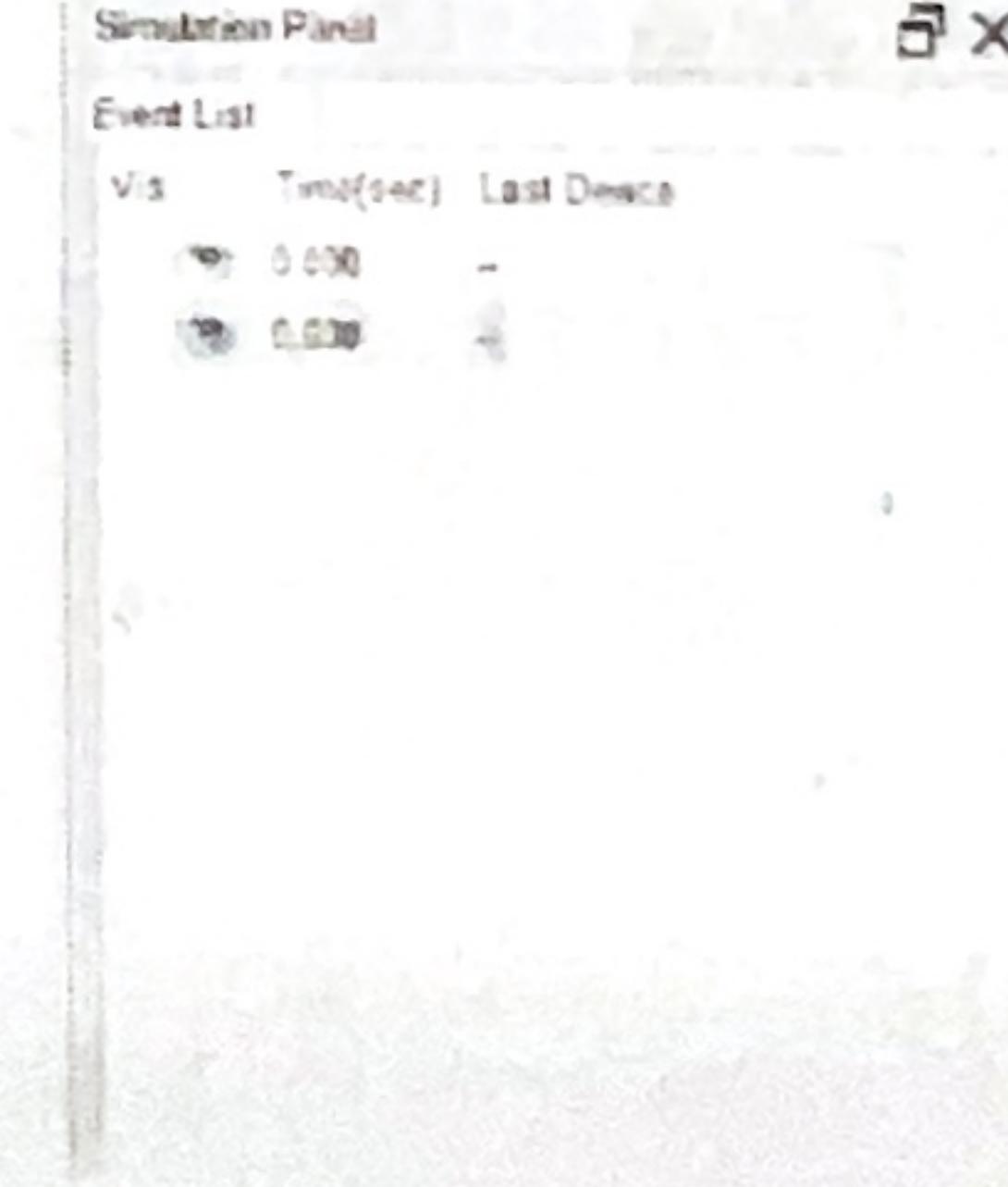
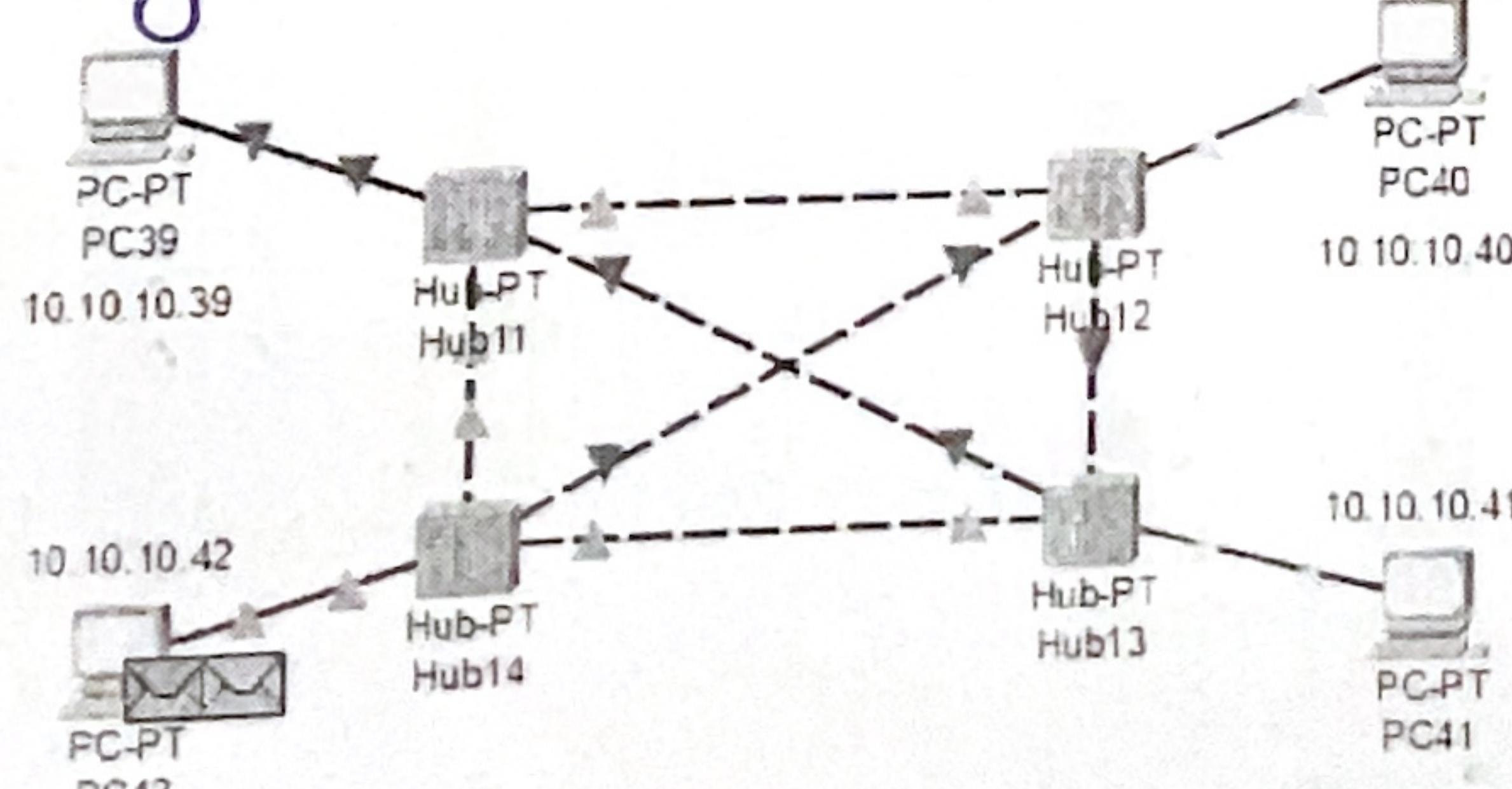
d) Using hub to transfer message from PC39 to PC41

