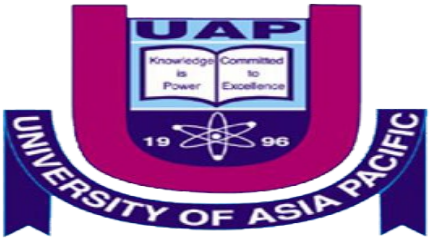

UNIVERSITY OF ASIA PACIFIC

Department of Computer Science & Engineering

DHCP with DNS

Course Code : CSE 320

Course Title : Computer Networks Lab

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Assistant Professor

Department of CSE

University of Asia Pacific

Definition of DHCP

Dynamic Host Configuration Protocol (DHCP) is an application layer protocol which is used to provide:

1. Subnet Mask (Option 1 – e.g., 255.255.255.0)
2. Router Address (Option 3 – e.g., 192.168.1.1)
3. DNS Address (Option 6 – e.g., 8.8.8.8)
4. Vendor Class Identifier (Option 43 – e.g., 'unifi' = 192.168.1.9 ##where unifi = controller)

DHCP is based on a client-server model and based on discovery, offer, request, and ACK.

DHCP is an under-the-covers mechanism that automates the assignment of IP addresses to fixed and mobile hosts that are connected wired or wirelessly.
When a device wants access to a network that's using DHCP, it sends a request for an IP address that is picked up by a DHCP server. The server responds be delivering an IP address to the device, then monitors the use of the address and takes it back after a specified time or when the device shuts down. The IP address is then returned to the pool of addresses managed by the DHCP server to be reassigned to another device as it seeks access to the network.
While the delegation of IP addresses is the central function of the protocol, DHCP also assigns a variety of related networking parameters including subnet mask, default gateway address, and domain name server (DNS). DHCP is an IEEE standard built on top of the older BOOTP (bootstrap protocol), which has become obsolete because it only works on IPv4 networks.

How DHCP works

DHCP runs at the application layer of the TCP/IP protocol stack to dynamically assign IP addresses to DHCP clients/nodes and to allocate TCP/IP configuration information to the DHCP clients.

Information includes subnet mask information, default gateway, IP addresses and domain name system addresses.
DHCP is based on client-server protocol in which servers manage a pool of unique IP addresses, as well as information about client configuration parameters, and assign addresses out of those address pools.

Components of DHCP
When working with DHCP, it is important to understand all of the components. Following are the list of components:

- **DHCP Server:** DHCP server is a networked device running the DCHP service that holds IP addresses and related configuration information. This is typically a server or a router but could be anything that acts as a host, such as an SD-WAN appliance.
- **DHCP client:** DHCP client is the endpoint that receives configuration information from a DHCP server. This can be any device like computer, laptop, IoT endpoint or anything else that requires connectivity to the network. Most of the devices are configured to receive DHCP information by default.
- **IP address pool:** IP address pool is the range of addresses that are available to DHCP clients. IP addresses are typically handed out sequentially from lowest to the highest.
- **Subnet:** Subnet is the partitioned segments of the IP networks. Subnet is used to keep networks manageable.
- **Lease:** Lease is the length of time for which a DHCP client holds the IP address information. When a lease expires, the client has to renew it.
- **DHCP relay:** A host or router that listens for client messages being broadcast on that network and then forwards them to a configured server. The server then sends responses back to the relay agent that passes them along to the client. DHCP relay can be used to centralize DHCP servers instead of having a server on each subnet.

Benefits of DHCP

There are following benefits of DHCP:

Centralized administration of IP configuration: DHCP IP configuration information can be stored in a single location and enables that administrator to centrally manage all IP address configuration information.

Dynamic host configuration: DHCP automates the host configuration process and eliminates the need to manually configure individual host. When TCP/IP (Transmission control protocol/Internet protocol) is first deployed or when IP infrastructure changes are required.

Seamless IP host configuration: The use of DHCP ensures that DHCP clients get accurate and timely IP configuration IP configuration parameter such as IP address, subnet mask, default gateway, IP address of DND server and so on without user intervention.

Flexibility and scalability: Using DHCP gives the administrator increased flexibility, allowing the administrator to move easily change IP configuration when the infrastructure changes.

Disadvantages of DHCP

- Tracing internet activity may be difficult as the same machine may have two or more different IP addresses over a period of time.
- Not having a static IP means computers with DHCP cannot be used as servers as their IP will change.

What is DNS?

The Domain Name System (DNS) is the phonebook of the Internet. Humans access information online through domain names, like nytimes.com or espn.com. Web browsers interact through Internet Protocol (IP) addresses. DNS translates domain names to IP addresses so browsers can load Internet resources.

Each device connected to the Internet has a unique IP address which

other machines use to find the device. DNS servers eliminate the need for humans to memorize IP addresses such as 192.168.1.1 (in IPv4), or more complex newer alphanumeric IP addresses such as 2400:cb00:2048:1::c629:d7a2 (in IPv6).

How does DNS work?

The process of DNS resolution involves converting a hostname (such as www.example.com) into a computer-friendly IP address (such as 192.168.1.1). An IP address is given to each device on the Internet, and that address is necessary to find the appropriate Internet device - like a street address is used to find a particular home. When a user wants to load a webpage, a translation must occur between what a user types into their web browser (example.com) and the machine-friendly address necessary to locate the example.com webpage.

In order to understand the process behind the DNS resolution, it's important to learn about the different hardware components a DNS query must pass between. For the web browser, the DNS lookup occurs "behind the scenes" and requires no interaction from the user's computer apart from the initial request.

Best DNS Servers

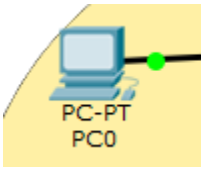
Here are some of the top DNS servers available:

1. **Cloudflare 1.1.1.1.** This is a simple-to-use DNS service that comes with tutorials for all of the most popular operating systems, such as Mac, Windows, Android, iOS, and Linux. Users can also use Cloudflare's service to block adult content.
2. **Google Public DNS.** The Google Public DNS service is different from Cloudflare's in that it is designed for more technically adept users. But you can find tutorials if needed.
3. **Quad9.** Quad9's DNS service is renowned for its fast performance. It also claims to block malicious sites using threat intelligence data.

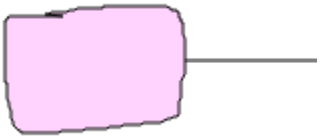
How to implement **DHCP with DNS (BASIC)**

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.

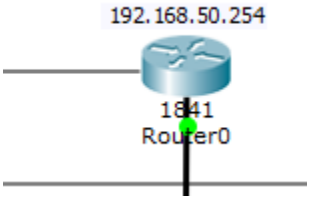
Step-2: Rename the equipment's to avoid confusion.



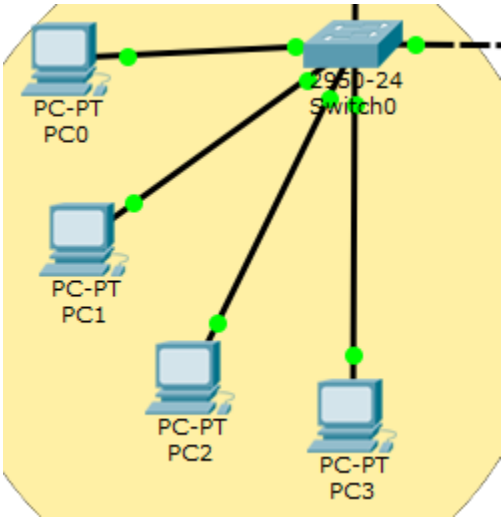
Step-3: Draw an ISP area.



Step-4: Place the router besides it.



Step-5: Assign switch and PC for each department and connect them using straight-though cable (for switch to switch use cross-over cable). Define each department with various color. I'm using 4 pc for IT department, 2 pc for HR department and 3 pc for accounts department. I have 3 switches for those 3 departments.



Step-6: Interface between switch and router still not up. Go to switch, then CLI and write down those codes:

enable
configure terminal
interface fastEthernet 0/0
ip address 192.168.50.254 255.255.255.0
no shutdown
exit

Assign DHCP commands:

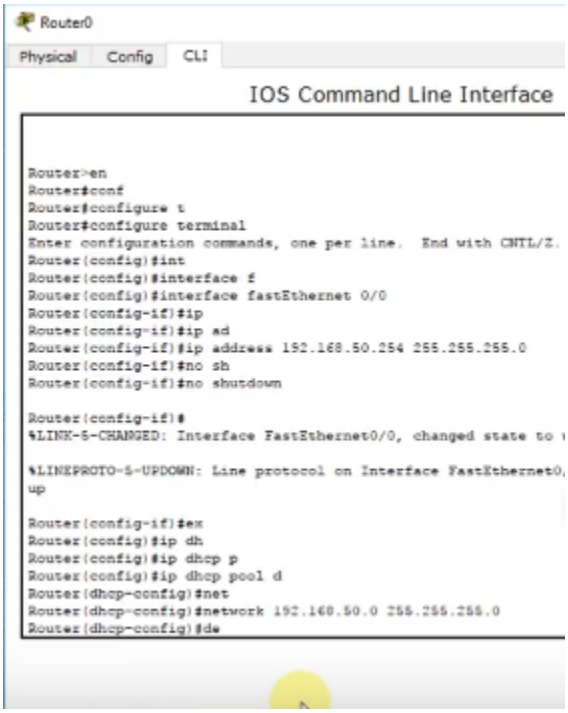
ip dhcp pool d
network 192.168.50.0 255.255.255.0
default-router 192.168.50.254
dns-server 8.8.8.8
exit

Apply excluded addresses:

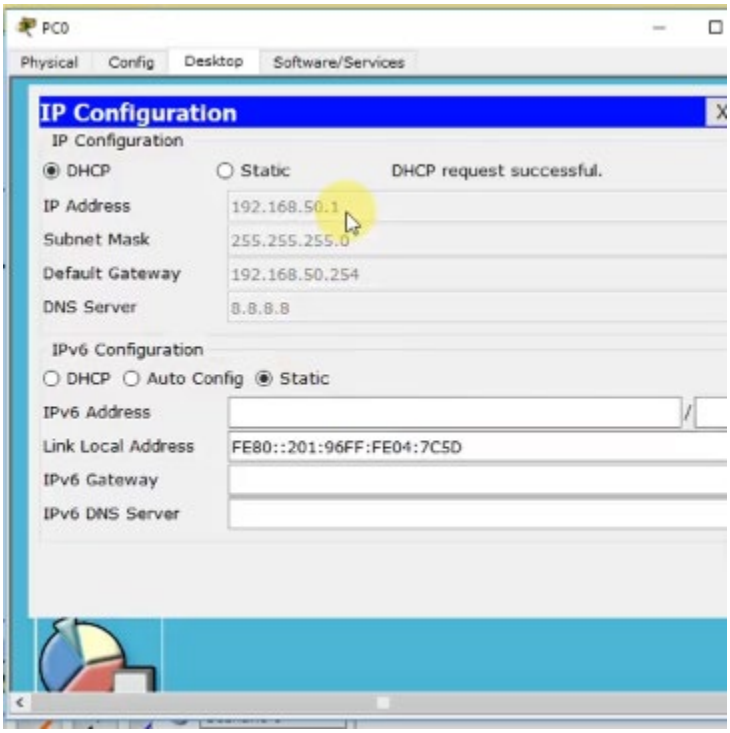
ip dhcp excluded-address 192.168.50.3 192.168.50.20
exit

Write the configuration:

wr



Step-7: Go to any pc, then desktop, select DHCP for IP Configuration, It will show DHCP request successful.

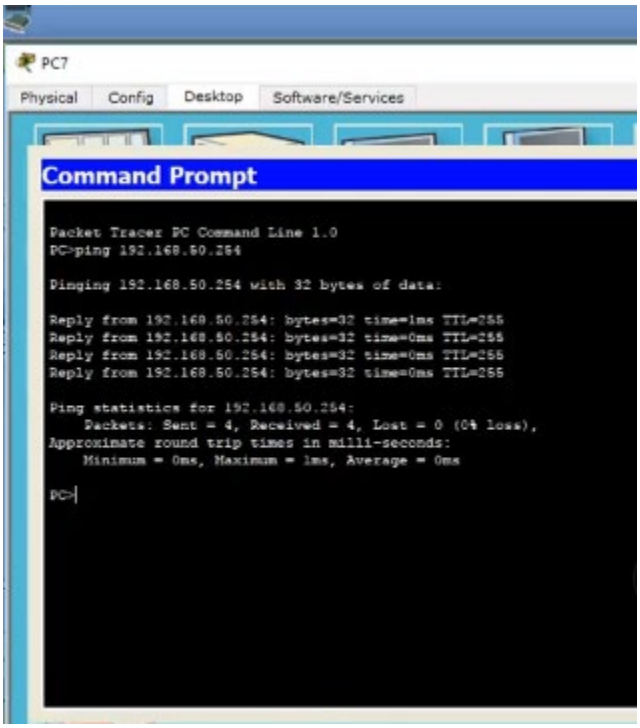


Step-8: Go to any pc, and ping. It should succeed with 0% loss.

ping 192.168.50.254

or,

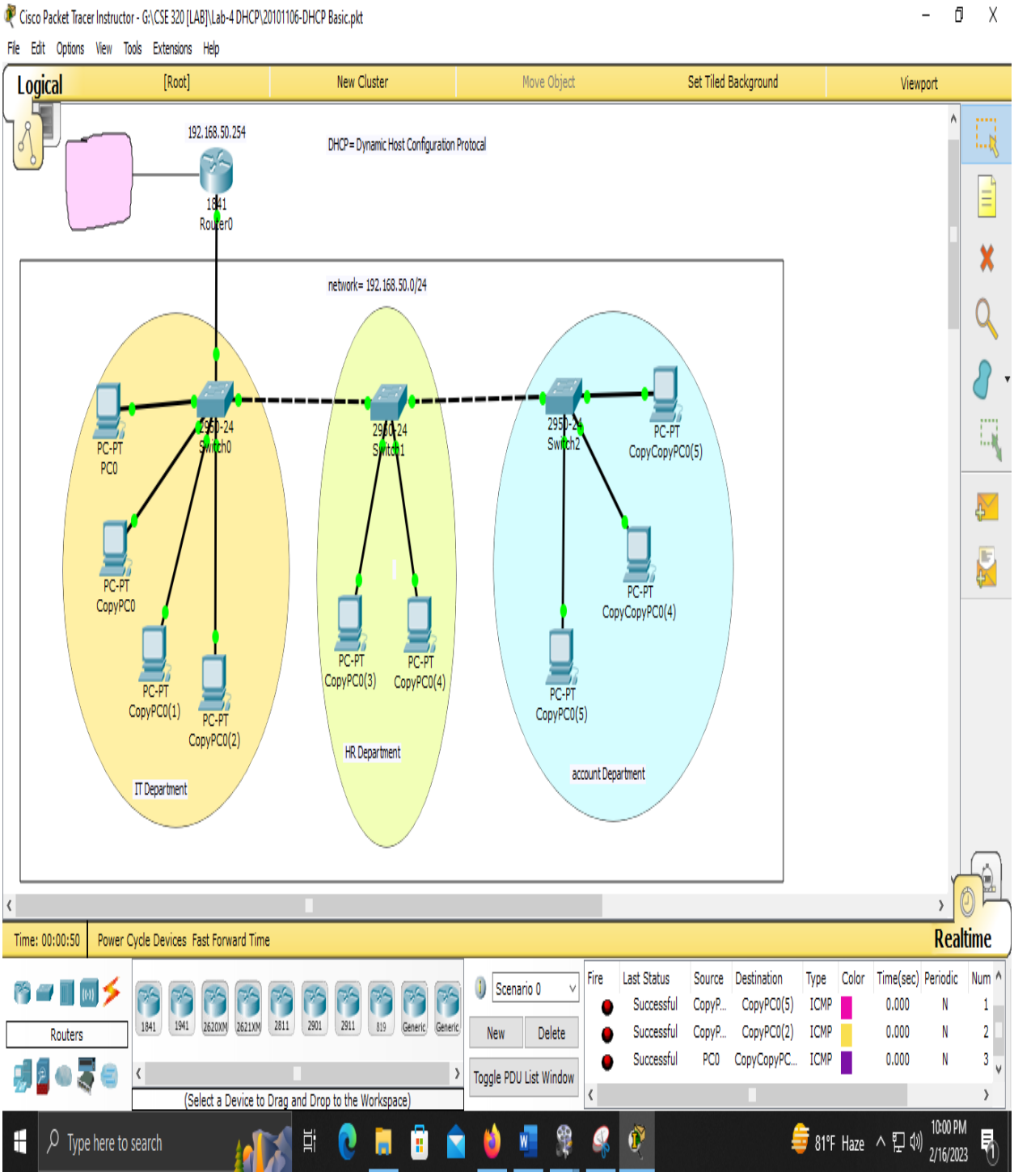
ping 192.168.50.1



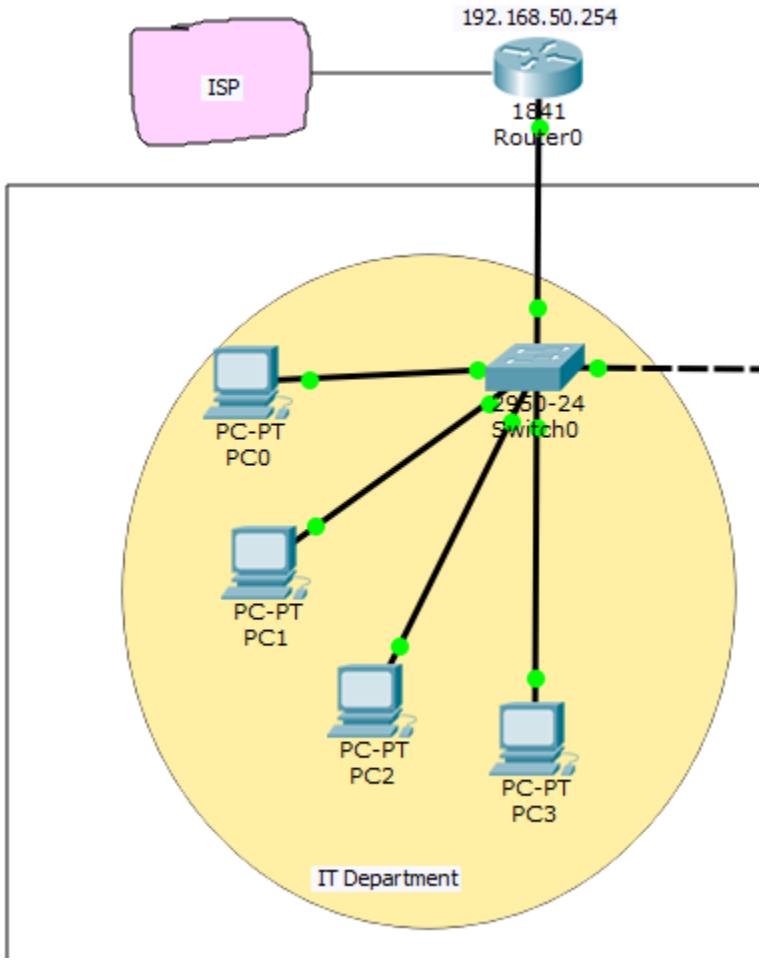
Step-9: Try to send packets using different pc's. It should succeed.

