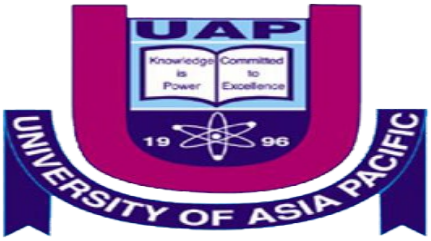


UNIVERSITY OF ASIA PACIFIC

Department of Computer Science & Engineering

OSPF

Course Code : CSE 320

Course Title : Computer Networks Lab

Submitted by:

Name : Sheikh Nafez Sadnan

Reg. No. : 20101106

Roll No. : 106

Section : B (2)

Submitted To:

Md. Akhtaruzzamman Adnan

Assistant Professor

Department of CSE

University of Asia Pacific

Definition of OSPF

Open Shortest Path First (OSPF) is a link-state routing protocol that is used to find the best path between the source and the destination router using its own Shortest Path First). OSPF is developed by Internet Engineering Task Force (IETF) as one of the Interior Gateway Protocol (IGP), i.e, the protocol which aims at moving the packet within a large autonomous system or routing domain. It is a network layer protocol which works on protocol number 89 and uses AD value 110. OSPF uses multicast address 224.0.0.5 for normal communication and 224.0.0.6 for update to designated router(DR)/Backup Designated Router (BDR).

OSPF terms –

1. **Router I'd –** It is the highest active IP address present on the router. First, the highest loopback address is considered. If no loopback is configured then the highest active IP address on the interface of the router is considered.

2. **Router priority –** It is an 8-bit value assigned to a router operating OSPF, used to elect DR and BDR in a broadcast network.

3. **Designated Router (DR) –** It is elected to minimize the number of adjacencies formed. DR distributes the LSAs to all the other routers. DR is elected in a broadcast network to which all the other routers share their DBD. In a broadcast network, the router requests for an update to DR, and DR will respond to that request with an update.

4. **Backup Designated Router (BDR) –** BDR is a backup to DR in a broadcast network. When DR goes down, BDR becomes DR and performs its functions.

DR and BDR election – DR and BDR election takes place in the broadcast network or multi-access network. Here are the criteria for the election:

1. Router having the highest router priority will be declared as DR.

2. If there is a tie in router priority then the highest router I'd be considered. First, the highest loopback address is considered. If no loopback is configured then the highest active IP address on the interface of the router is considered.

How does OSPF work?
There are three steps that can explain the working of OSPF:
Step 1: The first step is to become OSPF neighbors. The two connecting routers running OSPF on the same link creates a neighbor relationship.
Step 2: The second step is to exchange database information. After becoming the neighbors, the two routers exchange the LSDB information with each other.
Step 3: The third step is to choose the best route. Once the LSDB information has been exchanged with each other, the router chooses the best route to be added to a routing table based on the calculation of SPF.

How a router forms a neighbor relationship?
The first thing is happened before the relationship is formed is that each router chooses the router ID.
Router ID (RID): The router ID is a number that uniquely identifies each router on a network. The router ID is in the format of the IPv4 address. There are few ways to set the router ID, the first way is to set the router ID manually and the other way is to let the router decides itself.
The following is the logic that the router chooses to set the router

ID:

- Manually assigned: The router checks whether the router ID is manually set or not. If it manually set, then it is a router ID. If it is not manually set, then it will choose the highest 'up' status loopback interface IP address. If there are no loopback interfaces, then it will choose the highest 'up' status non-loopback interface IP address.

Two routers connected to each other through point to point or multiple routers are connected can communicate with each other through an OSPF protocol. The two routers are adjacent only when both the routers send the HELLO packet to each other. When both the routers receive the acknowledgment of the HELLO packet, then they come in a two-way state. As OSPF is a link state routing protocol, so it allows to create the neighbor relationship between the routers. The two routers can be neighbors only when they belong to the same subnet, share the same area id, subnet mask, timers, and authentication. The OSPF relationship is a relationship formed between the routers so that they can know each other. The two routers can be neighbors if atleast one of them is designated router or backup designated router in a network, or connected through a point-to-point link.

Types of links in OSPF

A link is basically a connection, so the connection between two routers is known as a link.

There are four types of links in OSPF:

1. **Point-to-point link:** The point-to-point link directly connects the two routers without any host or router in between.
2. **Transient link:** When several routers are attached in a network, they are known as a transient link.
   The transient link has two different implementations:
   Unrealistic topology: When all the routers are connected to each other, it is known as an unrealistic topology.
   Realistic topology: When some designated router exists in a

network then it is known as a realistic topology. Here designated router is a router to which all the routers are connected. All the packets sent by the routers will be passed through the designated router.

3. **Stub link:** It is a network that is connected to the single router. Data enters to the network through the single router and leaves the network through the same router.
4. **Virtual link:** If the link between the two routers is broken, the administration creates the virtual path between the routers, and that path could be a long one also.

Benefits of OSPF

1. OSPF is a true LOOP- FREE (route-free loop) routing protocol. It is derived from the merits of the algorithm itself.

2. Fast convergence of OSPF: The route changes can be transmitted to the entire autonomous system in the shortest time.

3. The concept of area division is proposed. After the autonomous system is divided into different regions, the summary of routing information between the regions is adopted, which greatly reduces the quantity of routing information to be transmitted. It also makes routing information not expand rapidly as the network scale increases.

4. The protocol itself minimizes the overhead. See below:
(1) For the discovery and maintenance of neighbor relationships, the hello messages that do not contain routing information are sent regularly and are very short. The message containing the routing information is the mechanism that triggers the update. (Send when there is a route change). However, in order to enhance the robustness of the protocol, it is re-issued every 1800 seconds.
(2) In broadcast networks, multicast addresses are used instead of

broadcast to reduce the interference to other network devices that do not operate OSPF.
(3) In various types of networks that can be accessed multiple times (broadcast, NBMA), by electing DR, the number of route exchanges (synchronizations) between routers on the same network segment is reduced from O (N*N) times to O (N) times.
(4) The concept of an NSSA area is proposed so that the introduced ASE route is no longer propagated within the NSSA area.
(5) Supports route aggregation on ABRs (Area Border Routers) to further reduce routing information transfer between regions.
(6) In the point-to-point interface type, OSPF over On Demand Circuits is configured so that it no longer sends hello packets periodically and updates routing information regularly. Updates are sent only when the network topology really changes.

