CS 305 Lab Tutorial
Lecture 12 NAT, RIP, OSPF

Dept. Computer Science and Engineering
Southern University of Science and Technology

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Thanks to Wei Wang

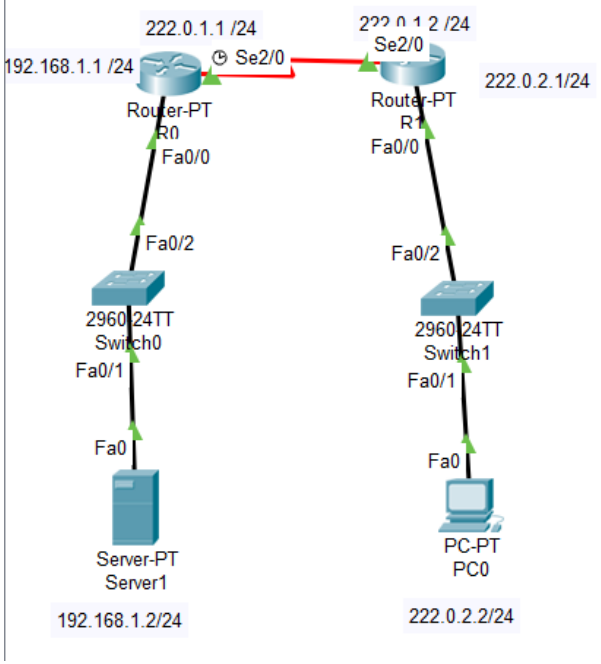
Topic

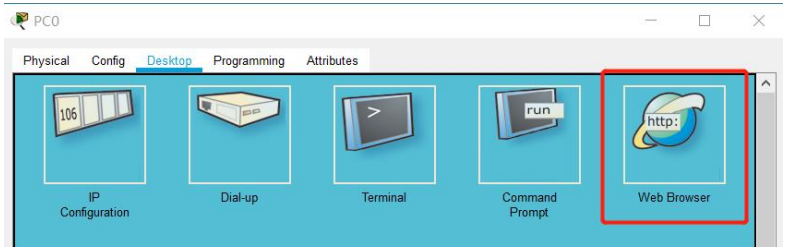
- NAT
  - Static conversion
  - Dynamic conversion
- Practice
  - Build network on simulator
  - Configure
  - Test

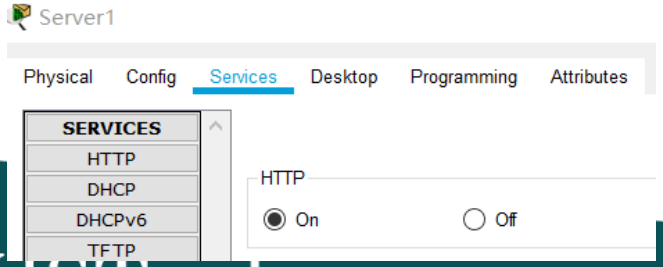
NAT(Static conversion)

The mapping relationship of IP addresses is one-to-one and remains unchanged.

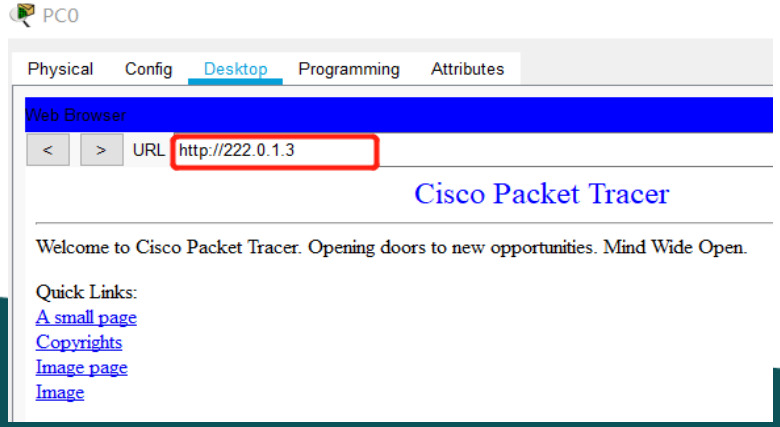
- With the help of static conversion, the access of external network to some special servers in internal network can be implemented.
- Configuration steps:
  - 1. Set **mapping relationship** between internal address and external address:
    - **ip nat inside source static 192.168.1.2 222.0.1.3**
  - 2. **Enable NAT on the interfaces:**
    - Specify external interfaces： **ip nat outside**
    - Specify internal interfaces： **ip nat inside**








```
ip nat inside source static 192.168.1.2 222.0.1.3
```