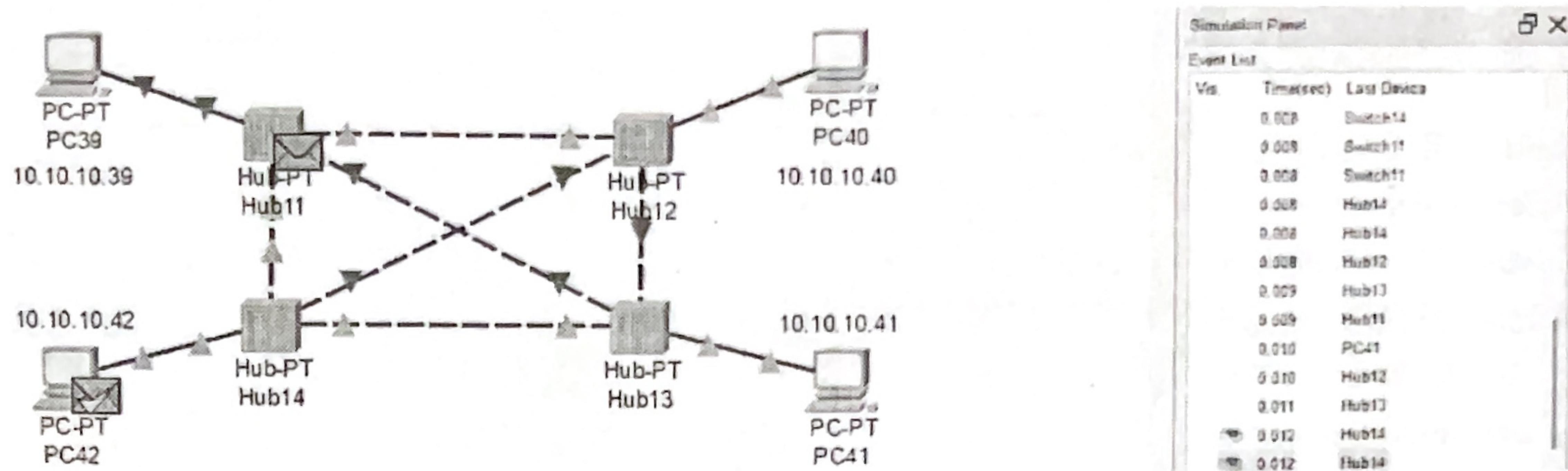


e) Transfer of message from PC39 to PC41 & PC40 to PC42



f) Turning PC39 off; then transferring message to PC42 from PC40





Conclusion → The implementation of network topologies - star, bus, ring and mesh - is vital for the performance, scalability, and fault tolerance of a network. Each topology has its own structure, advantages and limitations, which must be considered when designing a network. The practical analysis and simulation of these topologies, such as through Cisco Packet Tracer, help to understand how these layouts affect network behaviour & efficiency.

### Exercises →

(Q1) Differentiate Physical and logical topology.

Ans → Physical Topology →

i) Definition → Refers to the actual layout of the network's hardware components - how ~~does~~ devices, cables and network infrastructure are physically connected.

ii) Focus → Physical placement and connections (e.g., cables, switches, routers)

iii) Example → In a star physical topology, all devices are physically connected to a central hub.

Logical Topology →

i) Definition → Refers to how data actually moves through the network, regardless of its physical layout. It shows the path that data takes during communication between devices.

ii) Focus → Data flow and communication methods (e.g., protocols, signaling)

iii) Example → In a logical bus topology, data flows in a linear path across all devices even if physically arranged in a star shape.

Q) ii) State the advantages and disadvantages of bus, star, ring and mesh topology technologies.

Ans - i) Bus Topology →

Advantages →

- a) Easy to install and cost-effective for small networks
- b) Requires less cabling compared to other topologies.

Disadvantages →

- a) Main cable failure can take down the entire network.
- b) Network performance degrades as more devices are needed.
- c) Troubleshooting can be difficult.

ii) Ring Topology →

Advantages →

- a) Predictable data transmission since data flows in one direction
- b) Easy to install and configure for smaller networks.

Disadvantages →

- a) A single point of failure can disrupt the entire network.
- b) Adding or removing devices can be difficult.
- c) Data transmission can be slower than other topologies in large networks.

iii) Star Topology →

Advantages →

- a) Easy to manage, setup and expand
- b) Device failure doesn't affect the whole network.
- c) Centralized management and troubleshooting.

Disadvantages →

- a) Central hub failure disrupts the entire network.
- b) Requires more cabling, making it more expensive than bus or ring.

iv) Mesh Topology →

Advantages →

- a) Highly reliable due to multiple redundant paths

b) Failure of one connection doesn't affect the network

c) Ideal for networks where reliable is critical.

Disadvantages →

a) Complex to configure and maintain

b) Expensive due to the large number of connections and cabling required.

3) Briefly explain various factors for selecting a proper network topology.

Ans → i) Cost → The expenses associated with hardware, cabling, and maintenance. Simple topologies like bus are cheaper, while complex ones like mesh require more investment.

ii) Scalability → The ability to easily add more devices to the network without significant changes or costs. Star and mesh topologies are generally more scalable.

iii) Reliability → The tolerance for faults and the ability to maintain network operations during failures. Mesh topologies provide the highest reliability due to redundant connections, while bus and ring topologies are more prone to failure.

iv) Ease of Installation and Maintenance → Simplicity of setting up the network and troubleshooting issues. Star topologies are easier to manage, while mesh is more complex.

v) Performance → The network's ability to handle traffic efficiently. High-traffic networks may benefit from star or mesh topologies, which distribute data ~~efficiently~~ effectively.

vi) Network Size → The number of ~~devices~~ devices and geographical spread. Bus is suitable for small, localized networks, whereas star and mesh can handle larger networks.

vii) Data Transmission → The speed and direction of data flow. Ring topology allows predictable data flow, while star provides faster transmission due to direct connections.

4) For five devices in a network, what is the number of cable links required in a mesh, ring, bus, and star topology?

Ans → a) For 5 devices →  $\frac{5(5-1)}{2} = \frac{5 \times 4}{2} = 10$  links are required in mesh topology as every device is interconnected.

b) Ring Topology → The number of links are same as number of devices, as each device has 2 connections. So, for 5 devices, 5 links are required.

c) Bus Topology → All devices share a single communication line (the bus), so only one backbone cable is needed. For 5 devices, 1 link is required.

d) Star Topology → Each device is connected directly to a central hub.  
So, for 5 devices : 5 links are required

Q5) How does bus arbitration work in network topology?

Ans → Bus arbitration in network topology refers to the process of determining which device gets control of the shared communication bus when multiple devices request to transmit data simultaneously.

- i) Devices that wish to transmit data send a request to use the bus.
- ii) Arbitration logic (either centralized or distributed) resolves which device gets control.
- iii) The chosen device is granted access and can transmit data, while other devices must wait.
- iv) After the transmission, the bus becomes free, and other devices can compete again.