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num
	Successful	PC5	PC3	ICMP		0.000	N	1
	Successful	PC6	PC7	ICMP		0.000	N	2
	Successful	PC0	PC5	ICMP		0.000	N	3

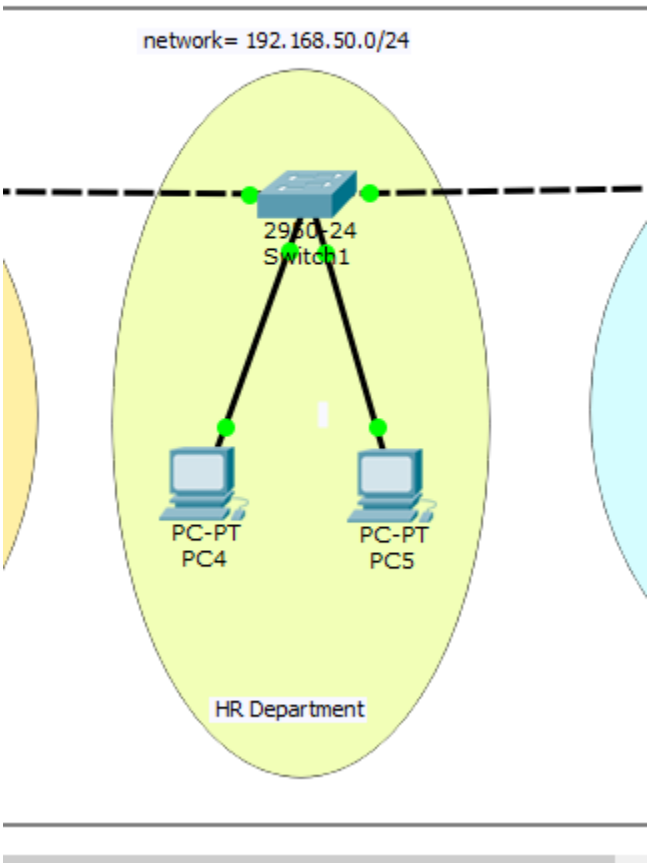
Overall screenshot of the whole architecture-

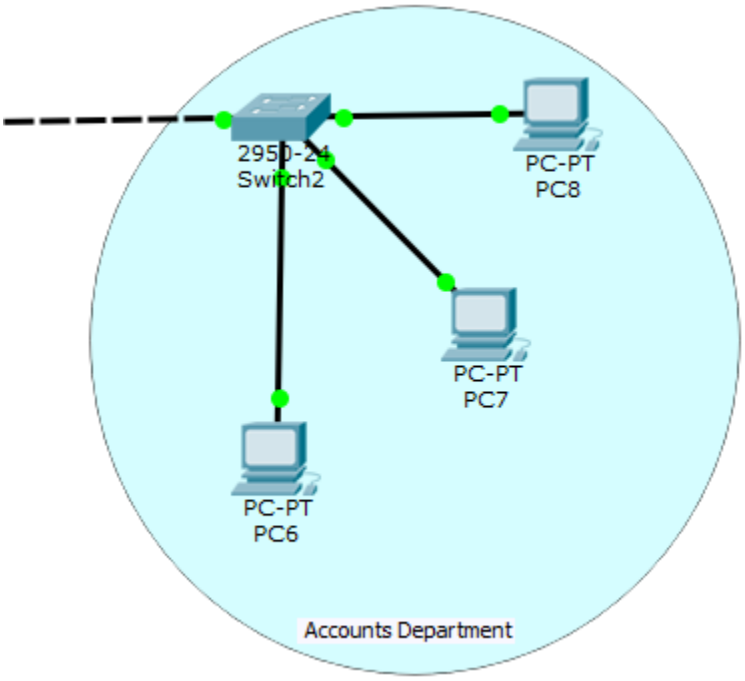


Part by part view-

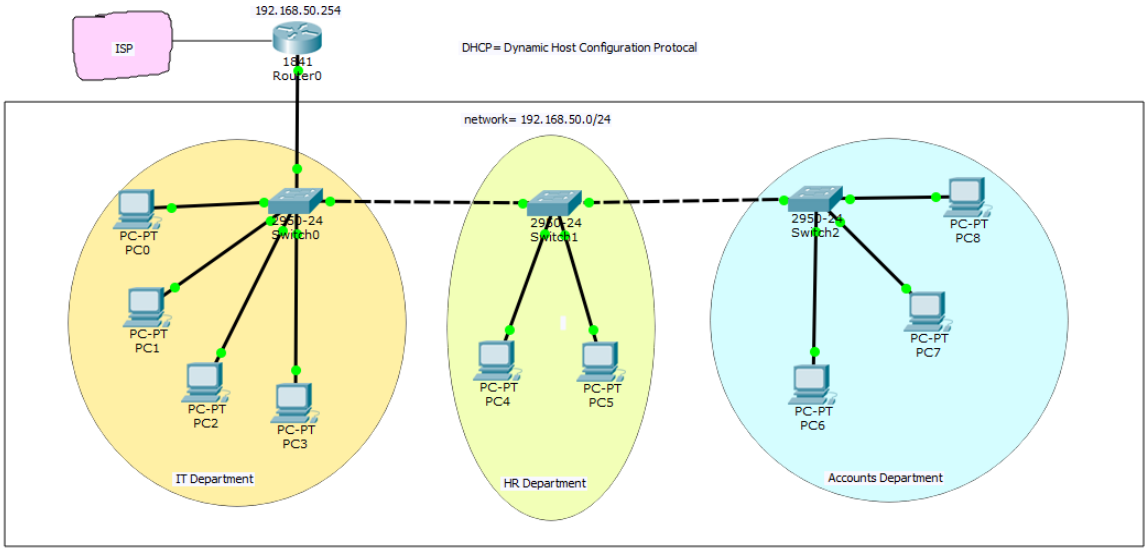


DHCP= Dynamic Host Configuration Protocal



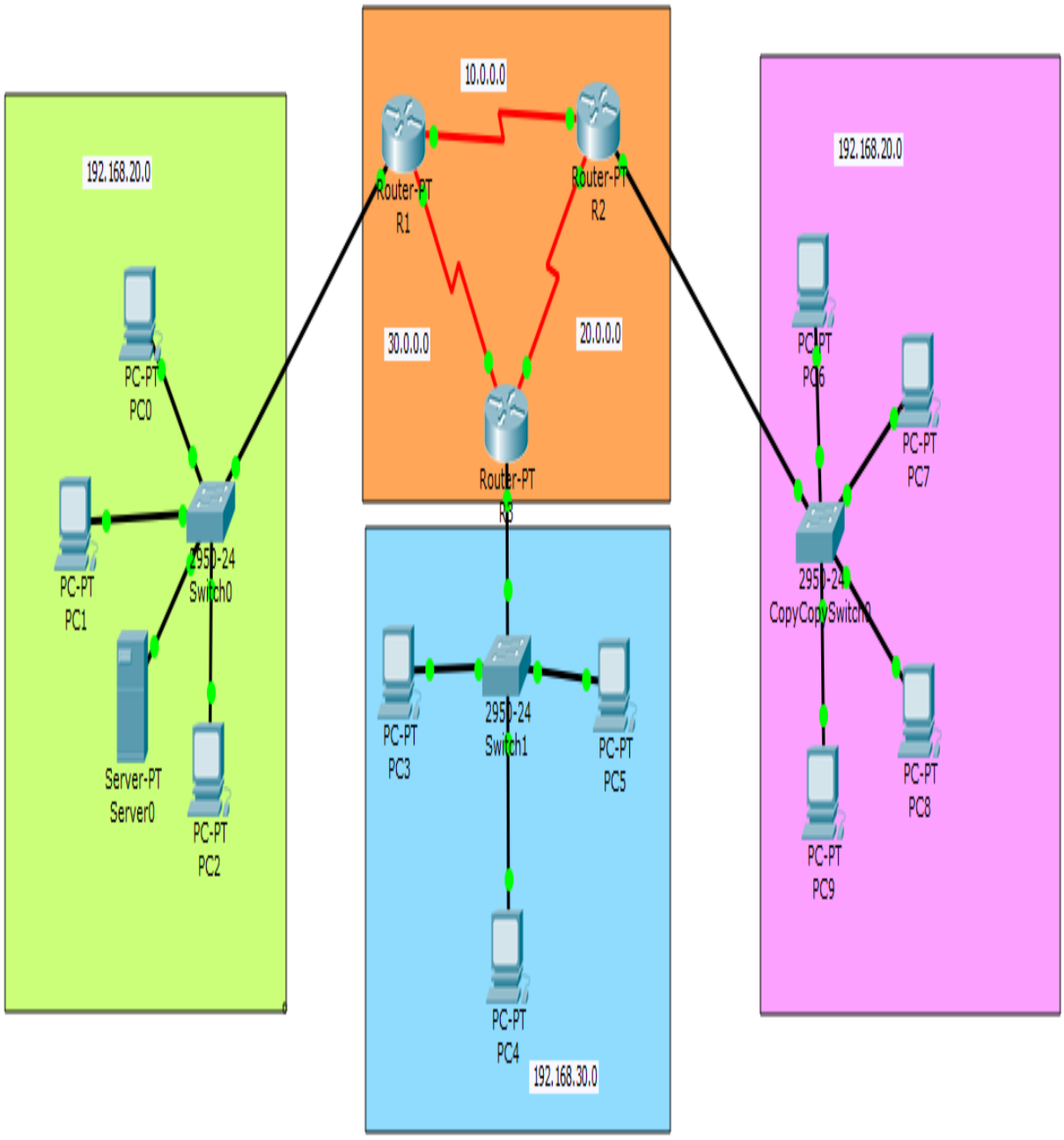


Detailed view-



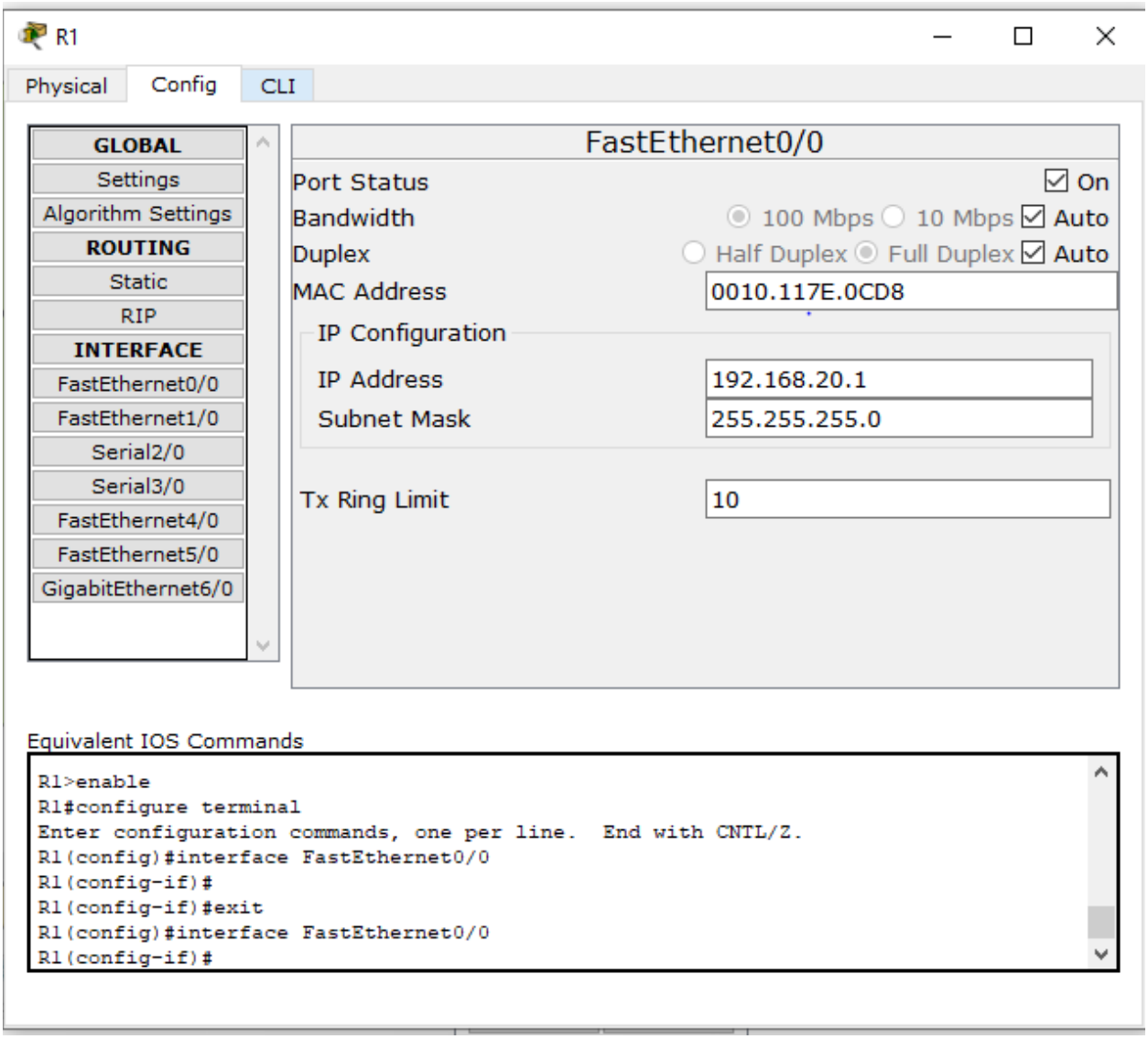
How to implement **DHCP with DNS (ADVANCED)**

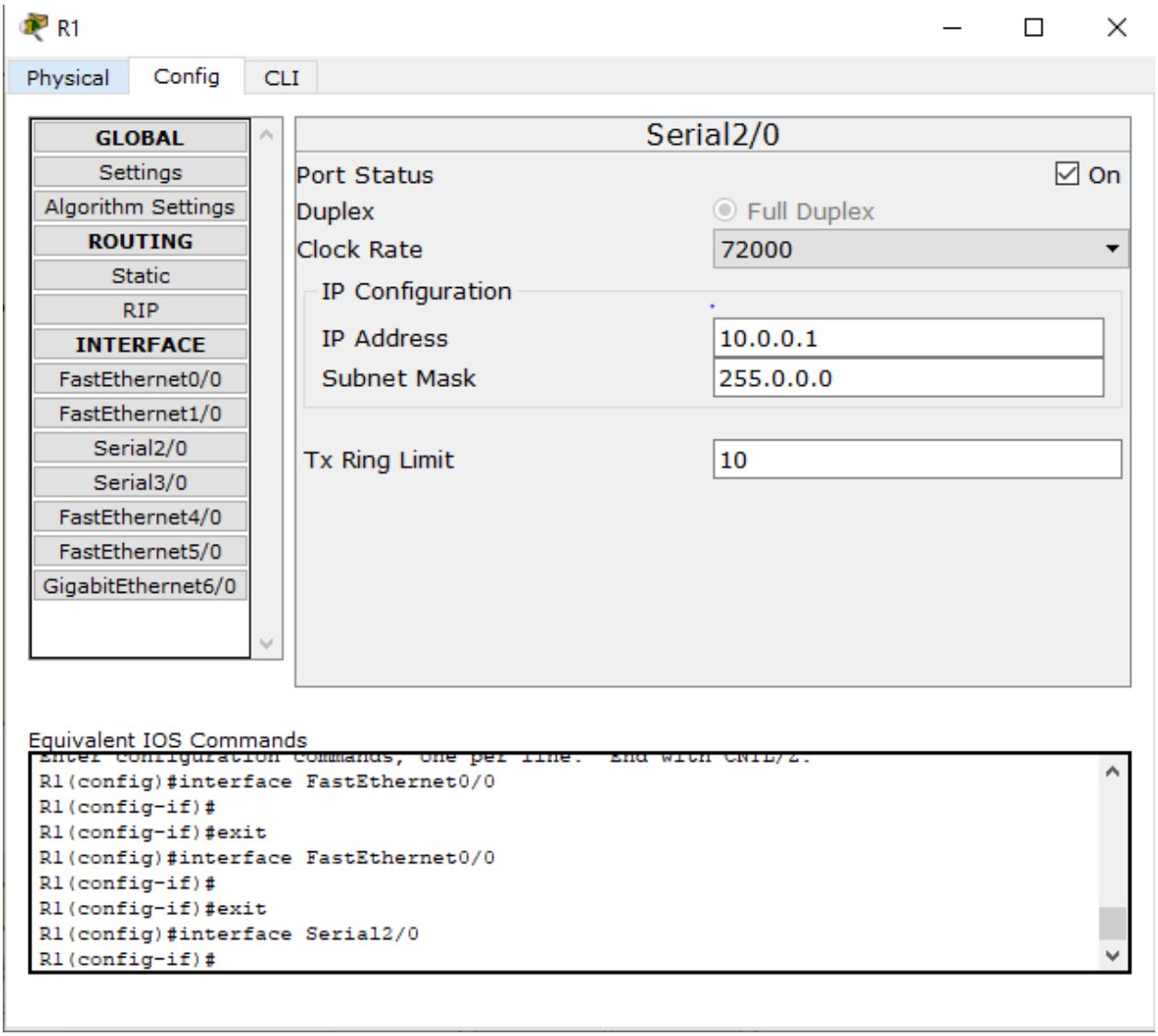
Step-1: Create networks with proper labeling of ports and networks.