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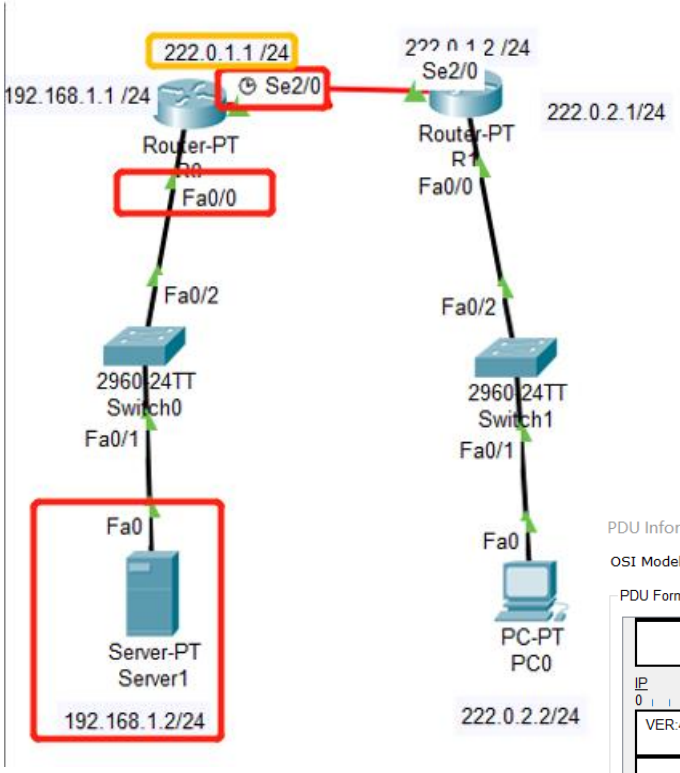
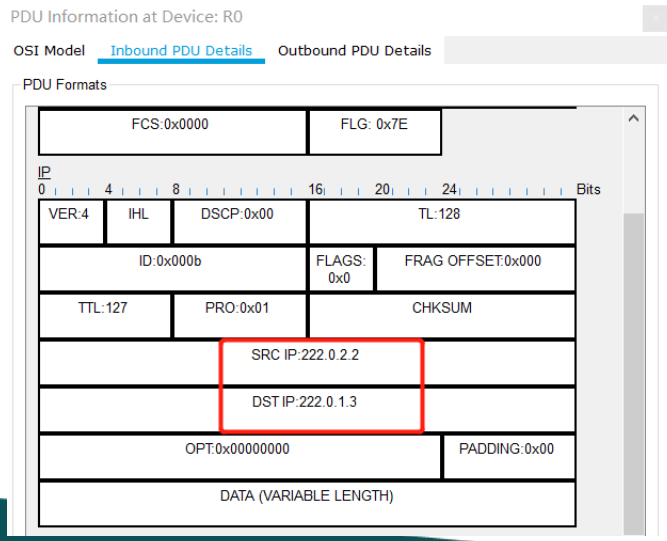
NAT(Static conversion)

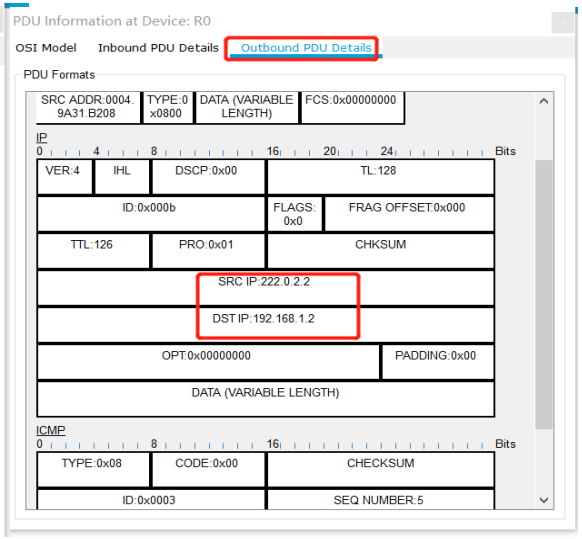



```
ip nat inside source static 192.168.1.2 222.0.1.3
```

```
interface FastEthernet0/0
 ip address 192.168.1.1 255.255.255.0
 ip nat inside
```

```
interface Serial2/0
 ip address 222.0.1.1 255.255.255.0
 ip nat outside
 clock rate 64000
```