5. Through the strict division of the level of routing (a total of four points), it provides more reliable routing.

6. Good security. OSPF supports interface-based plaintext and md5 authentication.

7. OSPF adapts to various scales of networks, up to thousands of units.

Disadvantages of OSPF

- It needs lots of information to calculate the best route for each destination. To store this information, OSPF consumes more memory than other routing protocols.

- To calculate the best route, it runs the SPF algorithm that requires extra CPU processing.

- It is complex to configure and difficult to troubleshoot. In a large network, only experienced network administrators can

configure it.

Usages of OSPF

Typically, OSPF is used in large enterprise networks that use routing equipment from different vendors. OSPF is also used in companies that have the policy to use an open standard protocol for routing which gives them flexibility when they need to replace an existing router or add a new router.

It is recommended to use an advanced routing protocol if you have more than 50 routers in your network. Currently, there are only two advanced routing protocols in use that can scale any size of the network. These protocols are EIGRP and OSPF. EIGRP is a Cisco proprietary protocol. It means if you want to use EIGRP, you have to use only Cisco routers in your network. If you have a non-Cisco router in your network, EIGRP will not work on it. In such a situation, you can use OSPF. Basically, in a mixed vendor environment, OSPF is the only choice we have for routing.

Key features of OSFP

- OSPF is an interior gateway protocol (IGP).
- It runs within a single routing domain, such as an autonomous system (AS).
- It uses a concept called areas, to optimize network traffic and simplify administration.
- It uses Dijkstra's algorithm to compute the shortest route to each destination.
- It runs over IP protocol but does not use a transport protocol (such as TCP or UDP) to encapsulate its data.
- It encapsulates its data directly in IP packets with protocol

number 89.
- It uses its own error detection and correction mechanism.

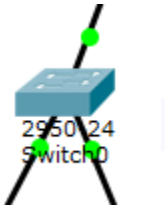
The following table compares the features of OSPFv2, RIP, and RIPv2.

Feature	**OSPFv2**	**RIPv1**	**RIPv2**
Protocol type	Link state	Distance vector	Distance vector
Algorithm	Dijkstra	Bellman ford	Bellman ford
Metric	Bandwidth	Hops	Hops
Hop count limit	None	15	15
VLSM support	Yes	No	Yes
Classless support	Yes	No	Yes
Non-contiguous network support	Yes	No	Yes
Auto-summarization	No	Yes	Yes
Manual summarization	Yes	No	Yes
Route propagation	Multicast	Broadcast	Broadcast
Convergence	Fast	Slow	Slow
Use authentication	Yes	No	Yes
Update	On event	periodic	periodic
Supported network type	All types	Flat only	Flat only

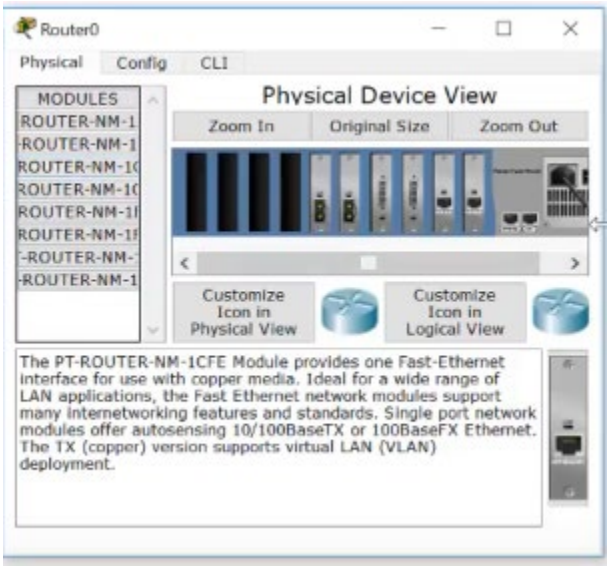
How to implement **OSPF**

Step-1: Open a project in Cisco Packet Tracer. Take a router, switch & PC from the drop-down menu. The amount of these equipment's depends on the architecture of the project.

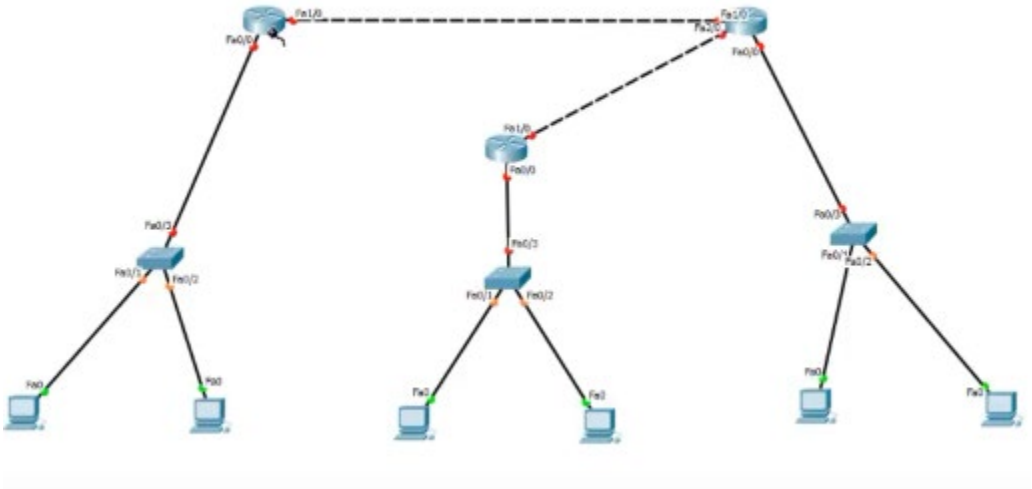
Step-2: Rename the equipment's to avoid confusion.