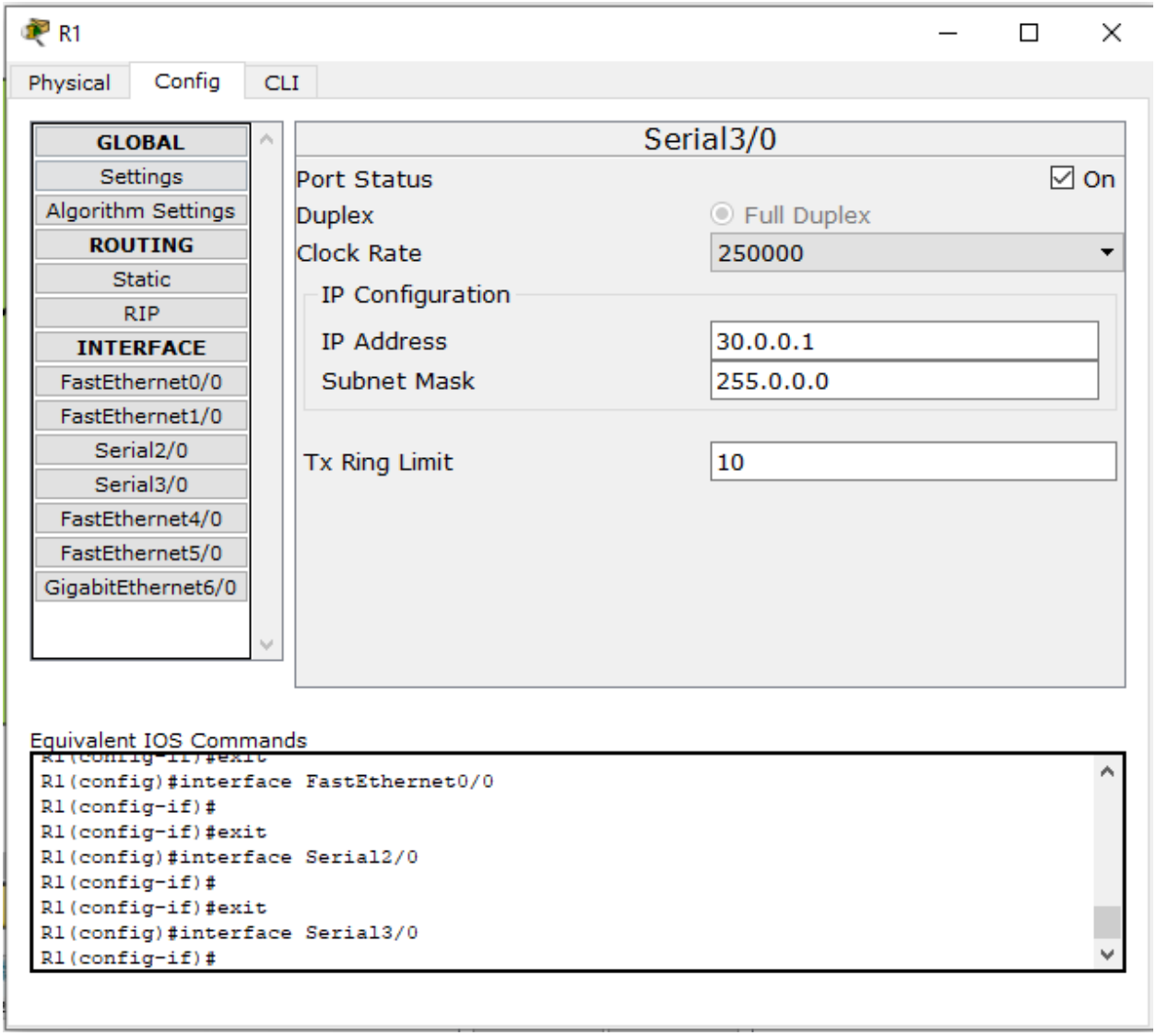


Step-2: Configure the ports of the routers.

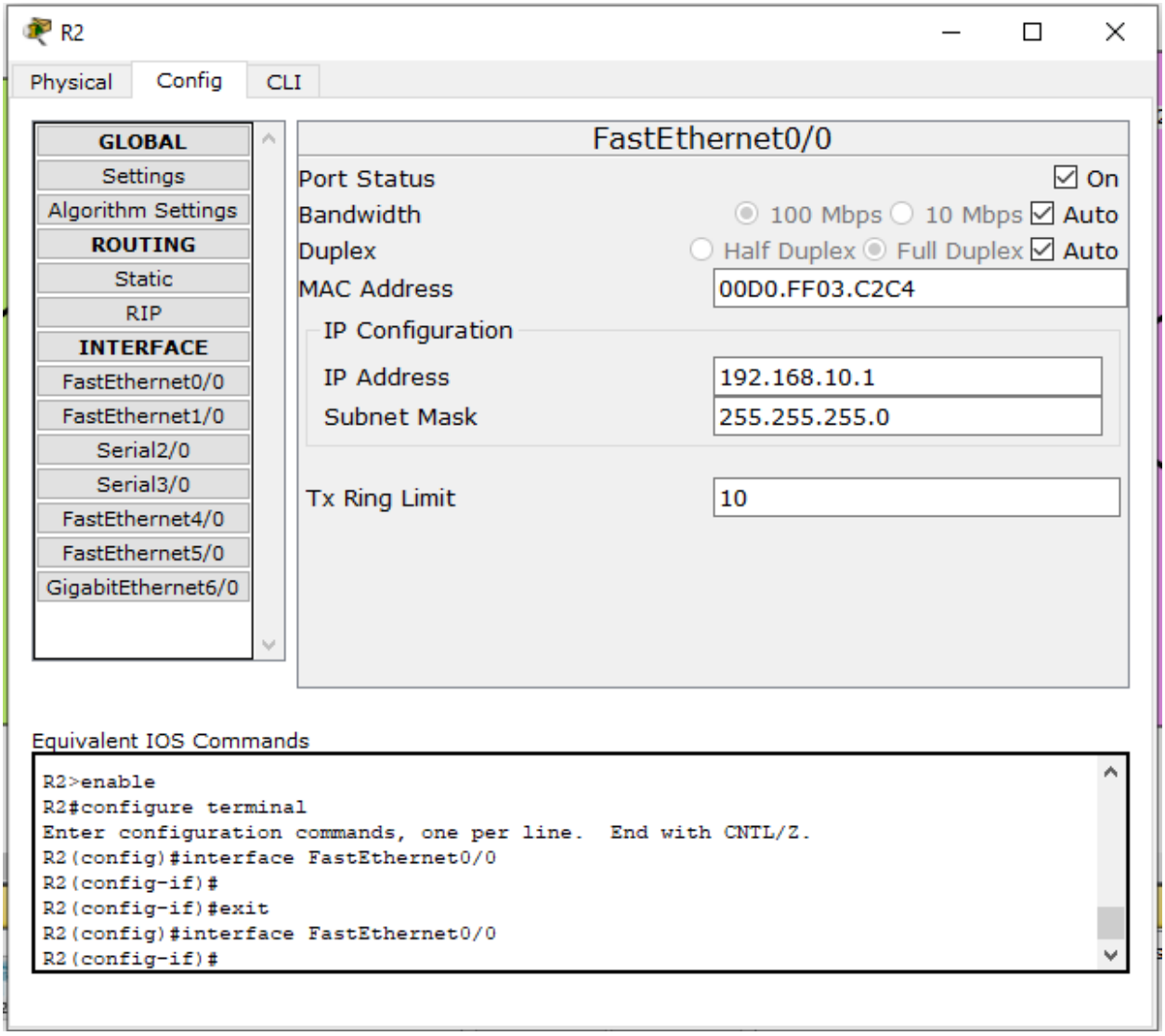
For 1st router and FastEthernet 0/0, Serial2/0 and serial3/0:

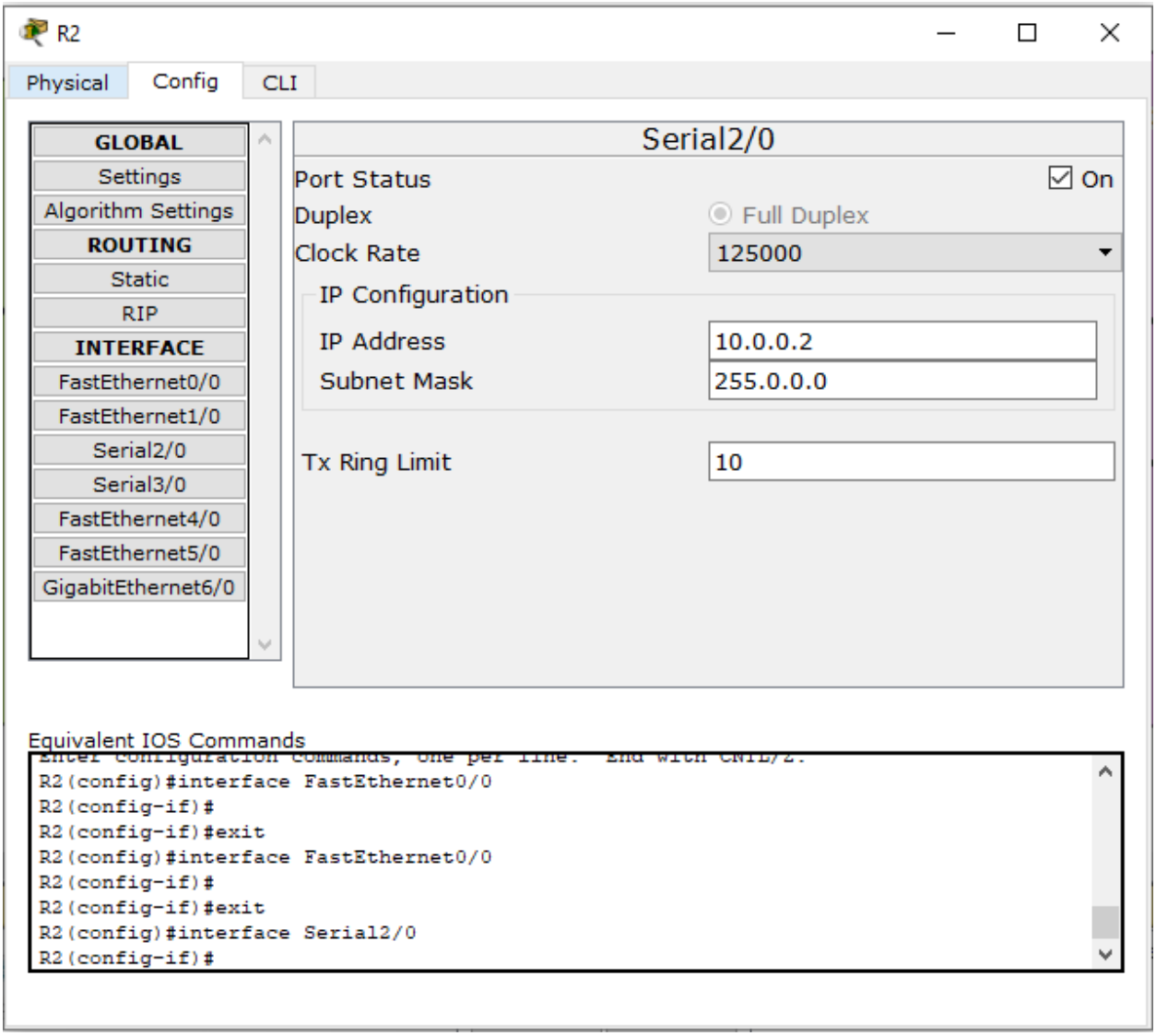


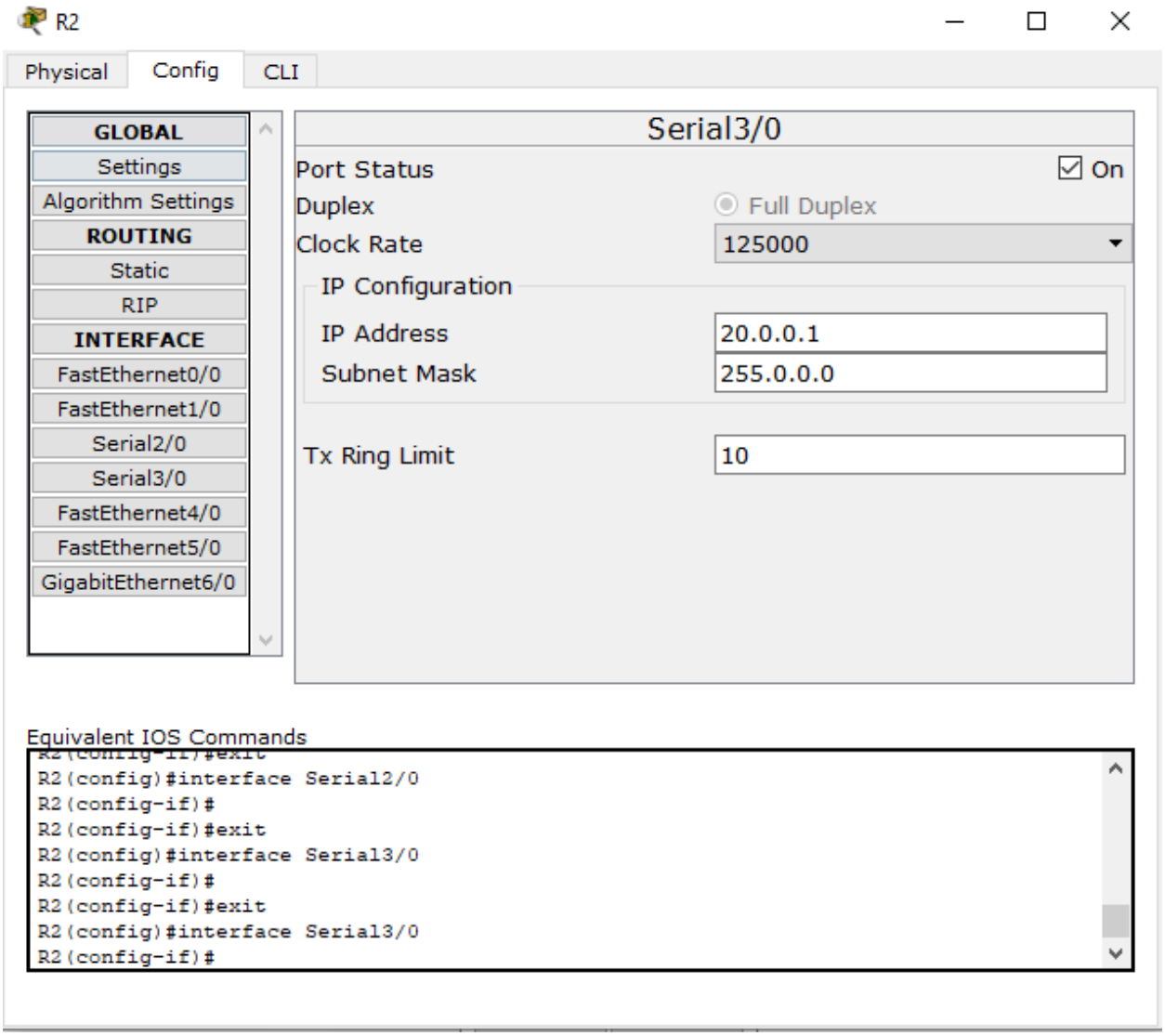

R1
Physical
Config
CLI
GLOBAL
Settings
Algorithm Settings
ROUTING
Static
RIP
INTERFACE
FastEthernet0/0
FastEthernet1/0
Serial2/0
Serial3/0
FastEthernet4/0
FastEthernet5/0
GigabitEthernet6/0
Serial2/0
Port Status
On
Duplex
Full Duplex
Clock Rate
72000
IP Configuration
IP Address
10.0.0.1
Subnet Mask
255.0.0.0
Tx Ring Limit
10
Equivalent IOS Commands
R1(config)#interface FastEthernet0/0
R1(config-if)#
R1(config-if)#exit
R1(config)#interface FastEthernet0/0
R1(config-if)#
R1(config-if)#exit
R1(config)#interface Serial2/0
R1(config-if)#


R1
Physical
Config
CLI
GLOBAL
Settings
Algorithm Settings
ROUTING
Static
RIP
INTERFACE
FastEthernet0/0
FastEthernet1/0
Serial2/0
Serial3/0
FastEthernet4/0
FastEthernet5/0
GigabitEthernet6/0
Serial3/0
Port Status
On
Duplex
Full Duplex
Clock Rate
250000
IP Configuration
IP Address
30.0.0.1
Subnet Mask
255.0.0.0
Tx Ring Limit
10
Equivalent IOS Commands
R1(config-if)#exit
R1(config)#interface FastEthernet0/0
R1(config-if)#
R1(config-if)#exit
R1(config)#interface Serial2/0
R1(config-if)#
R1(config-if)#exit
R1(config)#interface Serial3/0
R1(config-if)#