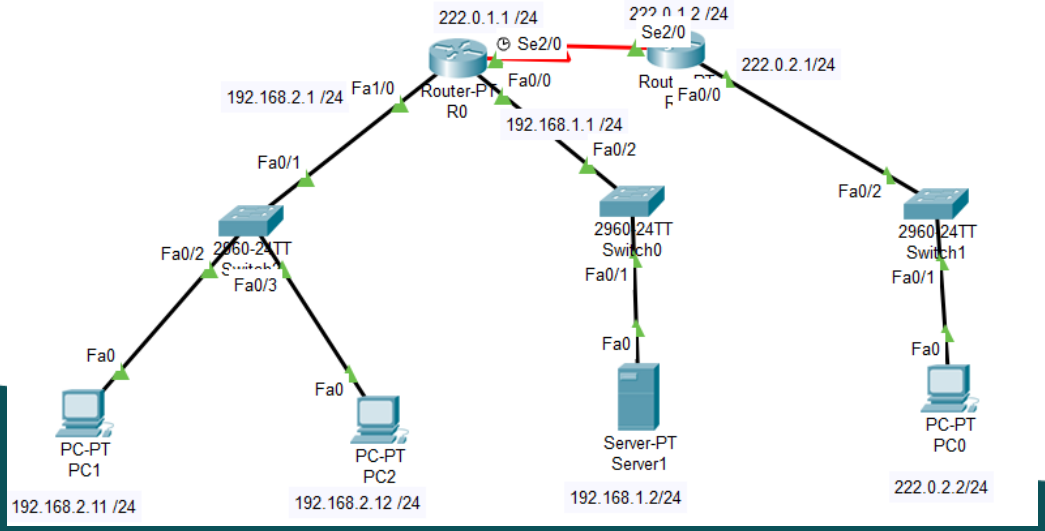


NAT(Dynamic conversion)

The mapping relationship of IP addresses is uncertain and random. All private addresses authorized to access the Internet can be randomly converted to any designated legitimate external IP address.

- It is suitable for scenarios where the number of hosts accessing the Internet at the same time in an internal network is less than the number of IP addresses in the configured legitimate address.
- Configuration steps:
  - 1. Configure **ACL** to limit **the range of intranets that can be addressed**
  - 2. Configuring **address pools** given by telecommunicat**ions**
  - **3. Set up the mapping relationship between ACL and address pool** to match the data stream for address translation.
  - 4. Specify **internal and external interfaces**

```
R0(config)#access-list 1 permit 192.168.2.0 0.0.0.255
R0(config)#ip nat pool np 222.0.1.11 222.0.1.15 netmask 255.255.255.0
R0(config)#ip nat inside source list 1 pool np
R0(config)#interface fa1/0
R0(config-if)#ip nat ind
R0(config-if)#ip nat inside
R0(config-if)#exit
R0(config)#inter
R0(config)#interface se2/0
R0(config-if)#ip nat outside
R0(config-if)#exit
R0(config)#
```