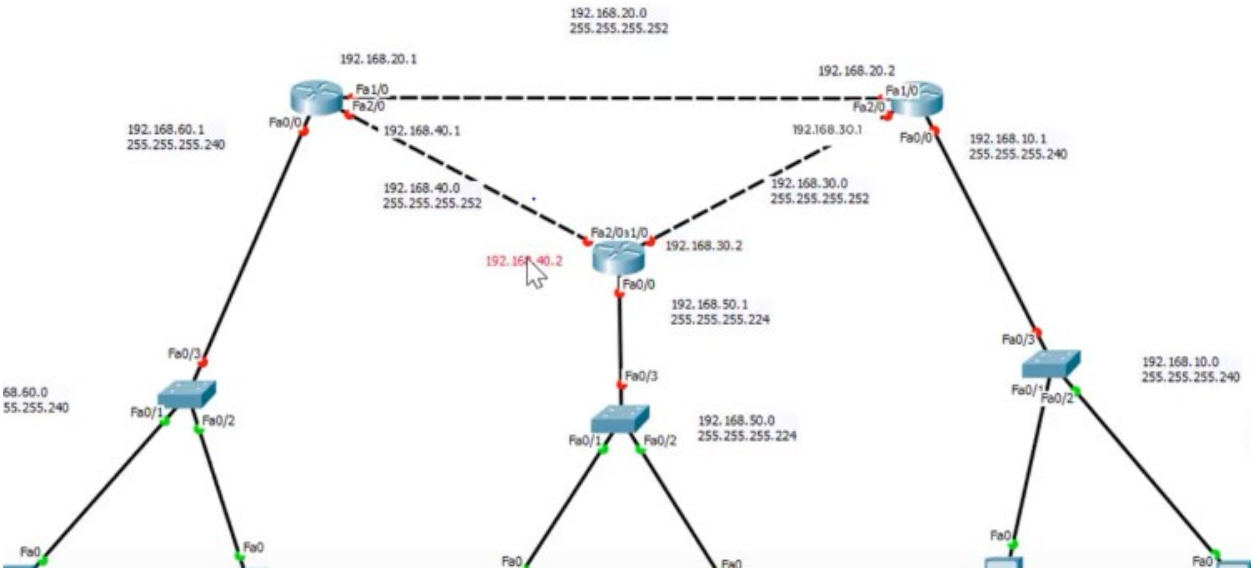
Step-3: Configure the routers.



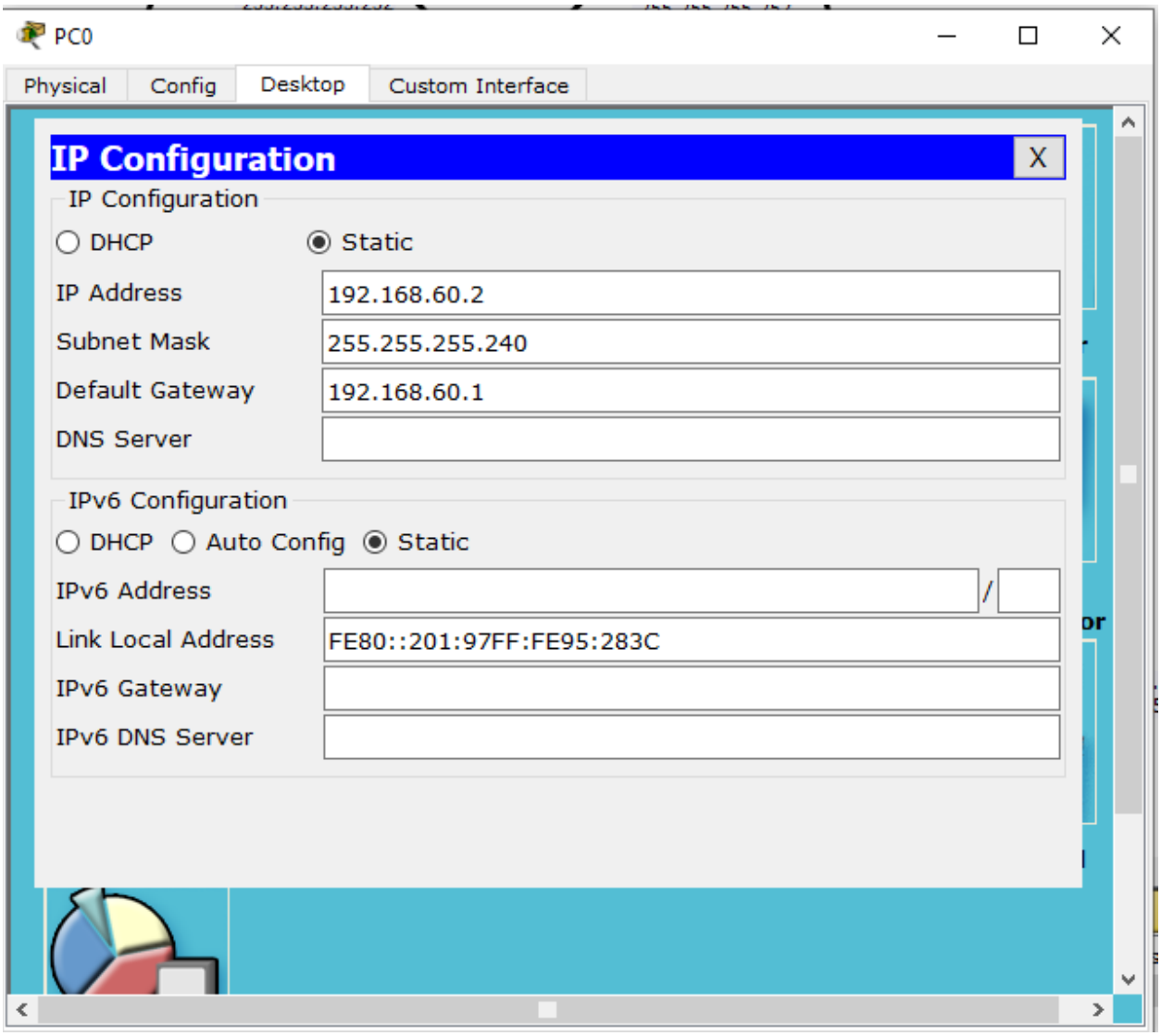
Step-4: Give connections.