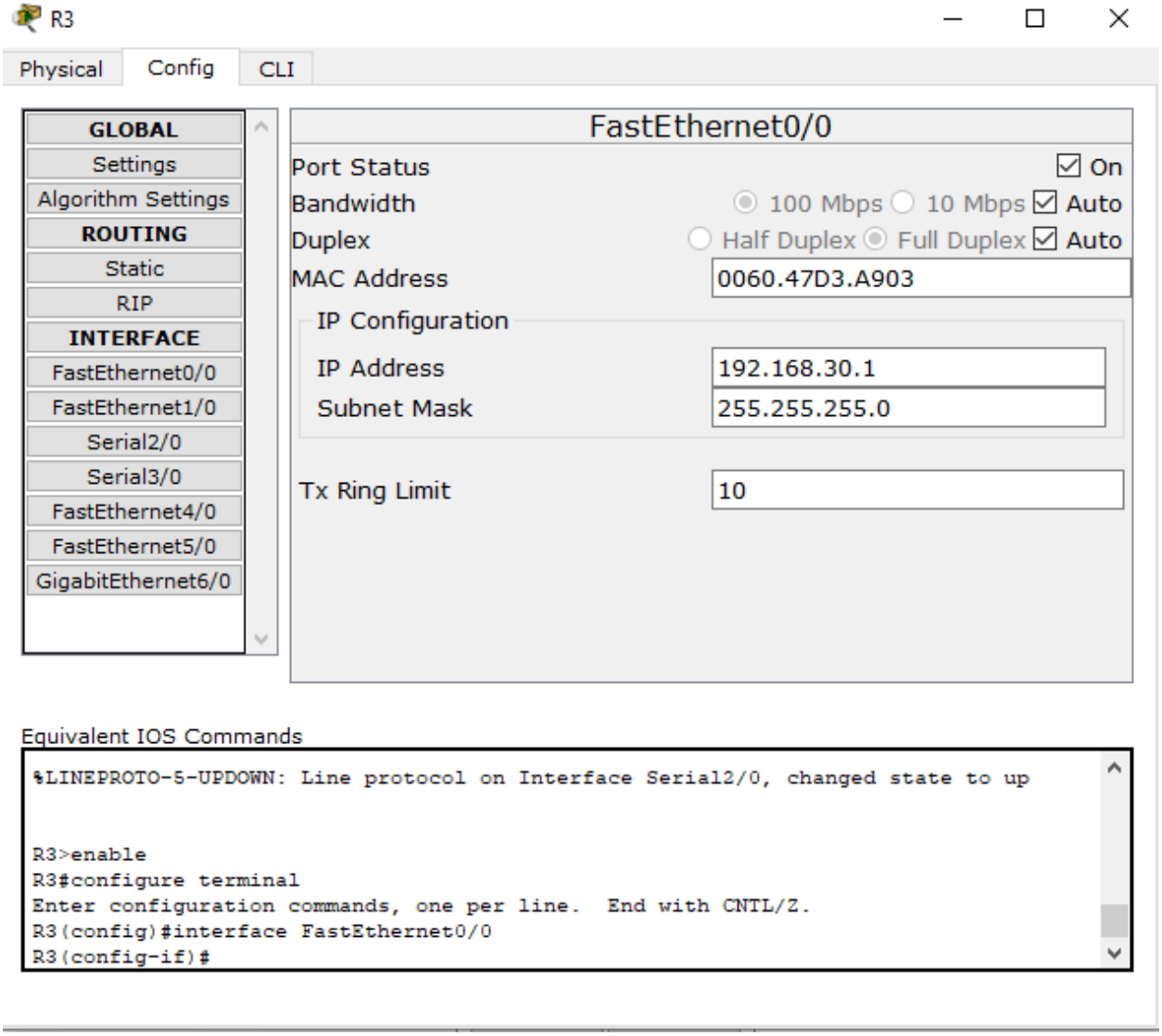
For 2nd router and FastEthernet 0/0, Serial2/0 and serial3/0:

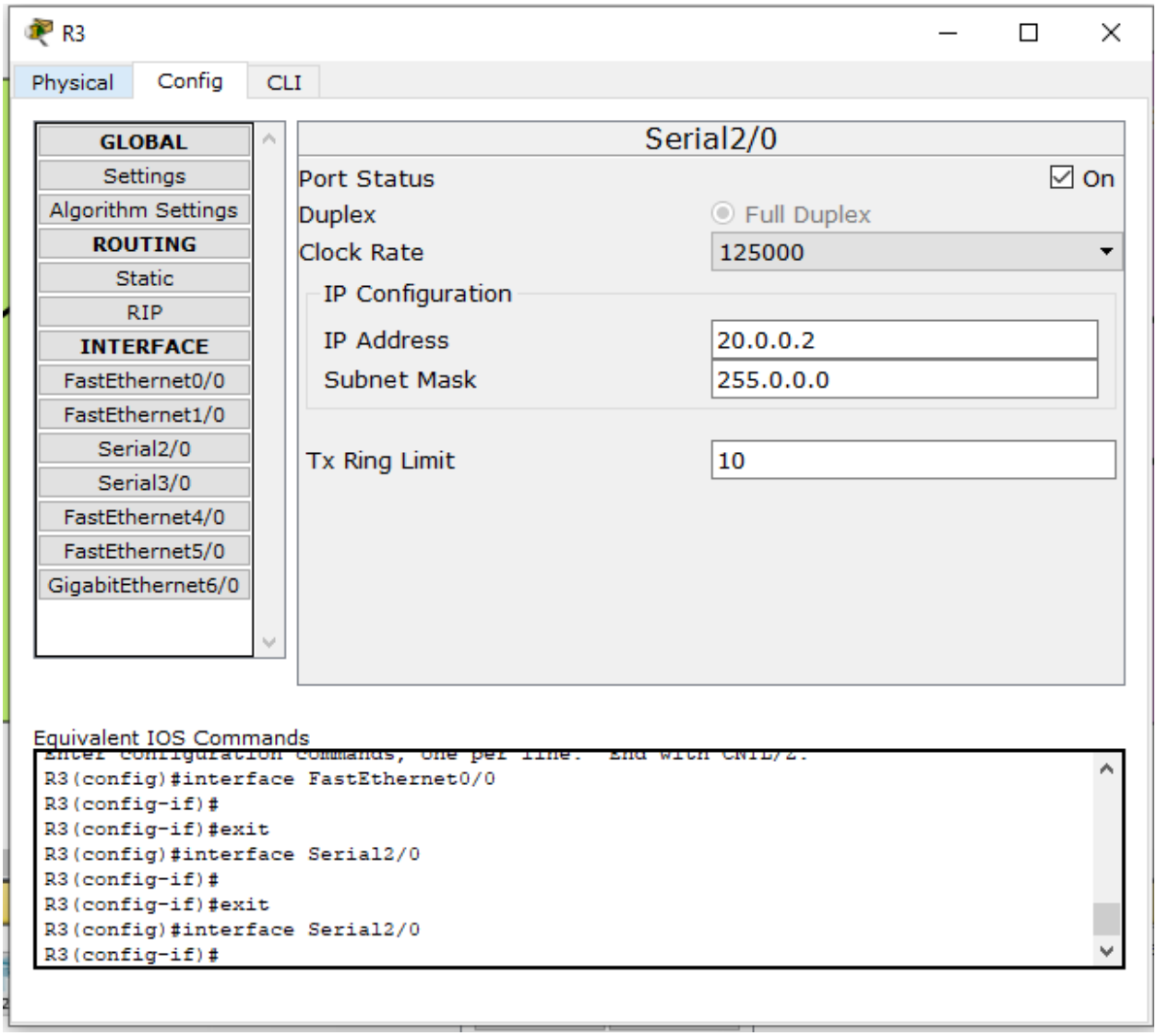


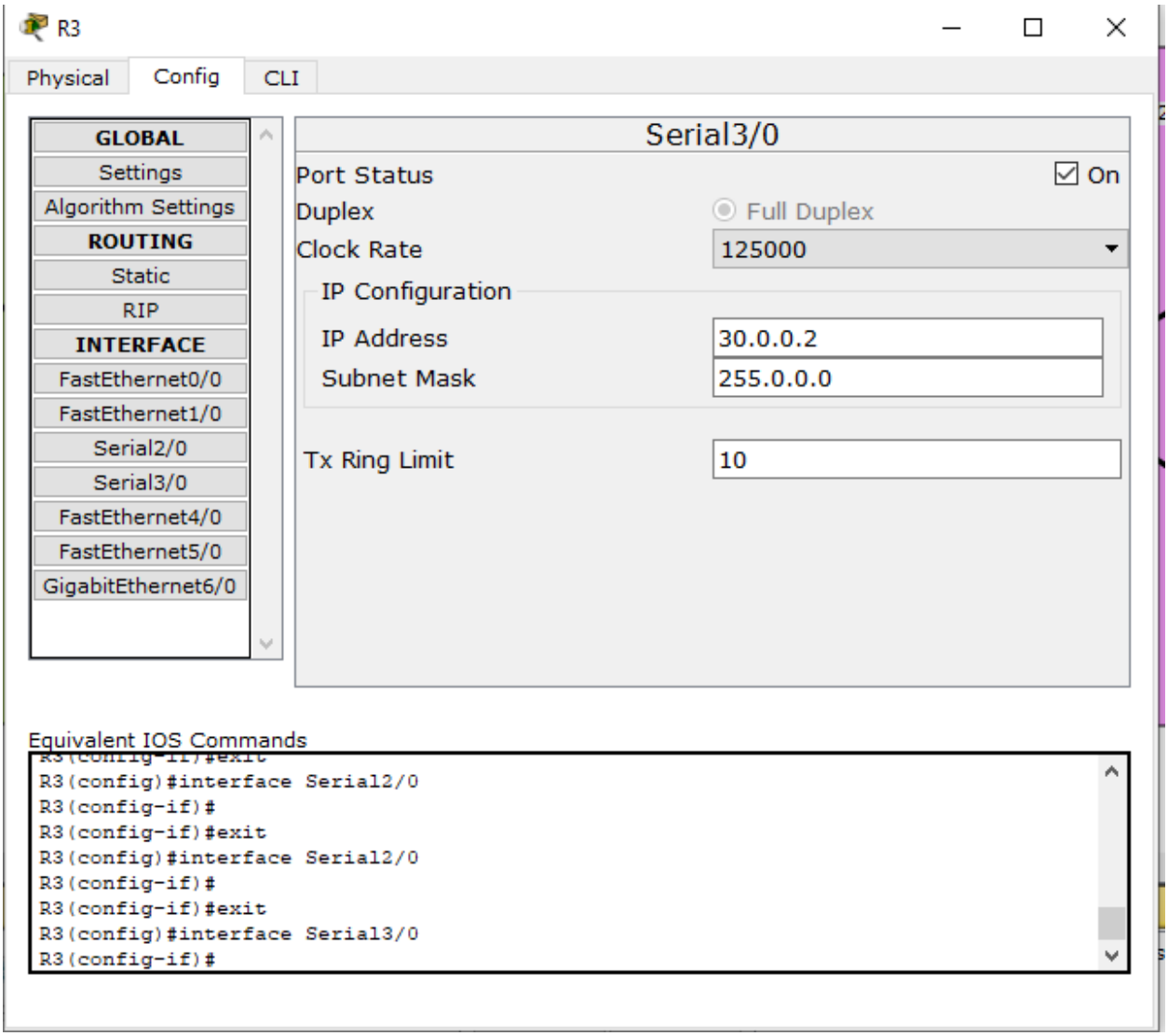

R2
Physical
Config
CLI
GLOBAL
Settings
Algorithm Settings
ROUTING
Static
RIP
INTERFACE
FastEthernet0/0
FastEthernet1/0
Serial2/0
Serial3/0
FastEthernet4/0
FastEthernet5/0
GigabitEthernet6/0
Serial2/0
Port Status
On
Duplex
Full Duplex
Clock Rate
125000
IP Configuration
IP Address
10.0.0.2
Subnet Mask
255.0.0.0
Tx Ring Limit
10
Equivalent IOS Commands
R2(config)#interface FastEthernet0/0
R2(config-if)#
R2(config-if)#exit
R2(config)#interface FastEthernet0/0
R2(config-if)#
R2(config-if)#exit
R2(config)#interface Serial2/0
R2(config-if)#


R2
Physical
Config
CLI
GLOBAL
Settings
Algorithm Settings
ROUTING
Static
RIP
INTERFACE
FastEthernet0/0
FastEthernet1/0
Serial2/0
Serial3/0
FastEthernet4/0
FastEthernet5/0
GigabitEthernet6/0
Serial3/0
Port Status
On
Duplex
Full Duplex
Clock Rate
125000
IP Configuration
IP Address
20.0.0.1
Subnet Mask
255.0.0.0
Tx Ring Limit
10
Equivalent IOS Commands
R2(config-if)#exit
R2(config)#interface Serial2/0
R2(config-if)#
R2(config-if)#exit
R2(config)#interface Serial3/0
R2(config-if)#
R2(config-if)#exit
R2(config)#interface Serial3/0
R2(config-if)#

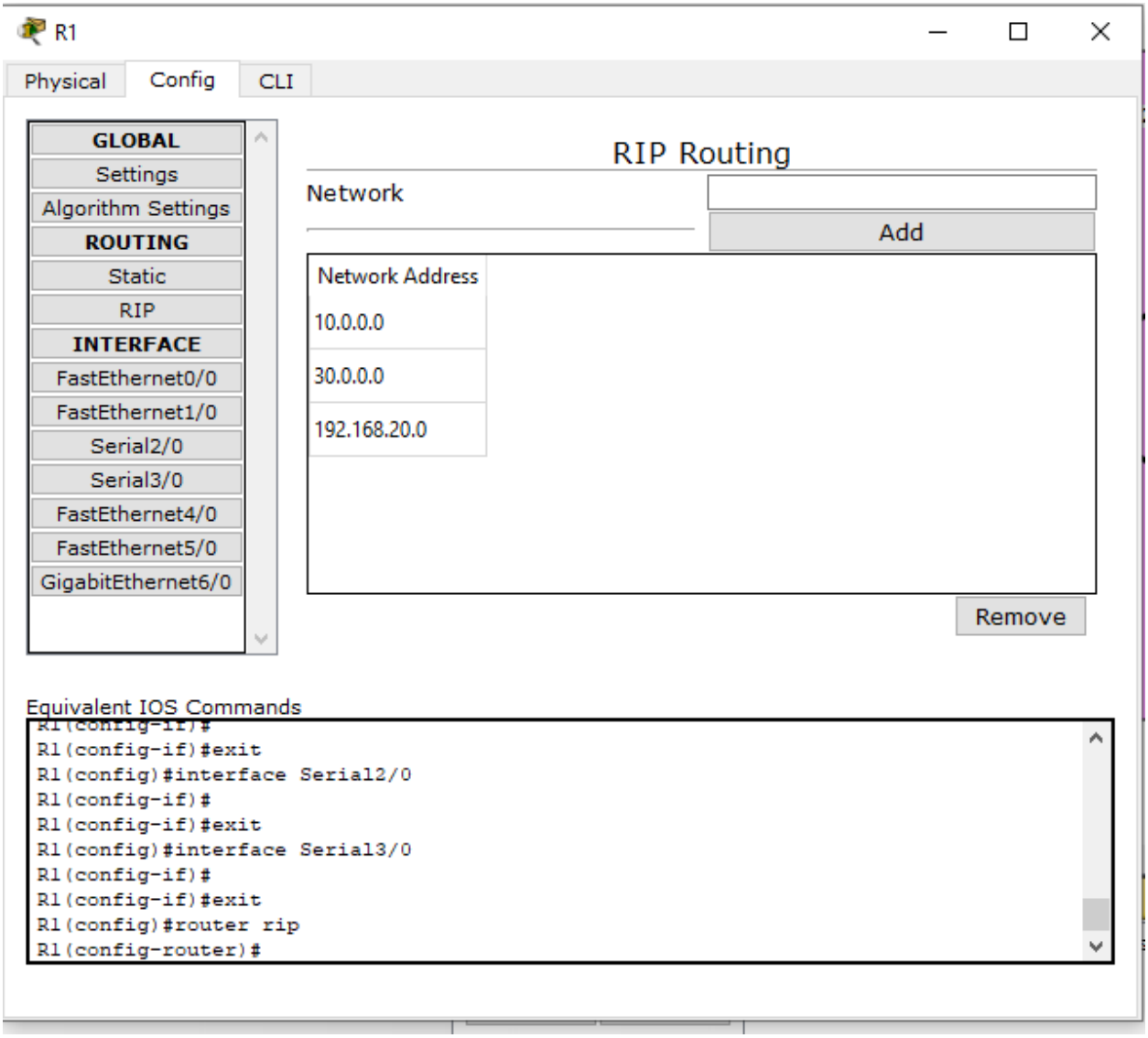
For 3rd router and FastEthernet 0/0, Serial2/0 and serial3/0:

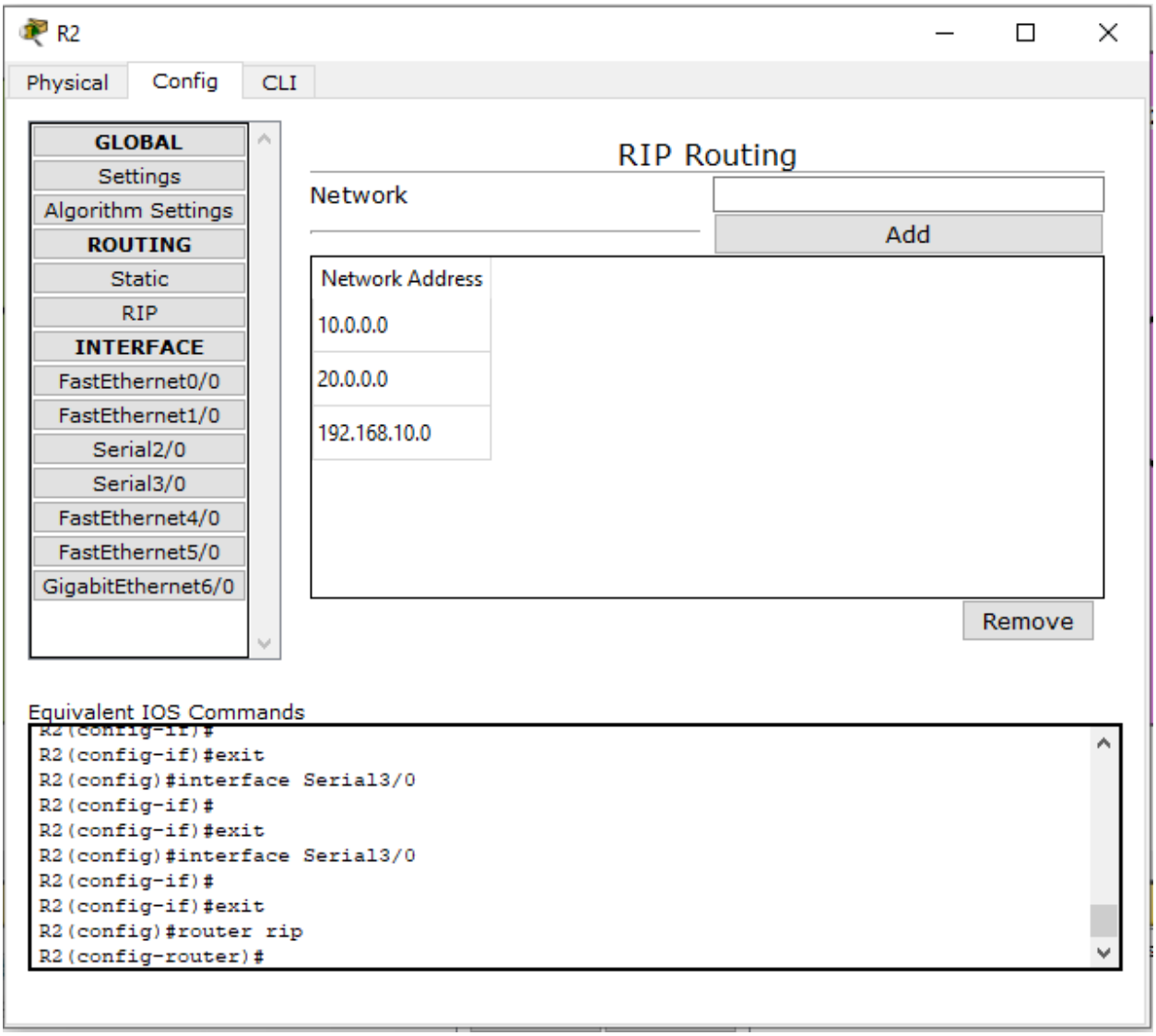


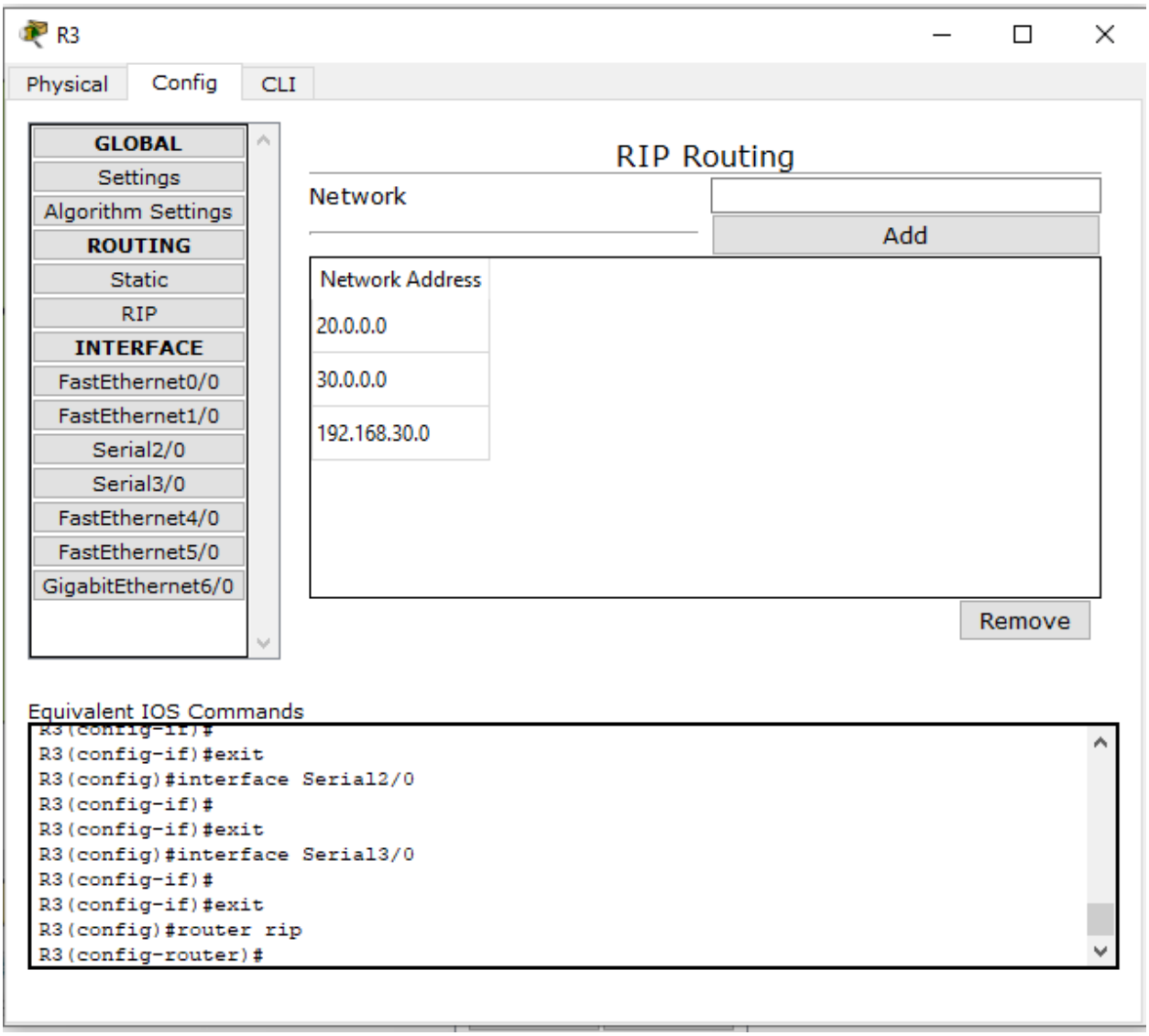

R3
Physical
Config
CLI
GLOBAL
Settings
Algorithm Settings
ROUTING
Static
RIP
INTERFACE
FastEthernet0/0
FastEthernet1/0
Serial2/0
Serial3/0
FastEthernet4/0
FastEthernet5/0
GigabitEthernet6/0
Serial2/0
Port Status
On
Duplex
Full Duplex
Clock Rate
125000
IP Configuration
IP Address
20.0.0.2
Subnet Mask
255.0.0.0
Tx Ring Limit
10
Equivalent IOS Commands
R3(config)#interface FastEthernet0/0
R3(config-if)#
R3(config-if)#exit
R3(config)#interface Serial2/0
R3(config-if)#
R3(config-if)#exit
R3(config)#interface Serial2/0
R3(config-if)#


R3
Physical
Config
CLI
GLOBAL
Settings
Algorithm Settings
ROUTING
Static
RIP
INTERFACE
FastEthernet0/0
FastEthernet1/0
Serial2/0
Serial3/0
FastEthernet4/0
FastEthernet5/0
GigabitEthernet6/0
Serial3/0
Port Status
On
Duplex
Full Duplex
Clock Rate
125000
IP Configuration
IP Address
30.0.0.2
Subnet Mask
255.0.0.0
Tx Ring Limit
10
Equivalent IOS Commands
R3(config)#interface Serial2/0
R3(config-if)#
R3(config-if)#exit
R3(config)#interface Serial2/0
R3(config-if)#
R3(config-if)#exit
R3(config)#interface Serial3/0
R3(config-if)#

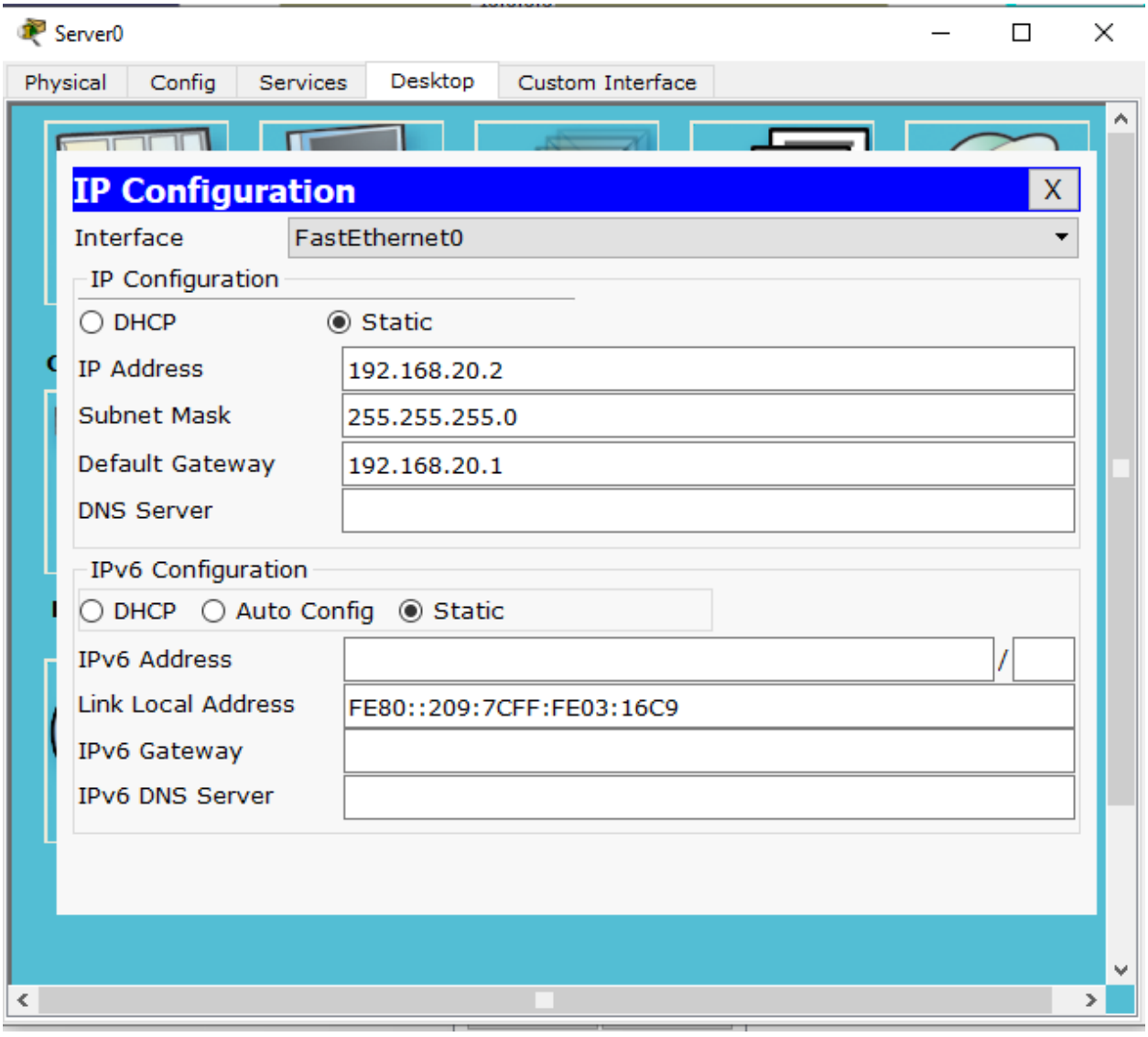
Step-3: Put routing information in the routers.

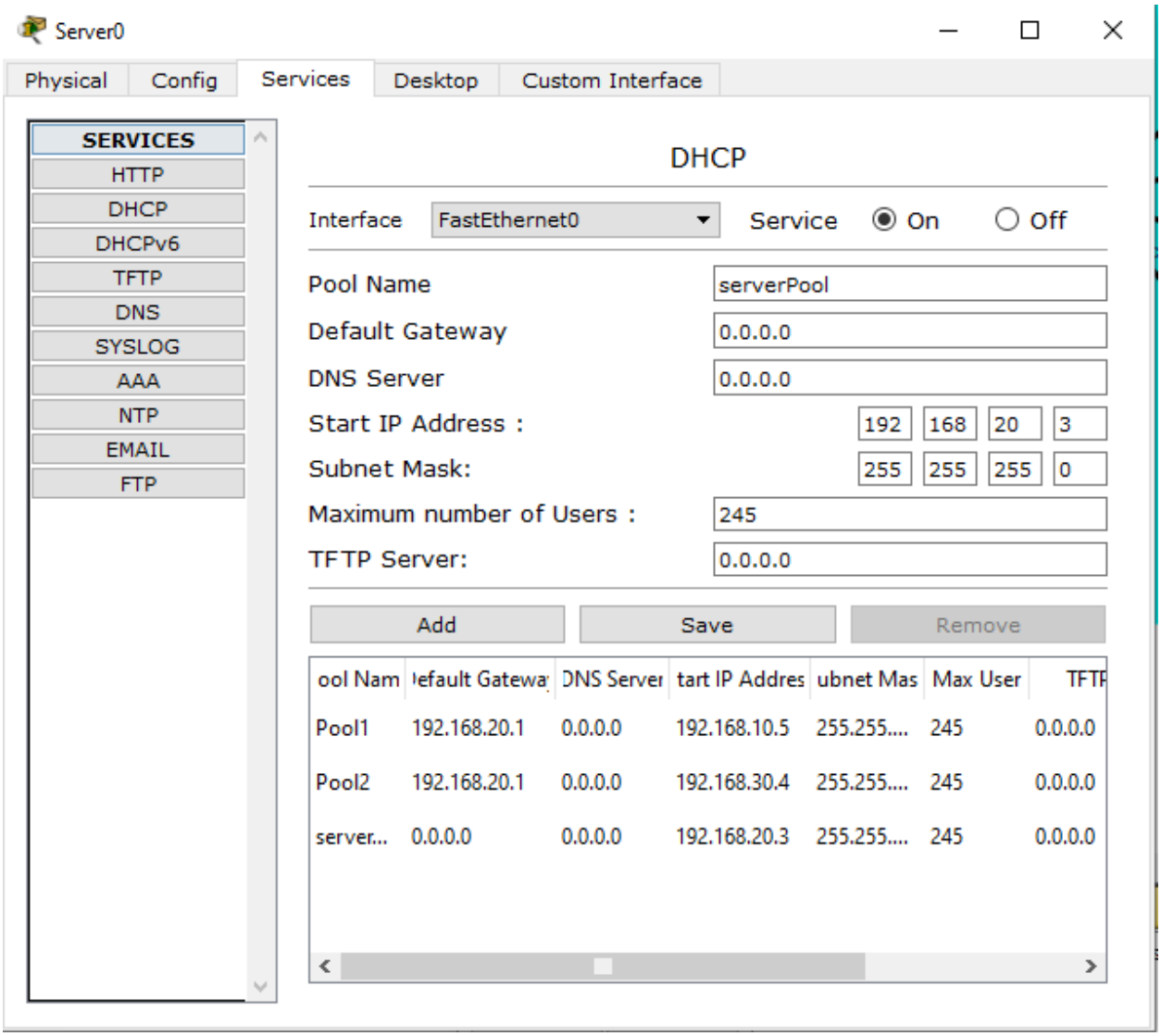



R2
Physical
Config
CLI
GLOBAL
Settings
Algorithm Settings
ROUTING
Static
RIP
INTERFACE
FastEthernet0/0
FastEthernet1/0
Serial2/0
Serial3/0
FastEthernet4/0
FastEthernet5/0
GigabitEthernet6/0
RIP Routing
Network
Add
Network Address
10.0.0.0
20.0.0.0
192.168.10.0
Remove
Equivalent IOS Commands
R2(config-if)#
R2(config-if)#exit
R2(config)#interface Serial3/0
R2(config-if)#
R2(config-if)#exit
R2(config)#interface Serial3/0
R2(config-if)#
R2(config-if)#exit
R2(config)#router rip
R2(config-router)#


R3
Physical
Config
CLI
GLOBAL
Settings
Algorithm Settings
ROUTING
Static
RIP
INTERFACE
FastEthernet0/0
FastEthernet1/0
Serial2/0
Serial3/0
FastEthernet4/0
FastEthernet5/0
GigabitEthernet6/0
RIP Routing
Network
Add
Network Address
20.0.0.0
30.0.0.0
192.168.30.0
Remove
Equivalent IOS Commands
R3(config-if)#
R3(config-if)#exit
R3(config)#interface Serial2/0
R3(config-if)#
R3(config-if)#exit
R3(config)#interface Serial3/0
R3(config-if)#
R3(config-if)#exit
R3(config)#router rip
R3(config-router)#

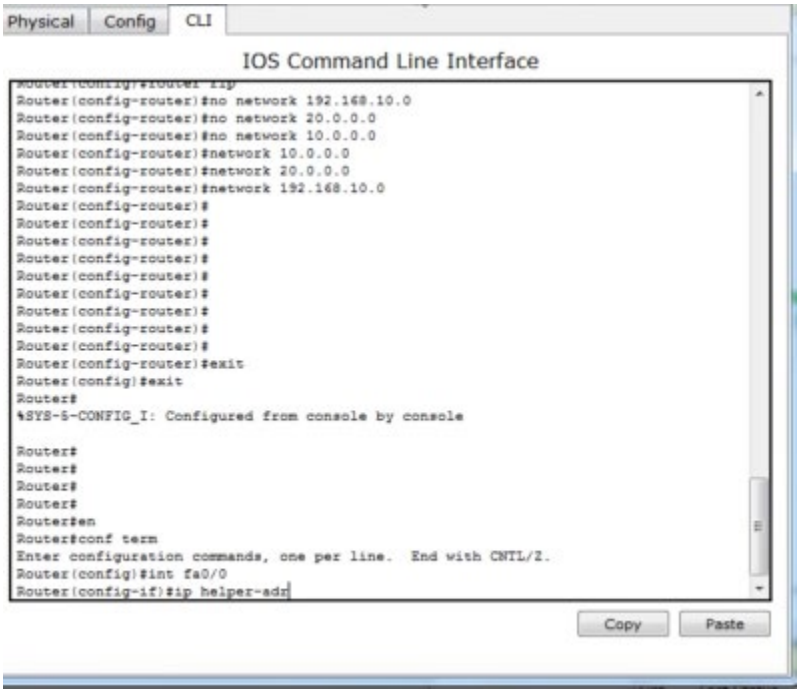
Step-4: Configure the DHCP server. Static ip addresses from the range of addresses where we are going to put the DHCP. Put address range of the networks.