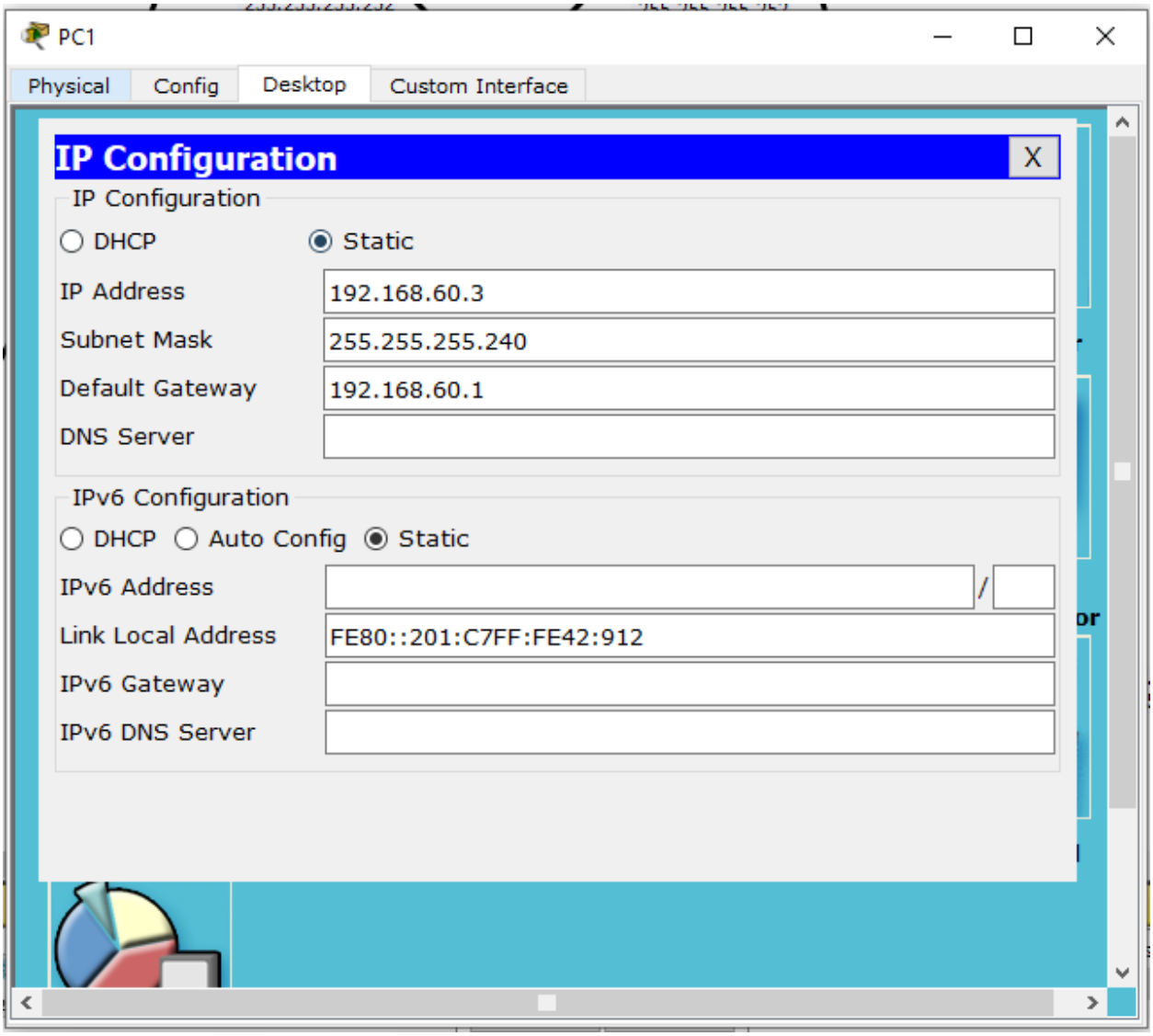


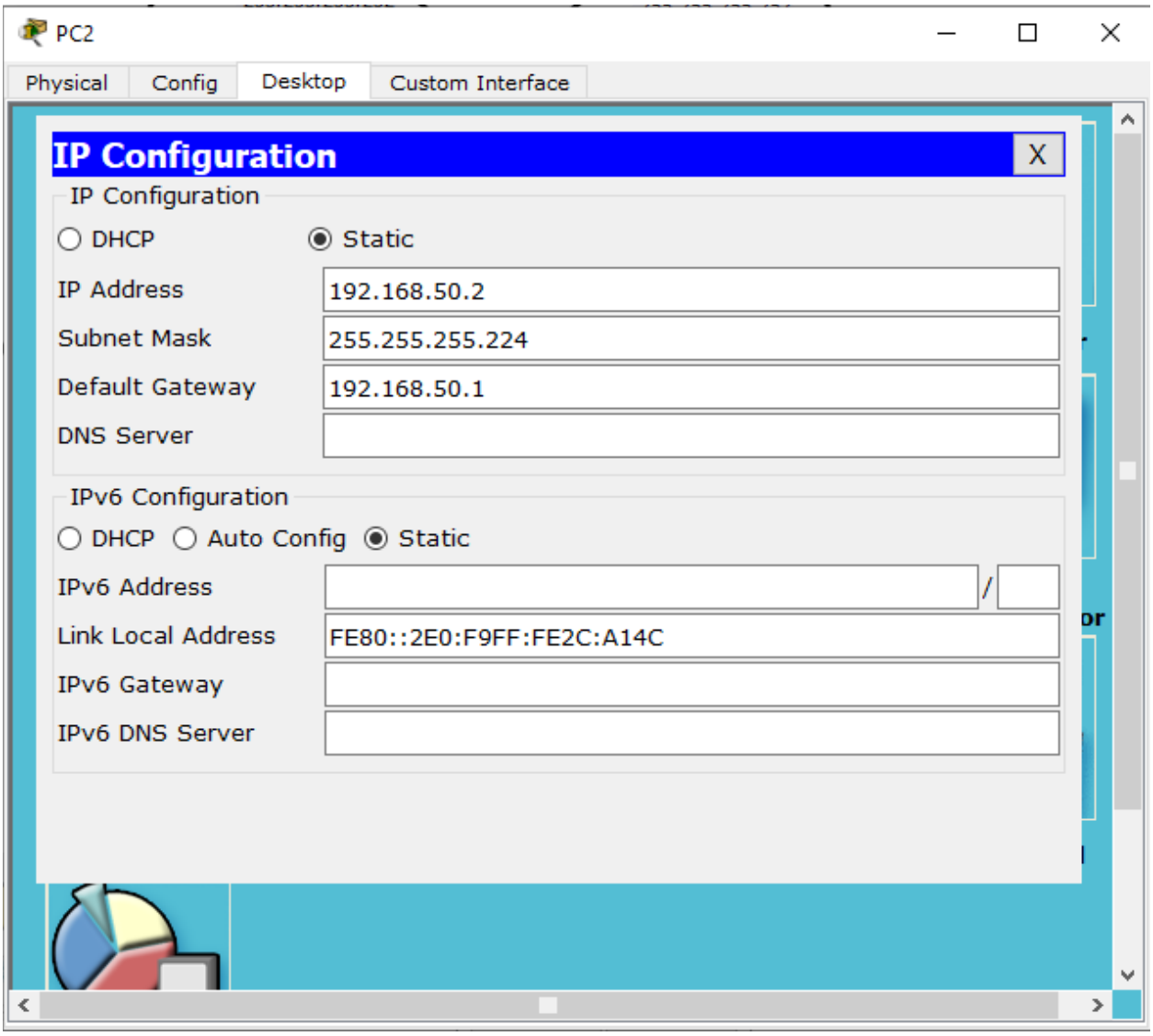
Step-5: Assign network address and ip's.

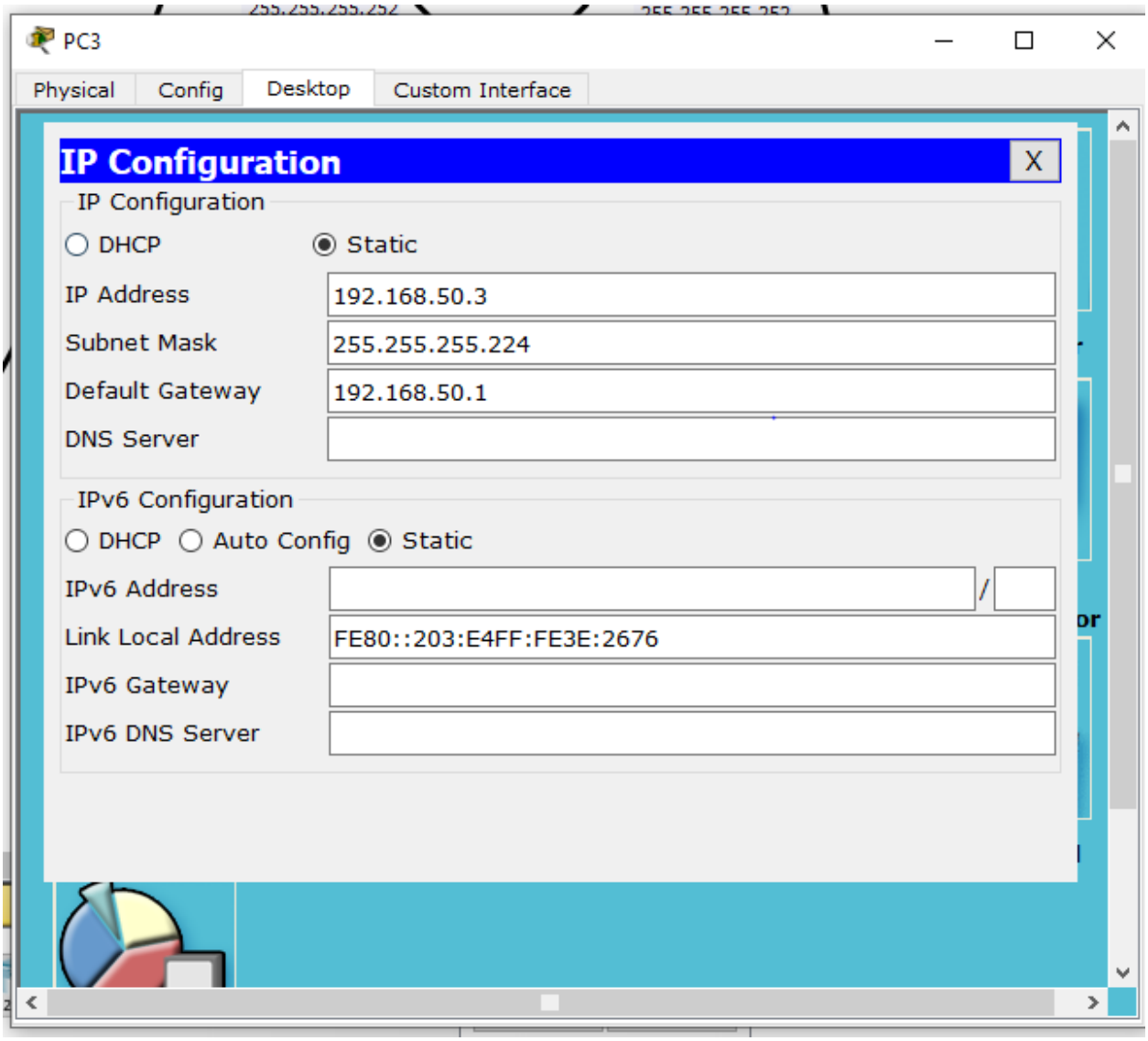


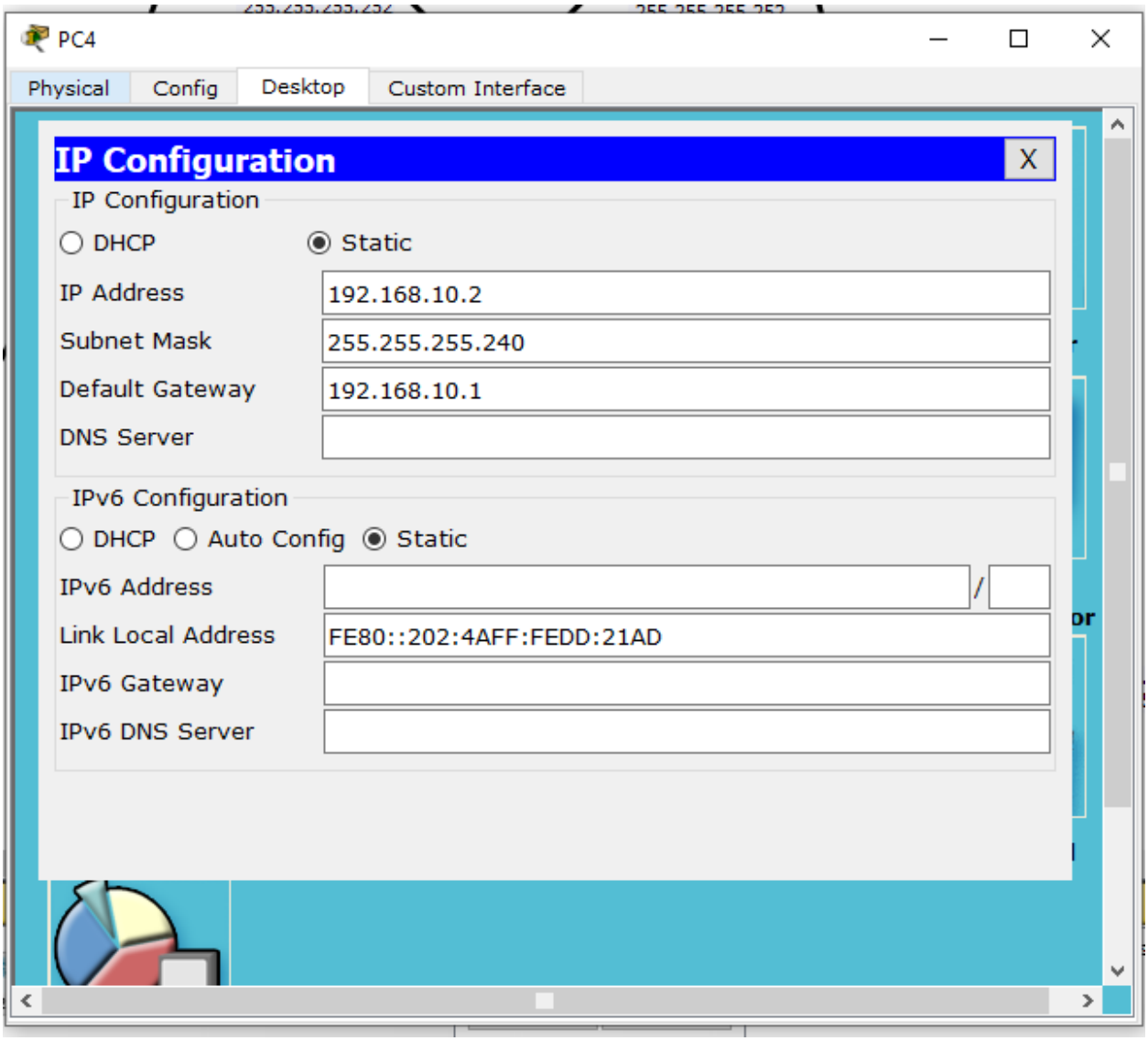
Step-6: Configure the pc's-

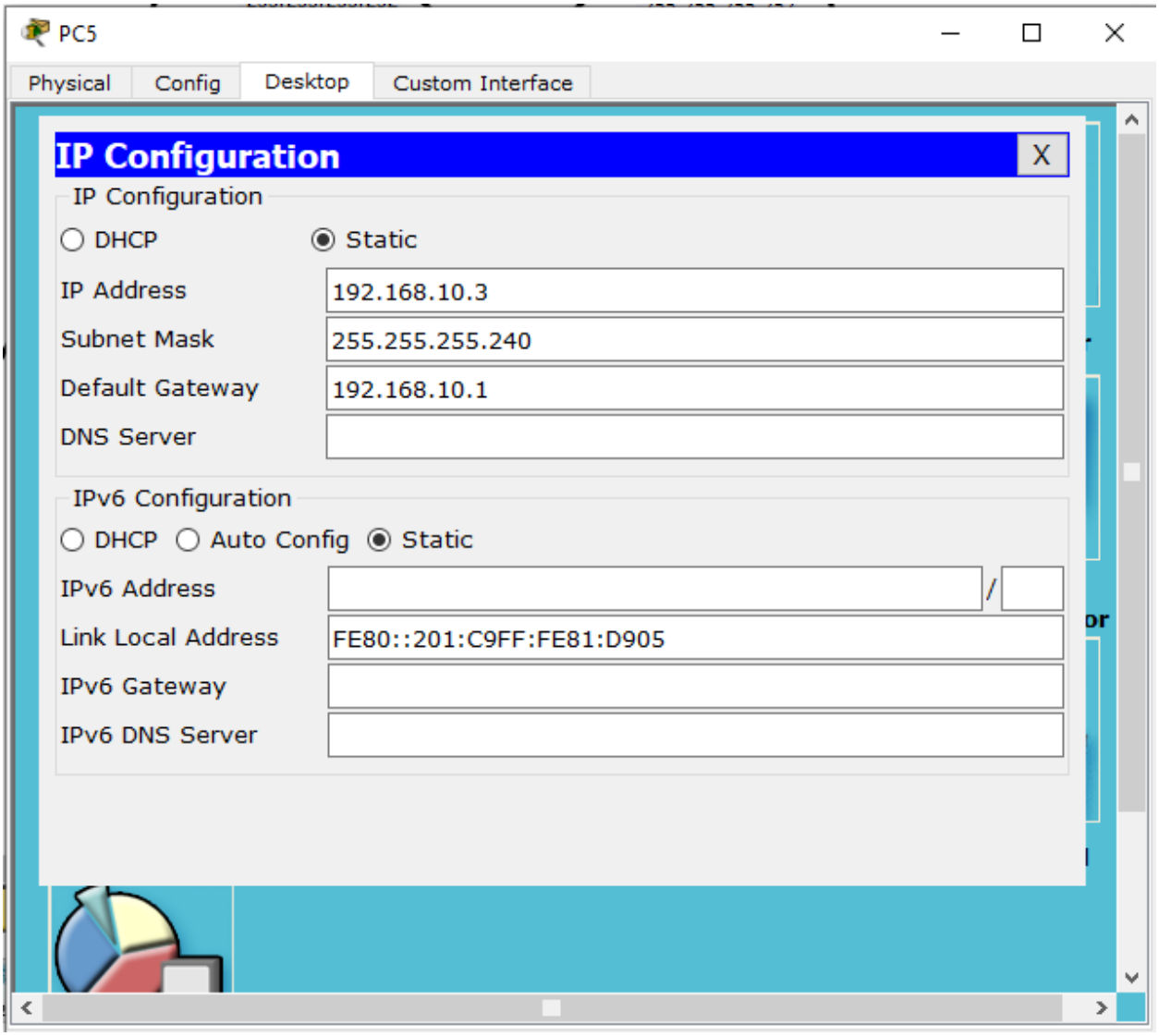

PC0
Physical
Config
Desktop
Custom Interface
IP Configuration
X
IP Configuration
DHCP
Static
IP Address
192.168.60.2
Subnet Mask
255.255.255.240
Default Gateway
192.168.60.1
DNS Server
IPv6 Configuration
DHCP
Auto Config
Static
IPv6 Address
Link Local Address
FE80::201:97FF:FE95:283C
IPv6 Gateway
IPv6 DNS Server


PC1
Physical
Config
Desktop
Custom Interface
IP Configuration
X
IP Configuration
DHCP
Static
IP Address
192.168.60.3
Subnet Mask
255.255.255.240
Default Gateway
192.168.60.1
DNS Server
IPv6 Configuration
DHCP
Auto Config
Static
IPv6 Address
Link Local Address
FE80::201:C7FF:FE42:912
IPv6 Gateway
IPv6 DNS Server