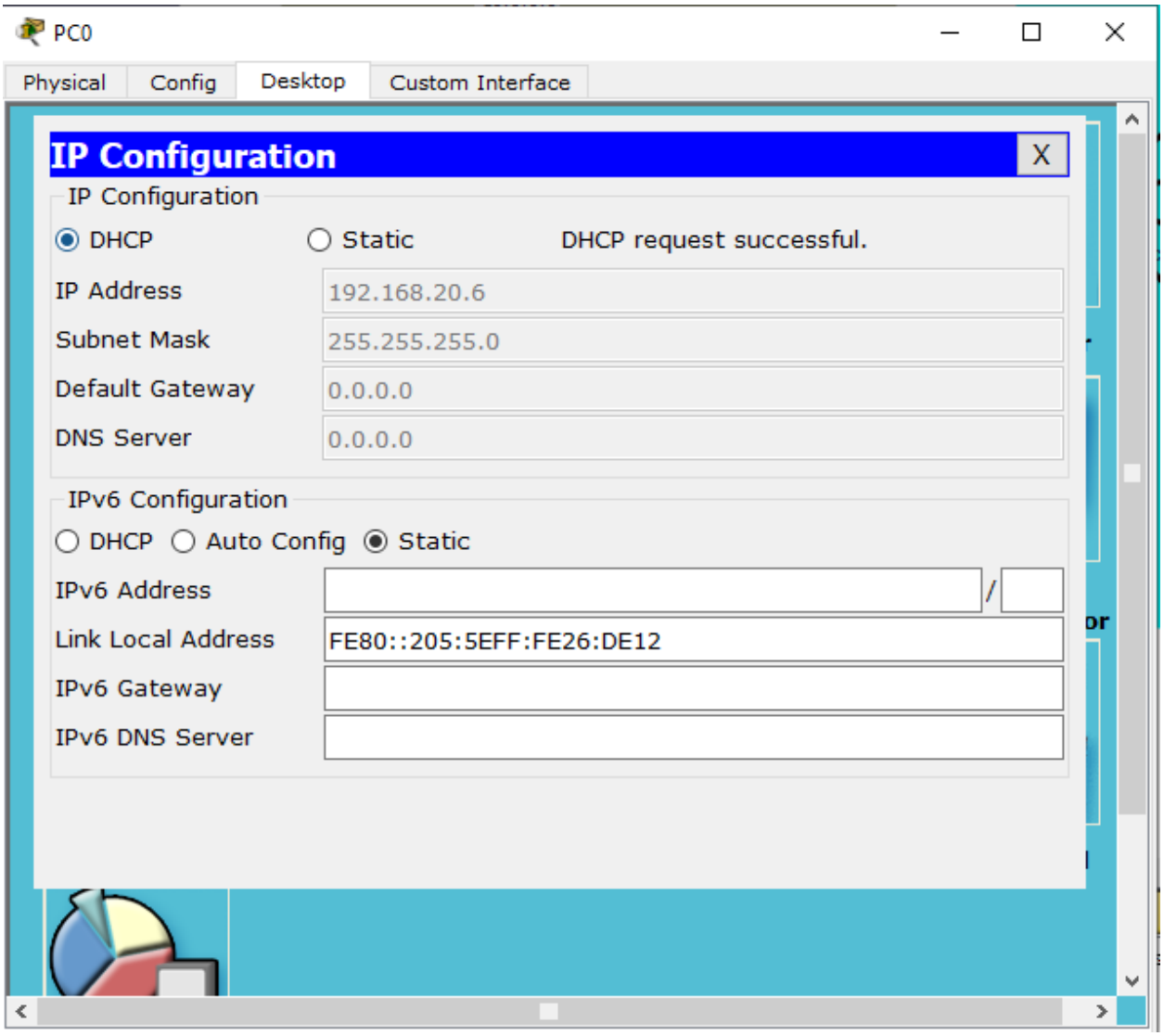

Server0
Physical
Config
Services
Desktop
Custom Interface
SERVICES
HTTP
DHCP
DHCPv6
TFTP
DNS
SYSLOG
AAA
NTP
EMAIL
FTP
DHCP
Interface
FastEthernet0
Service
On
Off
Pool Name
serverPool
Default Gateway
0.0.0.0
DNS Server
0.0.0.0
Start IP Address :
192
168
20
3
Subnet Mask:
255
255
255
0
Maximum number of Users :
245
TFTP Server:
0.0.0.0
Add
Save
Remove
ool Nam
efault Gatewa
DNS Server
tart IP Addres
ubnet Mas
Max User
TFTP
Pool1
192.168.20.1
0.0.0.0
192.168.10.5
255.255....
245
0.0.0.0
Pool2
192.168.20.1
0.0.0.0
192.168.30.4
255.255....
245
0.0.0.0
server...
0.0.0.0
0.0.0.0
192.168.20.3
255.255....
245
0.0.0.0

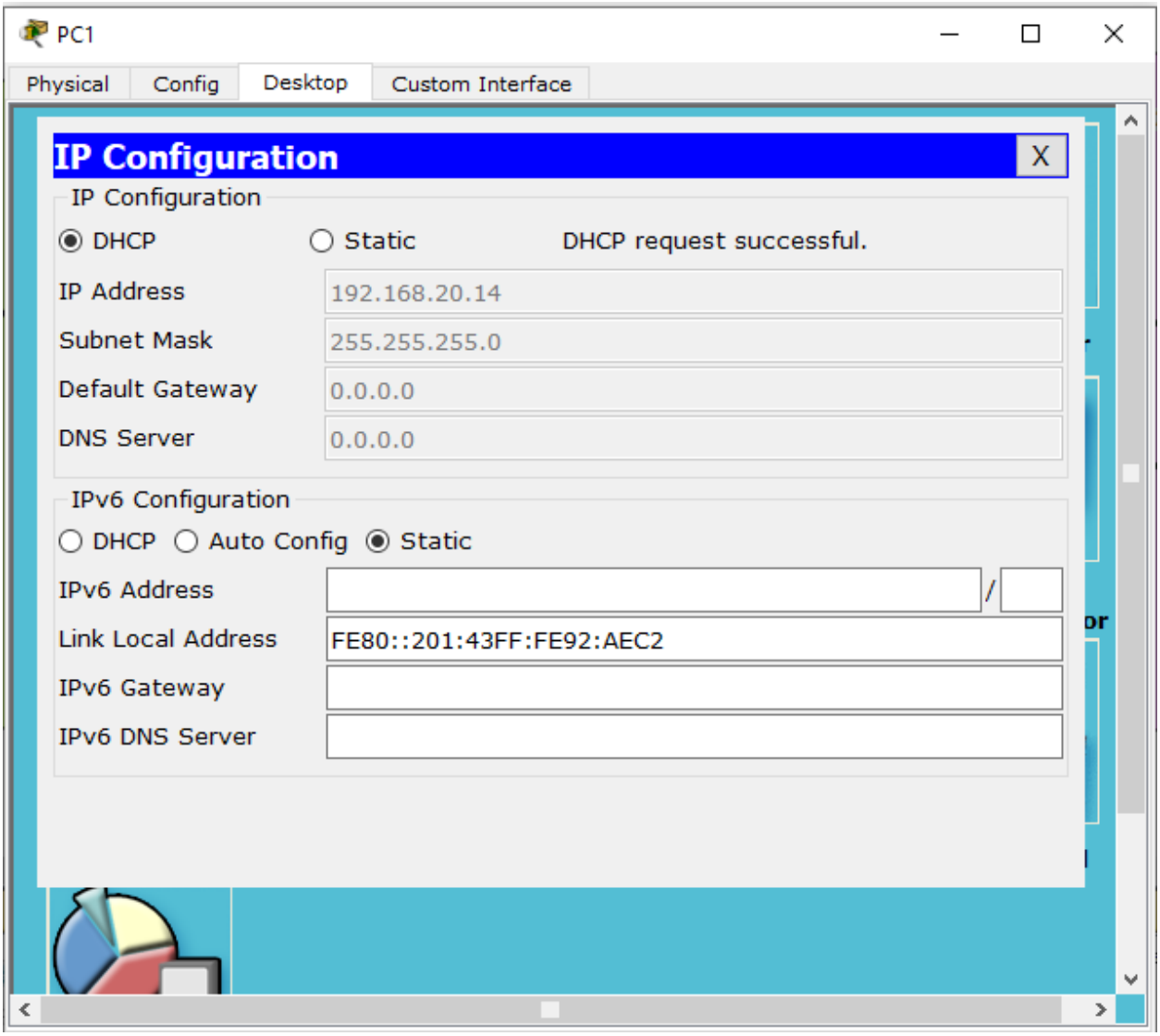
Step-5: Configure the ports which are gateway of the networks. Go to command line interface (CLI)

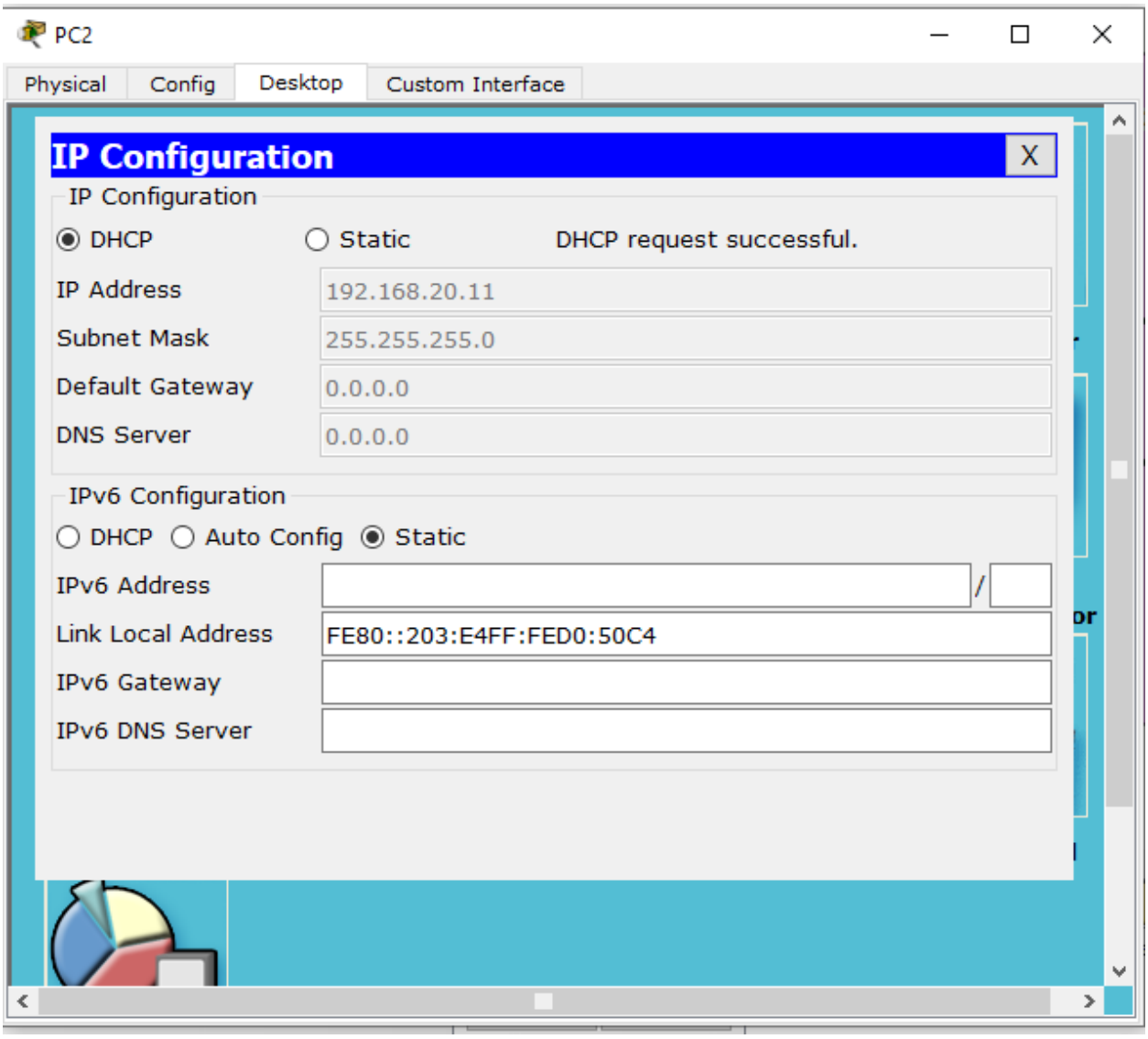
enable
configure terminal
int fa0/0
ip helper-address 192.168.20.2
exit
exit

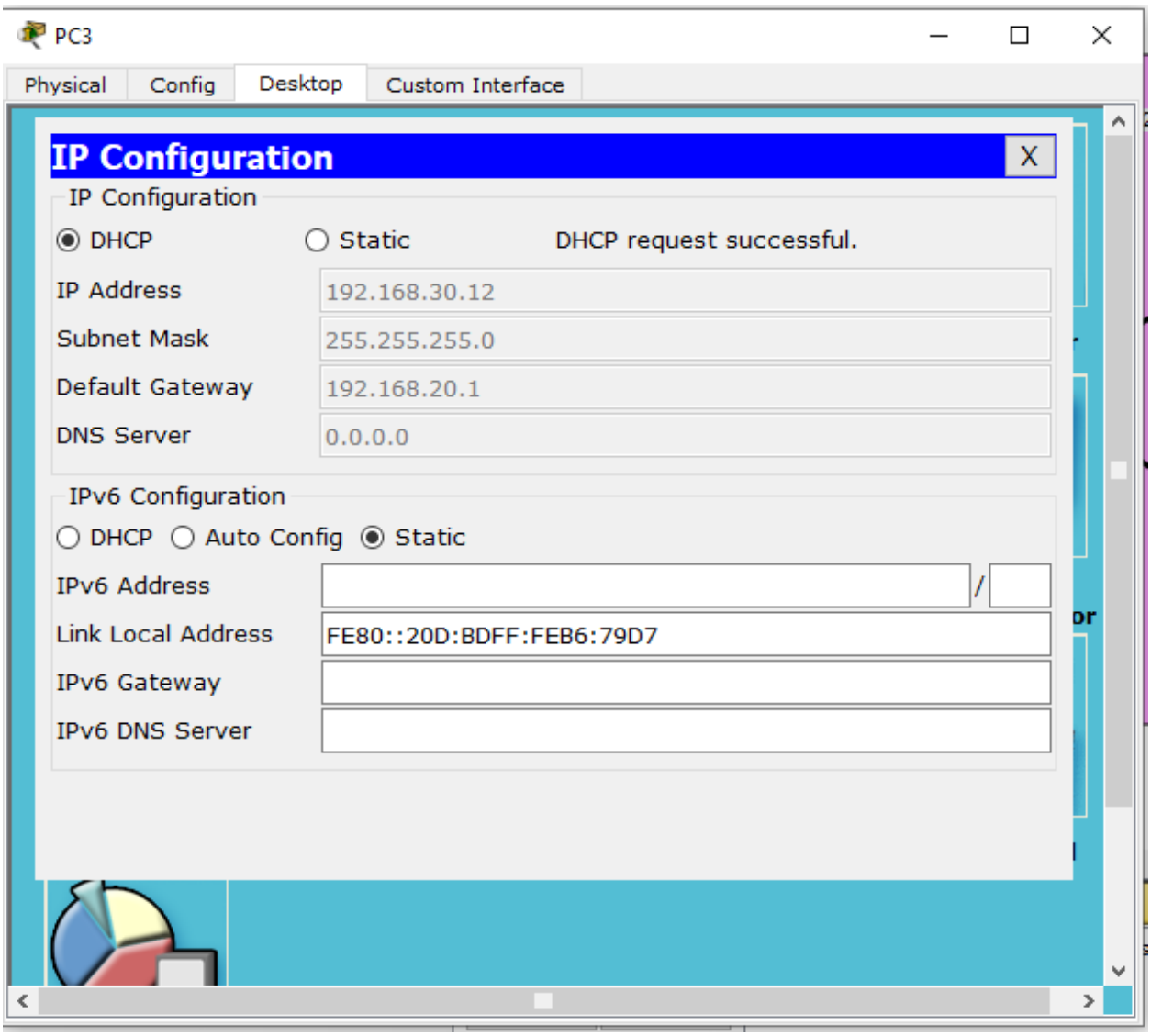


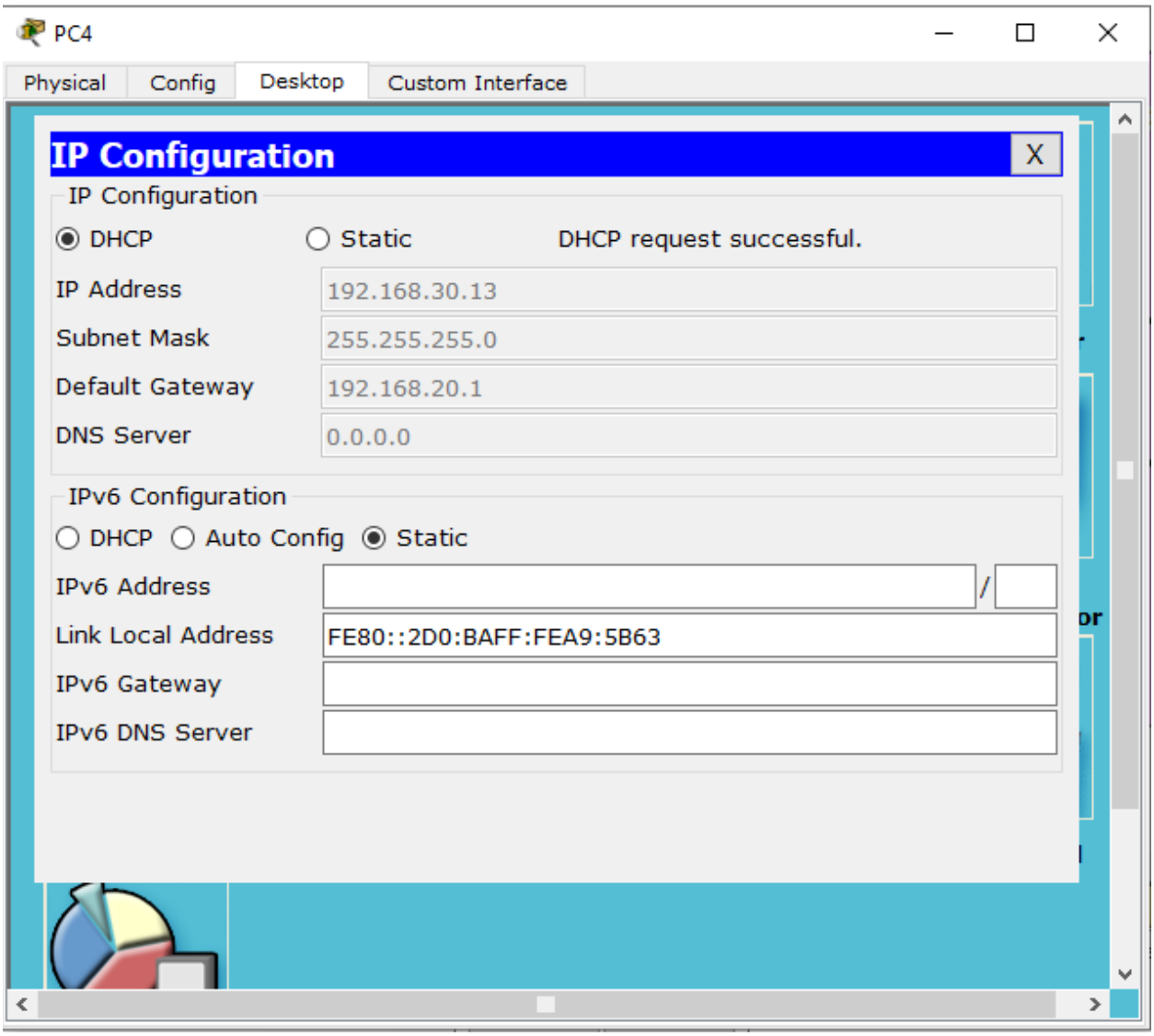
Step-6: Request for DHCP, It should succeed

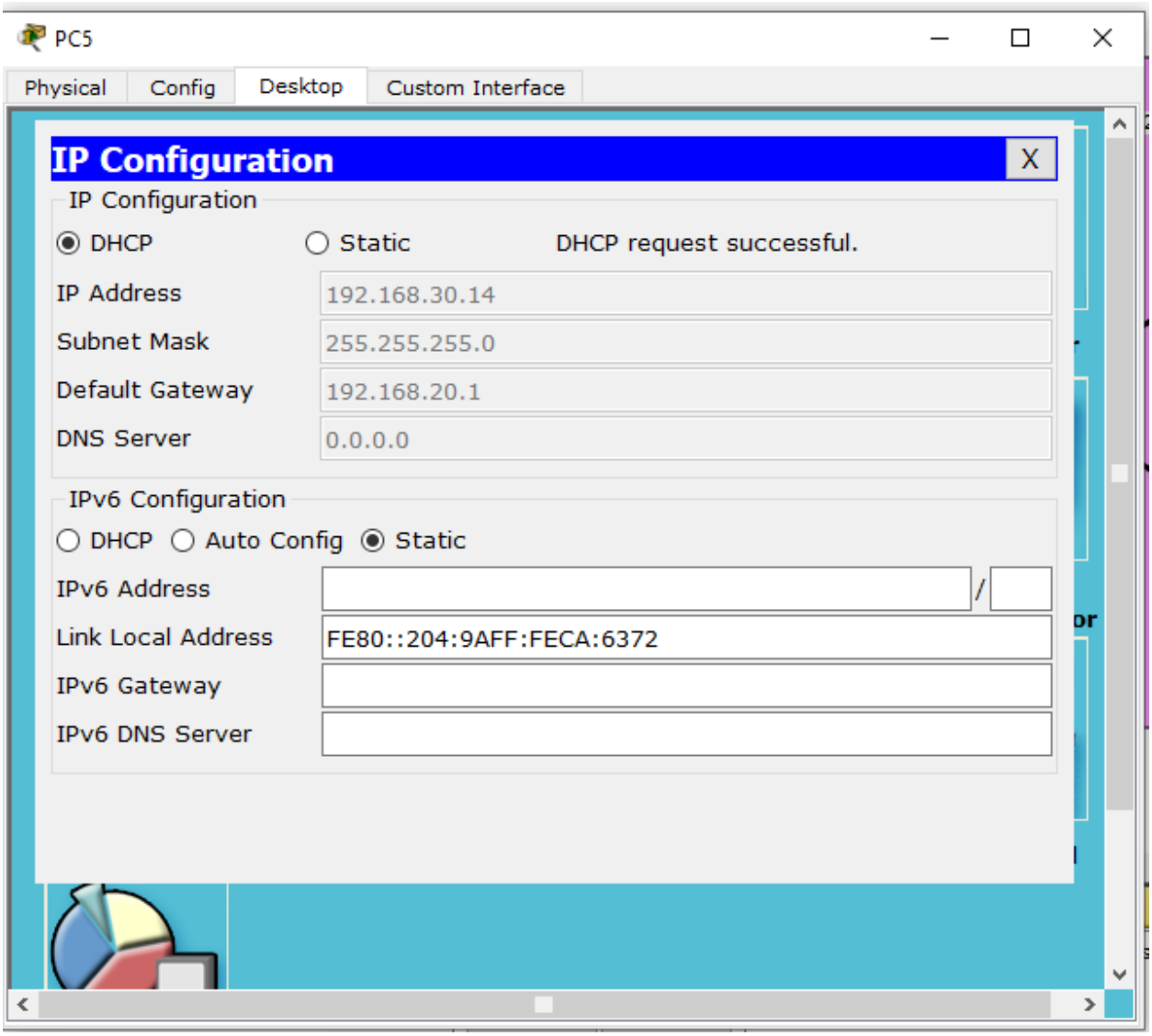


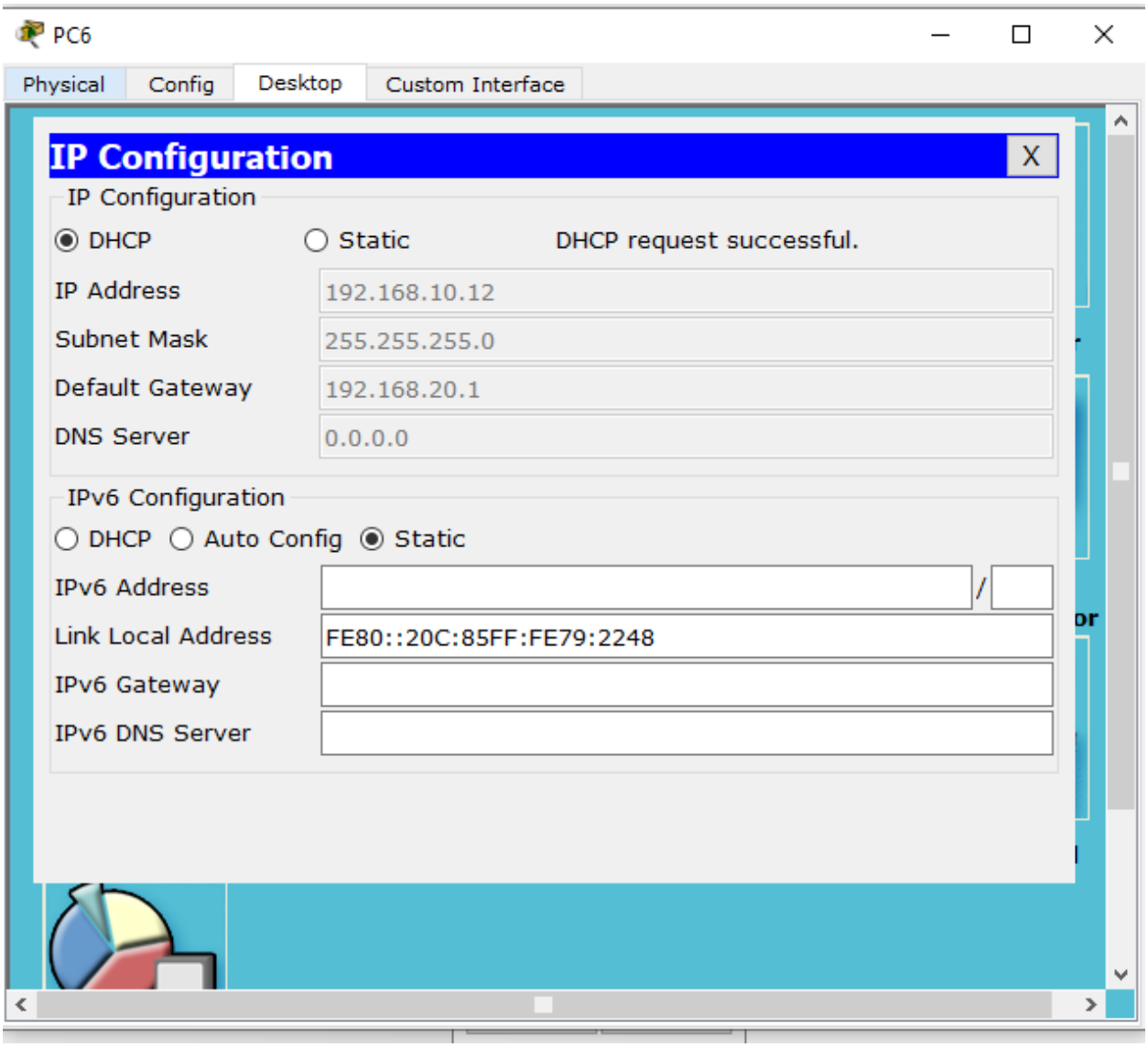

PC1
Physical
Config
Desktop
Custom Interface
IP Configuration
X
IP Configuration
DHCP
Static
DHCP request successful.
IP Address
192.168.20.14
Subnet Mask
255.255.255.0
Default Gateway
0.0.0.0
DNS Server
0.0.0.0
IPv6 Configuration
DHCP
Auto Config
Static
IPv6 Address
Link Local Address
FE80::201:43FF:FE92:AEC2
IPv6 Gateway
IPv6 DNS Server

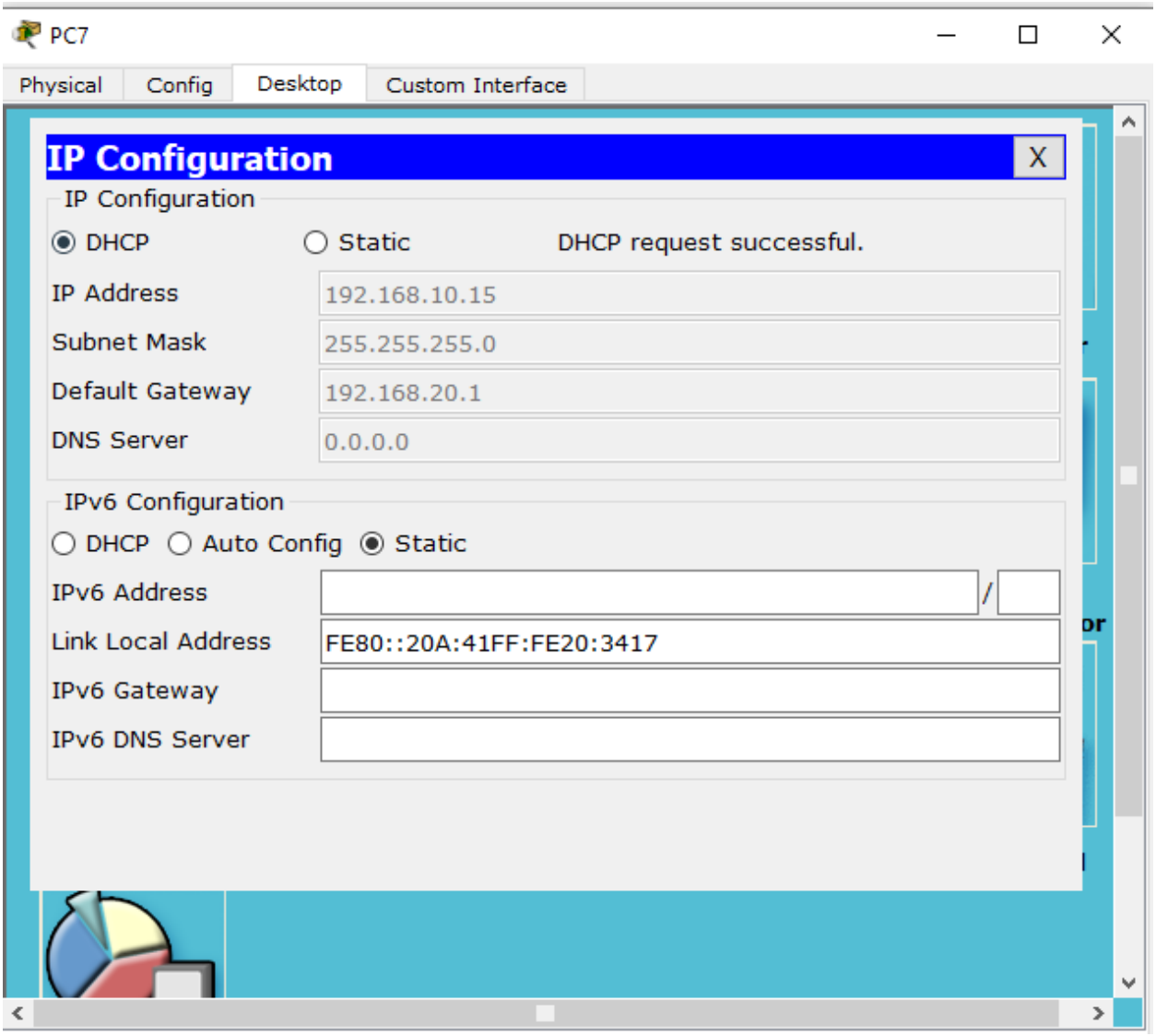

PC2
Physical
Config
Desktop
Custom Interface
IP Configuration
X
IP Configuration
DHCP
Static
DHCP request successful.
IP Address
192.168.20.11
Subnet Mask
255.255.255.0
Default Gateway
0.0.0.0
DNS Server
0.0.0.0
IPv6 Configuration
DHCP
Auto Config
Static
IPv6 Address
Link Local Address
FE80::203:E4FF:FED0:50C4
IPv6 Gateway
IPv6 DNS Server

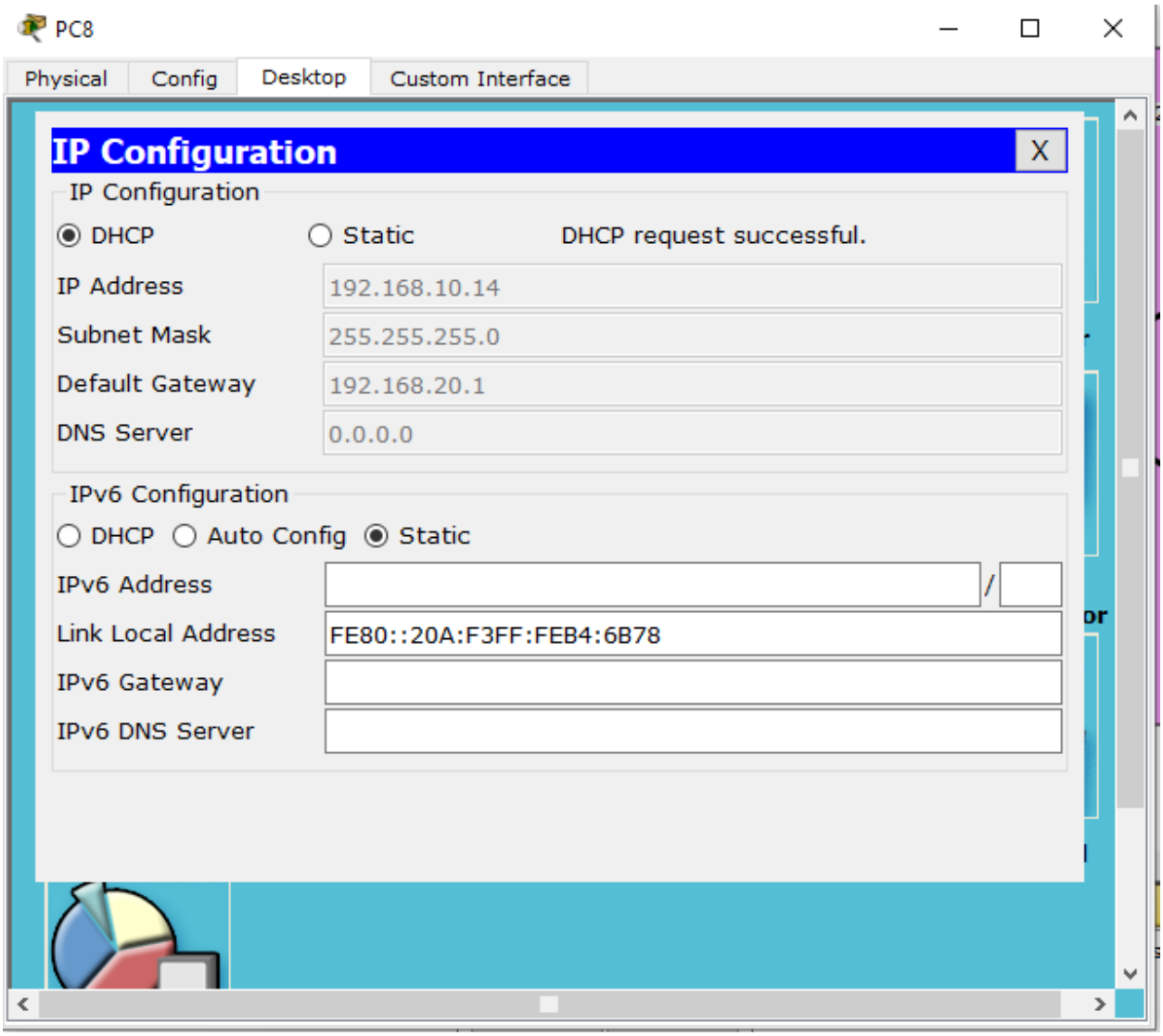

PC3
Physical
Config
Desktop
Custom Interface
IP Configuration
X
IP Configuration
DHCP
Static
DHCP request successful.
IP Address
192.168.30.12
Subnet Mask
255.255.255.0
Default Gateway
192.168.20.1
DNS Server
0.0.0.0
IPv6 Configuration
DHCP
Auto Config
Static
IPv6 Address
/
Link Local Address
FE80::20D:BDFF:FEB6:79D7
IPv6 Gateway
IPv6 DNS Server