PC2
Physical
Config
Desktop
Custom Interface
IP Configuration
X
IP Configuration
DHCP
Static
IP Address
192.168.50.2
Subnet Mask
255.255.255.224
Default Gateway
192.168.50.1
DNS Server
IPv6 Configuration
DHCP
Auto Config
Static
IPv6 Address
/
Link Local Address
FE80::2E0:F9FF:FE2C:A14C
IPv6 Gateway
IPv6 DNS Server


PC3
Physical
Config
Desktop
Custom Interface
IP Configuration
X
IP Configuration
DHCP
Static
IP Address
192.168.50.3
Subnet Mask
255.255.255.224
Default Gateway
192.168.50.1
DNS Server
IPv6 Configuration
DHCP
Auto Config
Static
IPv6 Address
Link Local Address
FE80::203:E4FF:FE3E:2676
IPv6 Gateway
IPv6 DNS Server


PC4
Physical
Config
Desktop
Custom Interface
IP Configuration
X
IP Configuration
DHCP
Static
IP Address
192.168.10.2
Subnet Mask
255.255.255.240
Default Gateway
192.168.10.1
DNS Server
IPv6 Configuration
DHCP
Auto Config
Static
IPv6 Address
Link Local Address
FE80::202:4AFF:FEDD:21AD
IPv6 Gateway
IPv6 DNS Server



Step-7: Configure the routers-

For router 0 the codes are-

en
conf t
int fa0/0
ip address 192.168.60.1 255.255.255.240
no shut
exit

int fa1/0
ip address 192.168.20.1 255.255.255.252
no shut
exit
int fa2/0
ip address 192.168.40.1 255.255.255.252
no shut
exit
router ospf 1
network 192.168.60.0 0.0.0.15 area 1
network 192.168.40.0 0.0.0.3 area 1
network 192.168.20.0 0.0.0.3 area 1
exit

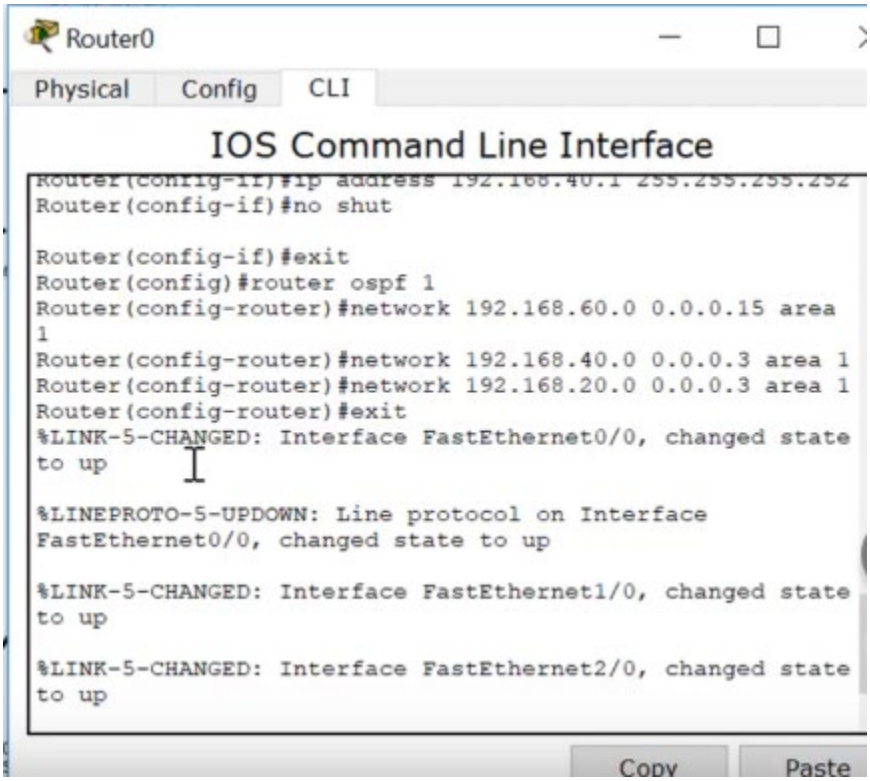
For router 2 the codes are-

en
conf t
int fa0/0
ip address 192.168.50.1 255.255.255.224
no shut
exit
int fa1/0
ip address 192.168.30.2 255.255.255.252
no shut
exit
int fa2/0
ip address 192.168.40.2 255.255.255.252
no shut
exit
router ospf 2
network 192.168.50.0 0.0.0.31 area 1
network 192.168.30.0 0.0.0.3 area 1
network 192.168.40.0 0.0.0.3 area 1