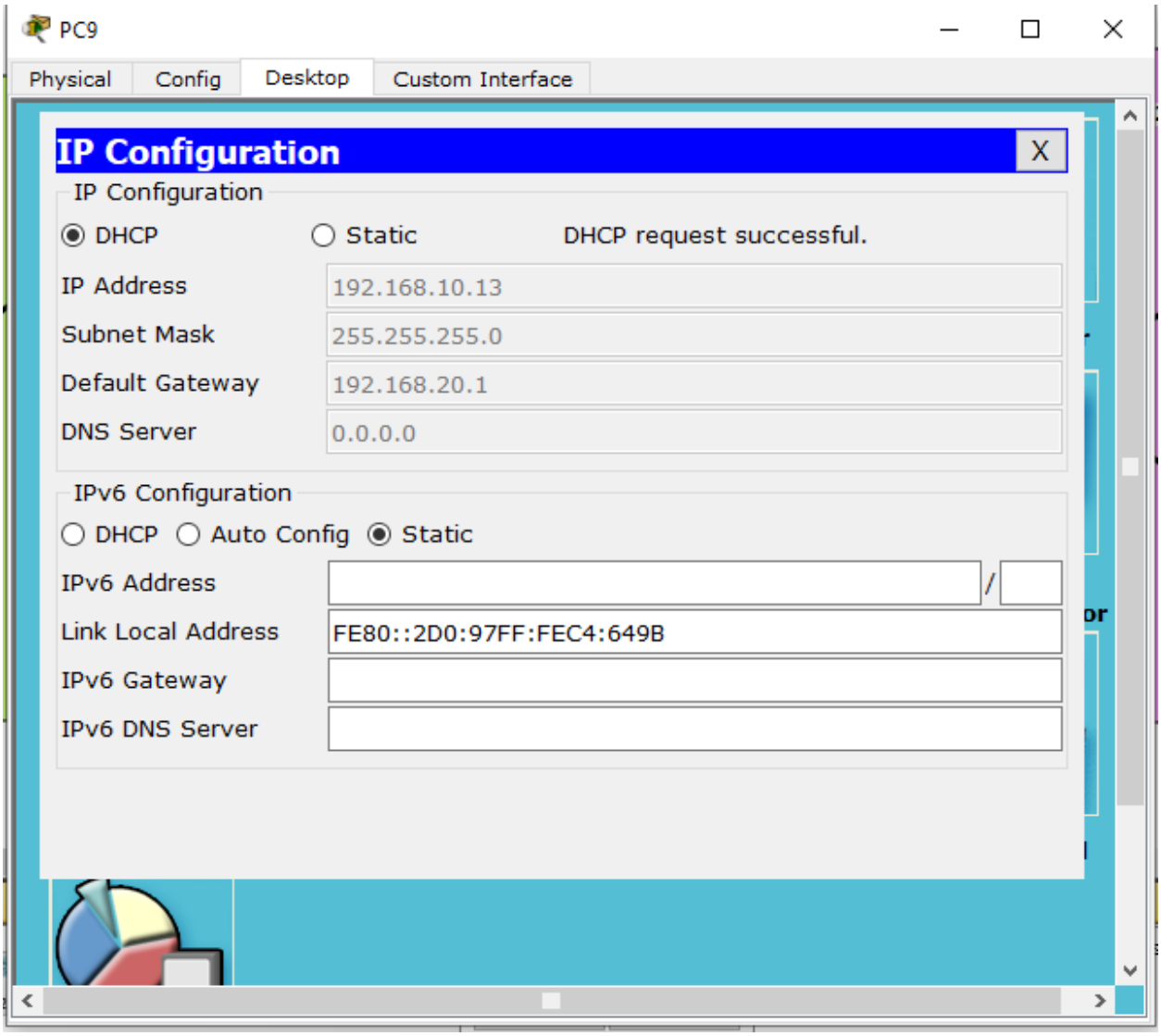

PC4
Physical
Config
Desktop
Custom Interface
IP Configuration
X
IP Configuration
DHCP
Static
DHCP request successful.
IP Address
192.168.30.13
Subnet Mask
255.255.255.0
Default Gateway
192.168.20.1
DNS Server
0.0.0.0
IPv6 Configuration
DHCP
Auto Config
Static
IPv6 Address
/
Link Local Address
FE80::2D0:BAFF:FEA9:5B63
IPv6 Gateway
IPv6 DNS Server


PC5
Physical
Config
Desktop
Custom Interface
IP Configuration
X
IP Configuration
DHCP
Static
DHCP request successful.
IP Address
192.168.30.14
Subnet Mask
255.255.255.0
Default Gateway
192.168.20.1
DNS Server
0.0.0.0
IPv6 Configuration
DHCP
Auto Config
Static
IPv6 Address
/
Link Local Address
FE80::204:9AFF:FECA:6372
IPv6 Gateway
IPv6 DNS Server


PC6
Physical
Config
Desktop
Custom Interface
IP Configuration
X
IP Configuration
DHCP
Static
DHCP request successful.
IP Address
192.168.10.12
Subnet Mask
255.255.255.0
Default Gateway
192.168.20.1
DNS Server
0.0.0.0
IPv6 Configuration
DHCP
Auto Config
Static
IPv6 Address
/
Link Local Address
FE80::20C:85FF:FE79:2248
IPv6 Gateway
IPv6 DNS Server


PC7
Physical
Config
Desktop
Custom Interface
IP Configuration
X
IP Configuration
DHCP
Static
DHCP request successful.
IP Address
192.168.10.15
Subnet Mask
255.255.255.0
Default Gateway
192.168.20.1
DNS Server
0.0.0.0
IPv6 Configuration
DHCP
Auto Config
Static
IPv6 Address
/
Link Local Address
FE80::20A:41FF:FE20:3417
IPv6 Gateway
IPv6 DNS Server

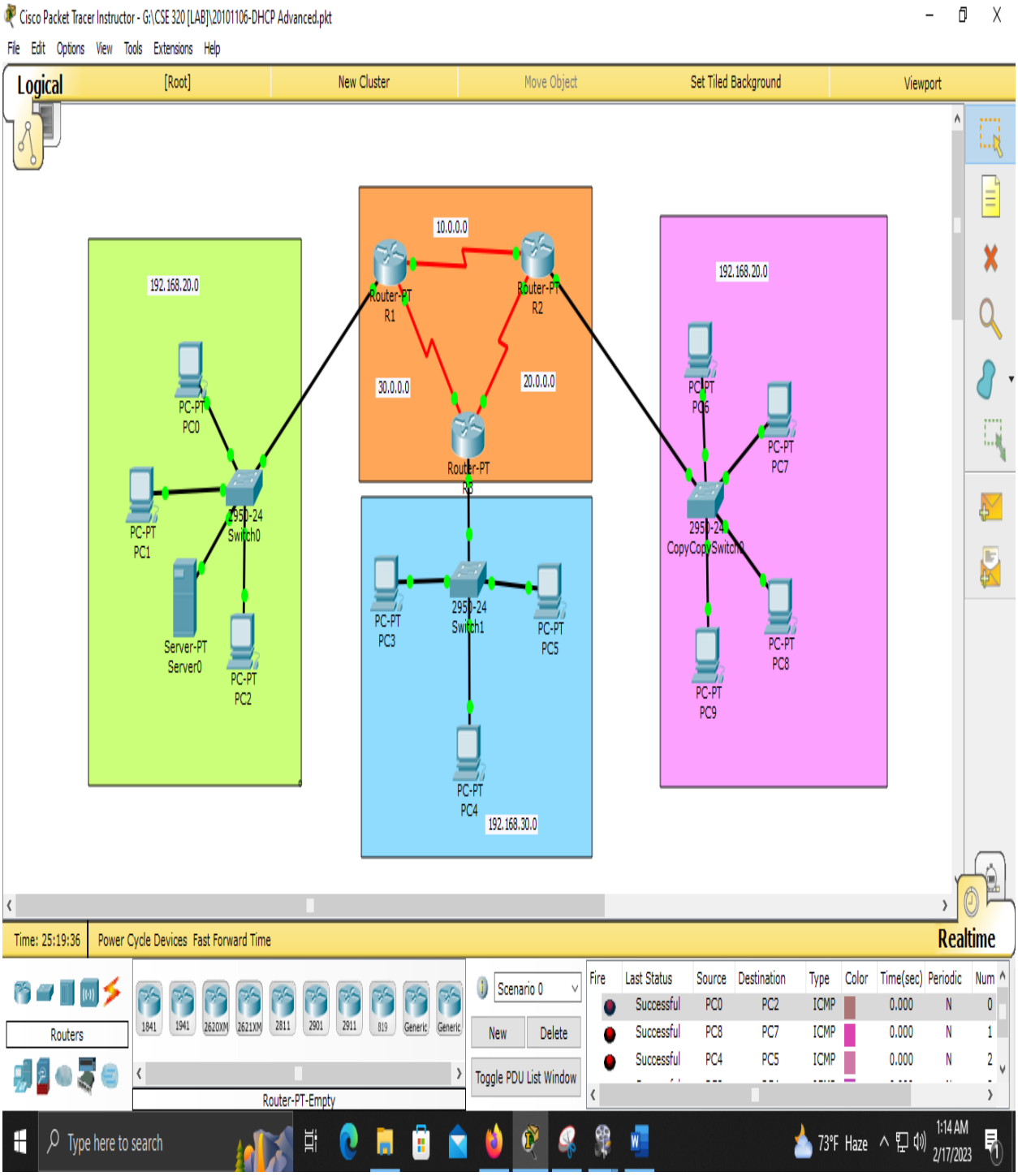

PC8
Physical
Config
Desktop
Custom Interface
IP Configuration
X
IP Configuration
DHCP
Static
DHCP request successful.
IP Address
192.168.10.14
Subnet Mask
255.255.255.0
Default Gateway
192.168.20.1
DNS Server
0.0.0.0
IPv6 Configuration
DHCP
Auto Config
Static
IPv6 Address
/
Link Local Address
FE80::20A:F3FF:FEB4:6B78
IPv6 Gateway
IPv6 DNS Server



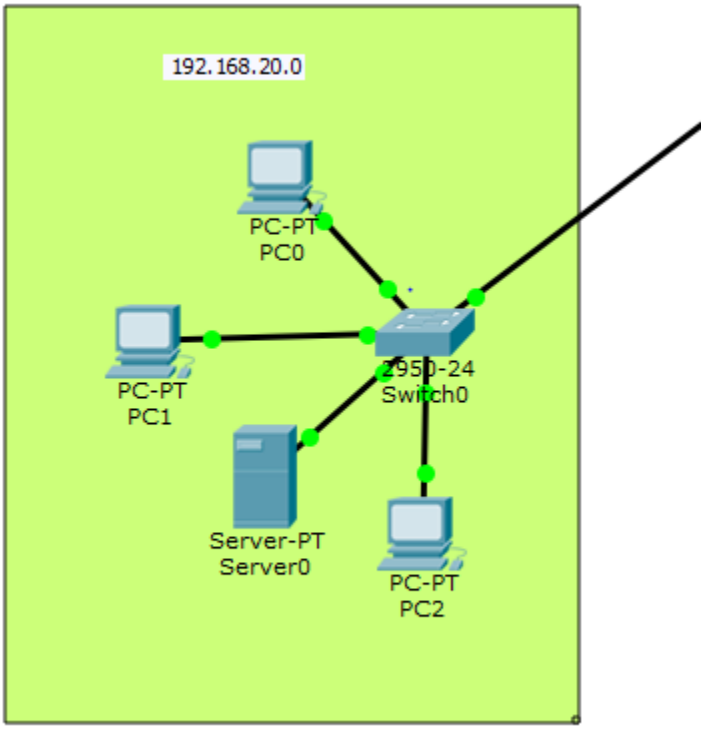
Step-7: Try to send packets using different pc's. It should succeed.

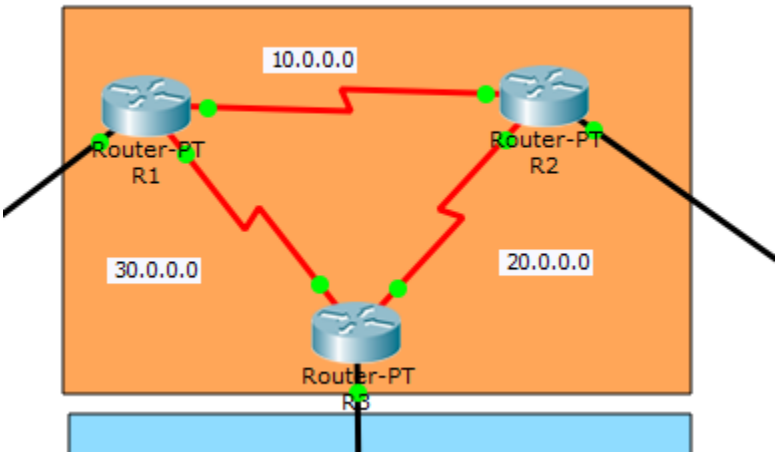
Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num
	Successful	PC0	PC2	ICMP		0.000	N	0
	Successful	PC3	PC5	ICMP		0.000	N	1
	Successful	PC6	PC9	ICMP		0.000	N	2

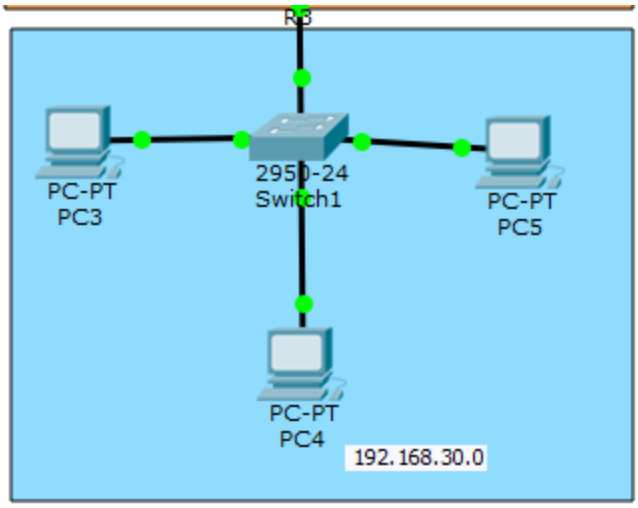
Overall screenshot of the whole architecture-

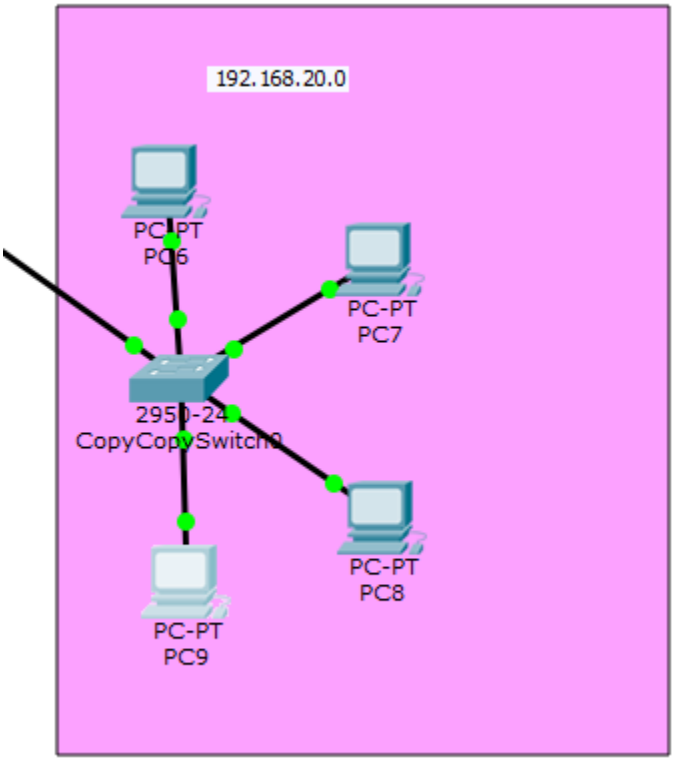


Part by part view-

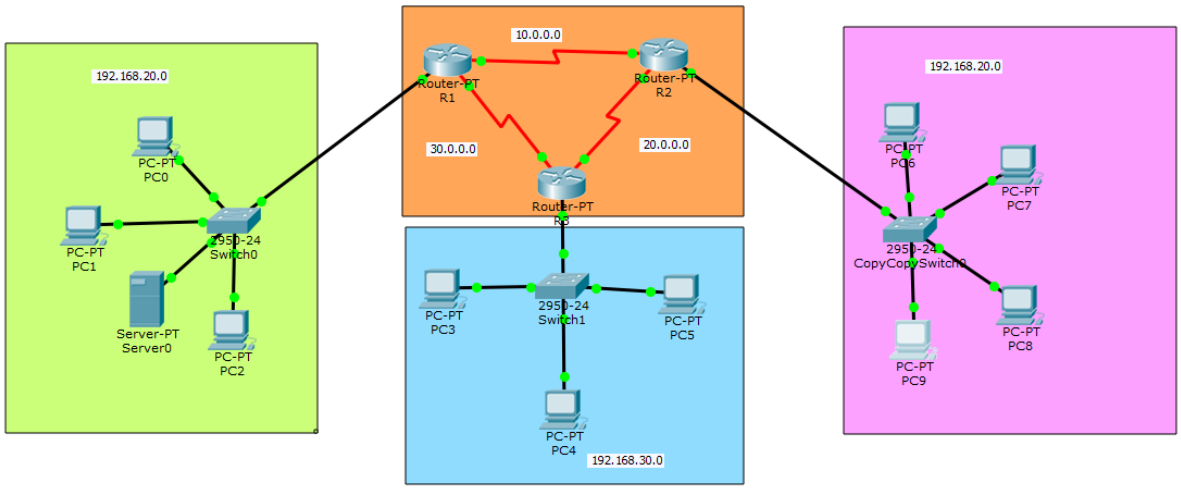





R3
PC-PT
PC3
2950-24
Switch1
PC-PT
PC5
PC-PT
PC4
192.168.30.0


192.168.20.0
PC-PT
PC6
PC-PT
PC7
2950-24
CopyCopySwitch0
PC-PT
PC8
PC-PT
PC9

Detailed view-



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