exit

For router 1 the codes are-

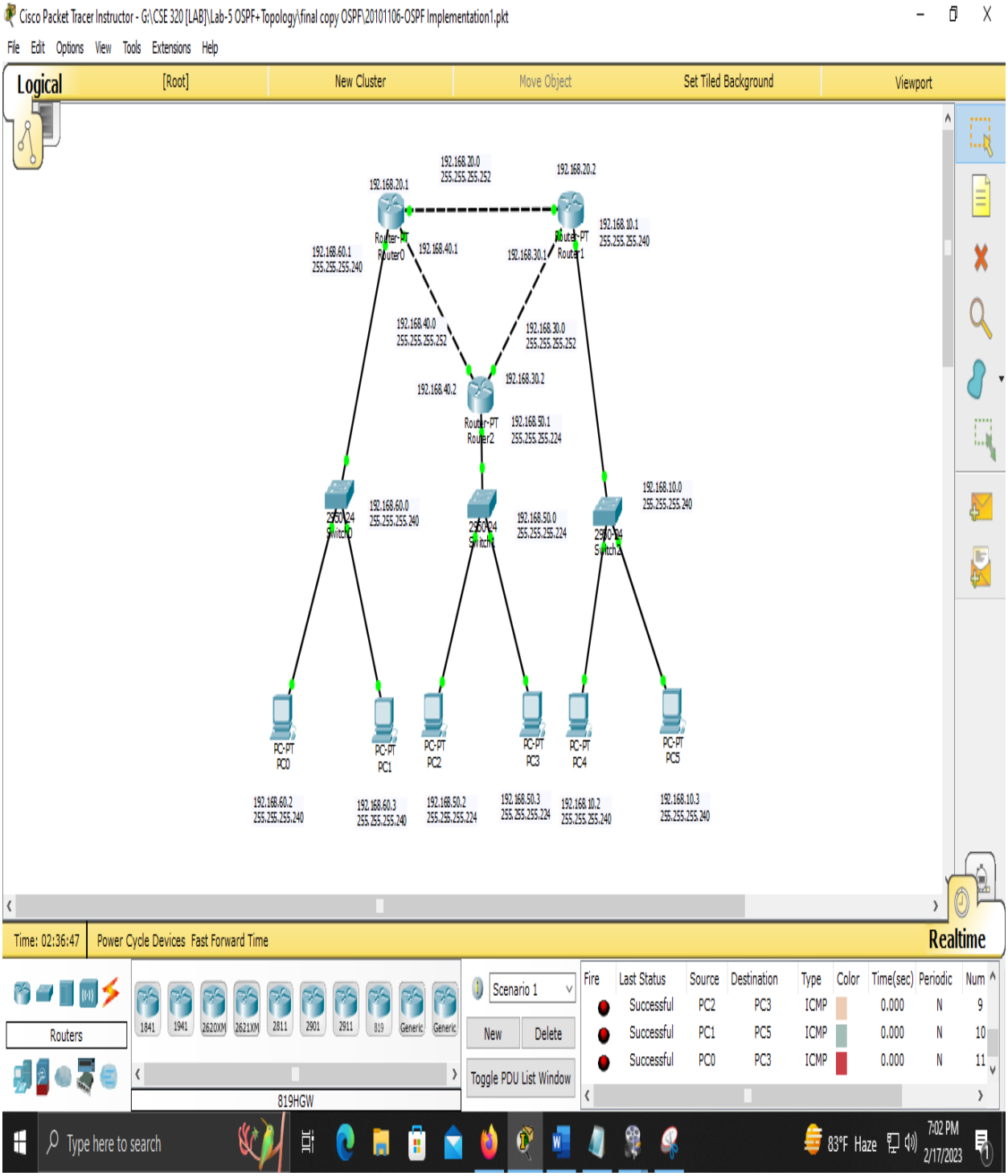
en
conf t
int fa0/0
ip address 192.168.10.1 255.255.255.240
no shut
exit
int fa1/0
ip address 192.168.20.2 255.255.255.252
no shut
exit
int fa2/0
ip address 192.168.30.1 255.255.255.252
no shut
exit
router ospf 3
network 192.168.10.0 0.0.0.15 area 1
network 192.168.30.0 0.0.0.3 area 1
network 192.168.20.0 0.0.0.3 area 1
exit



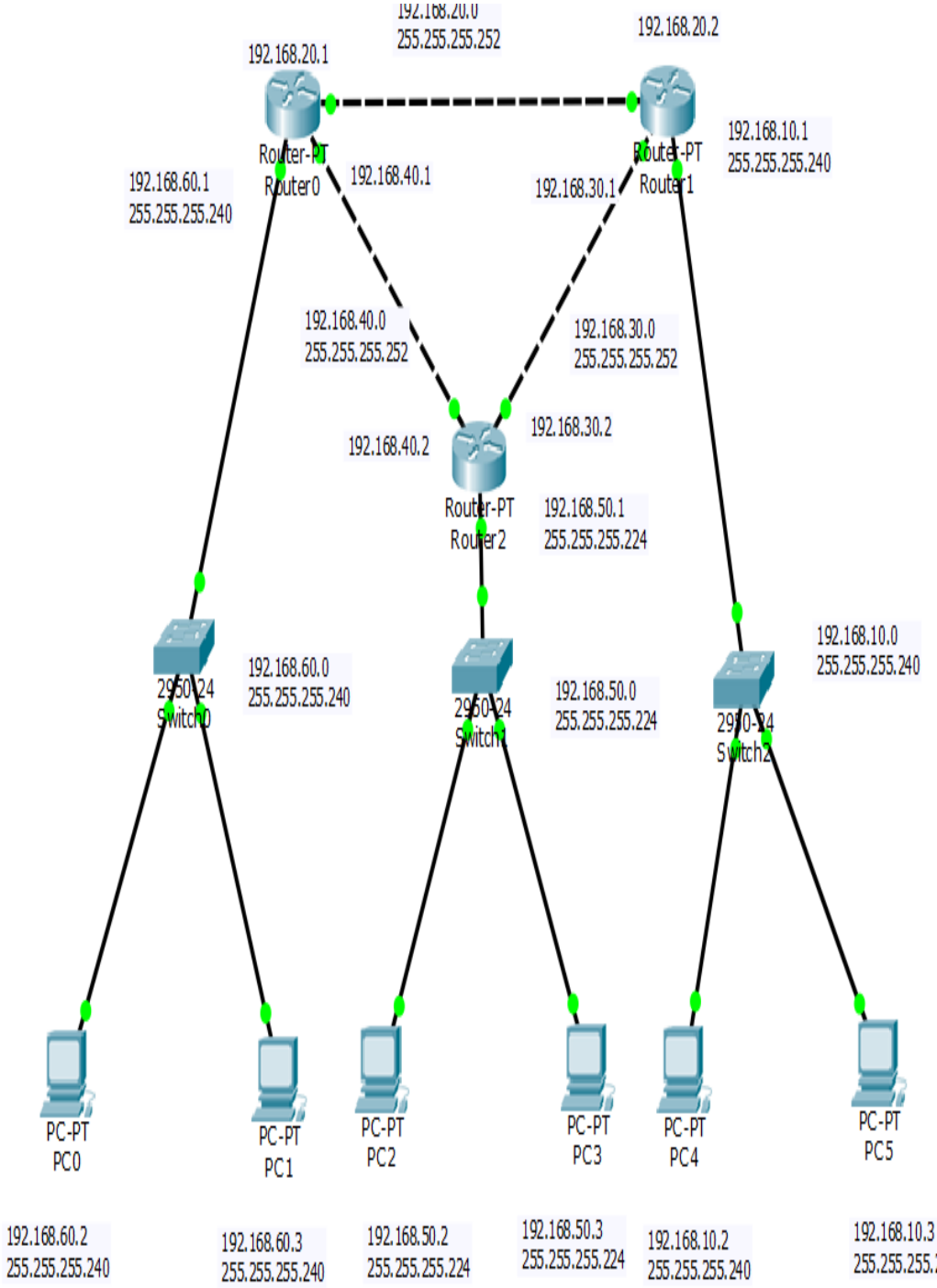
Step-8: Try to send packets, it should succeed.

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num
	Successful	PC2	PC3	ICMP		0.000	N	9
	Successful	PC1	PC5	ICMP		0.000	N	10
	Successful	PC0	PC3	ICMP		0.000	N	11

Overall screenshot of the whole architecture-



Detailed view-



----------THANK YOU FOR READING----------