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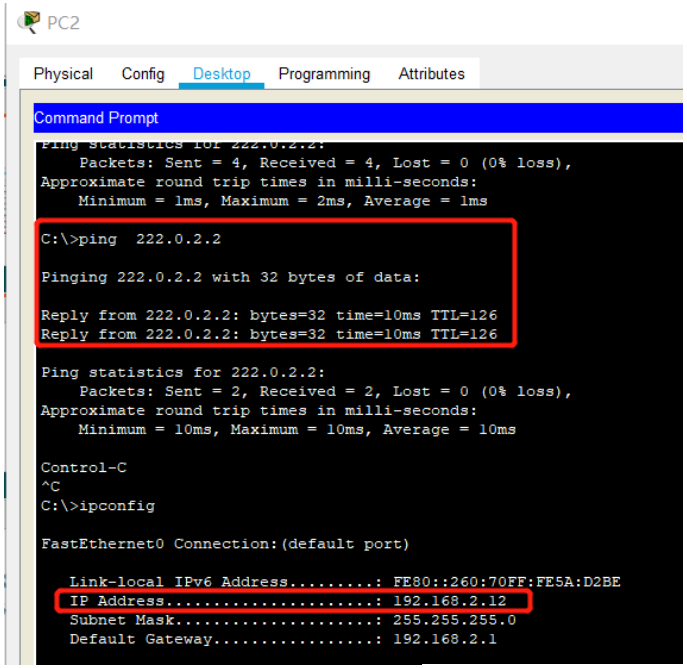
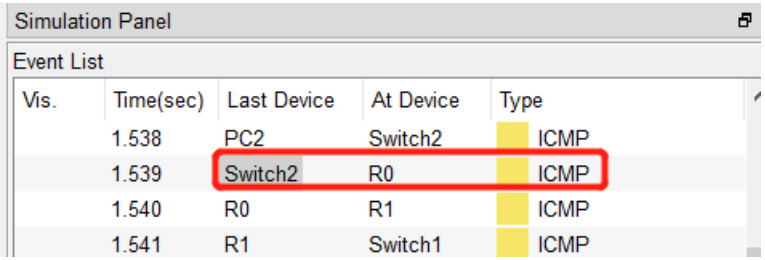
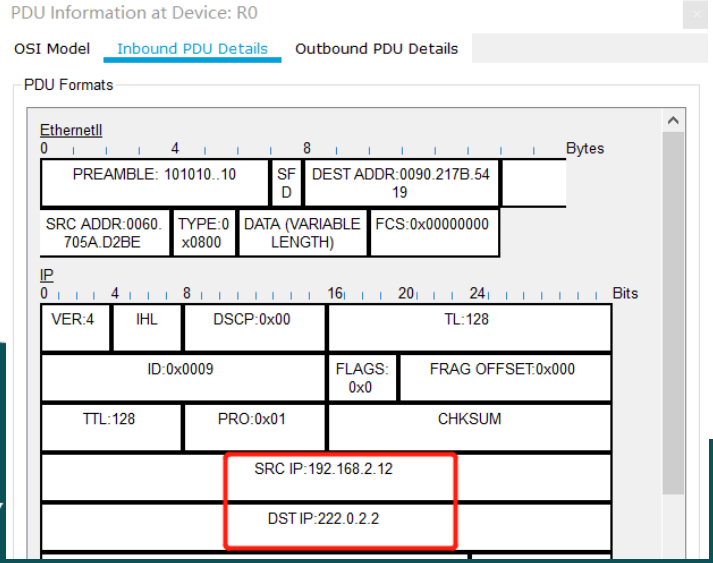
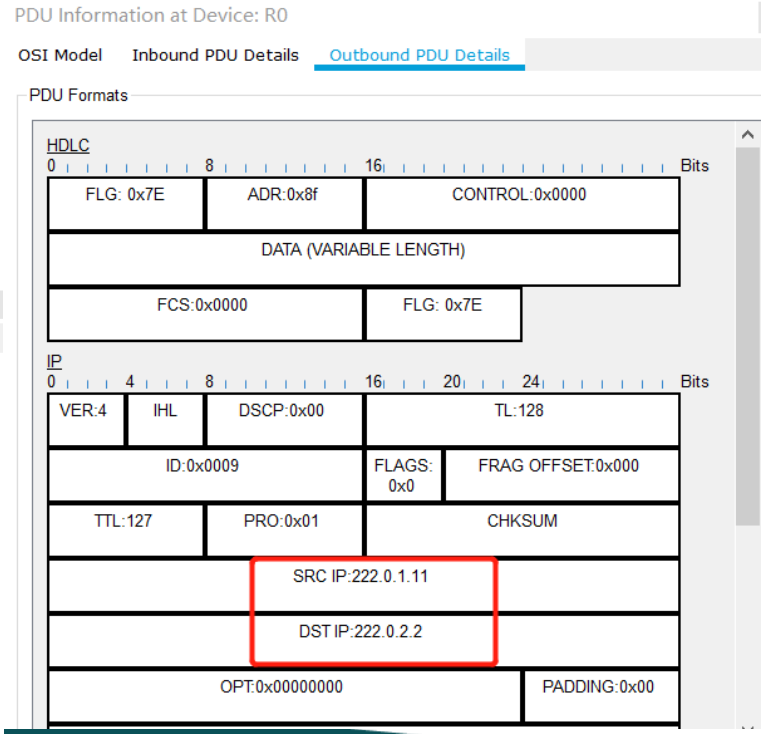
NAT(Dynamic conversion)









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Practice(1)

Build the following network topology, complete the basic configuration, achieve the following functions

① **fa1/0 of R0** is the gateway of **LAN 192.168.2.0/24**. Please set its IP address.

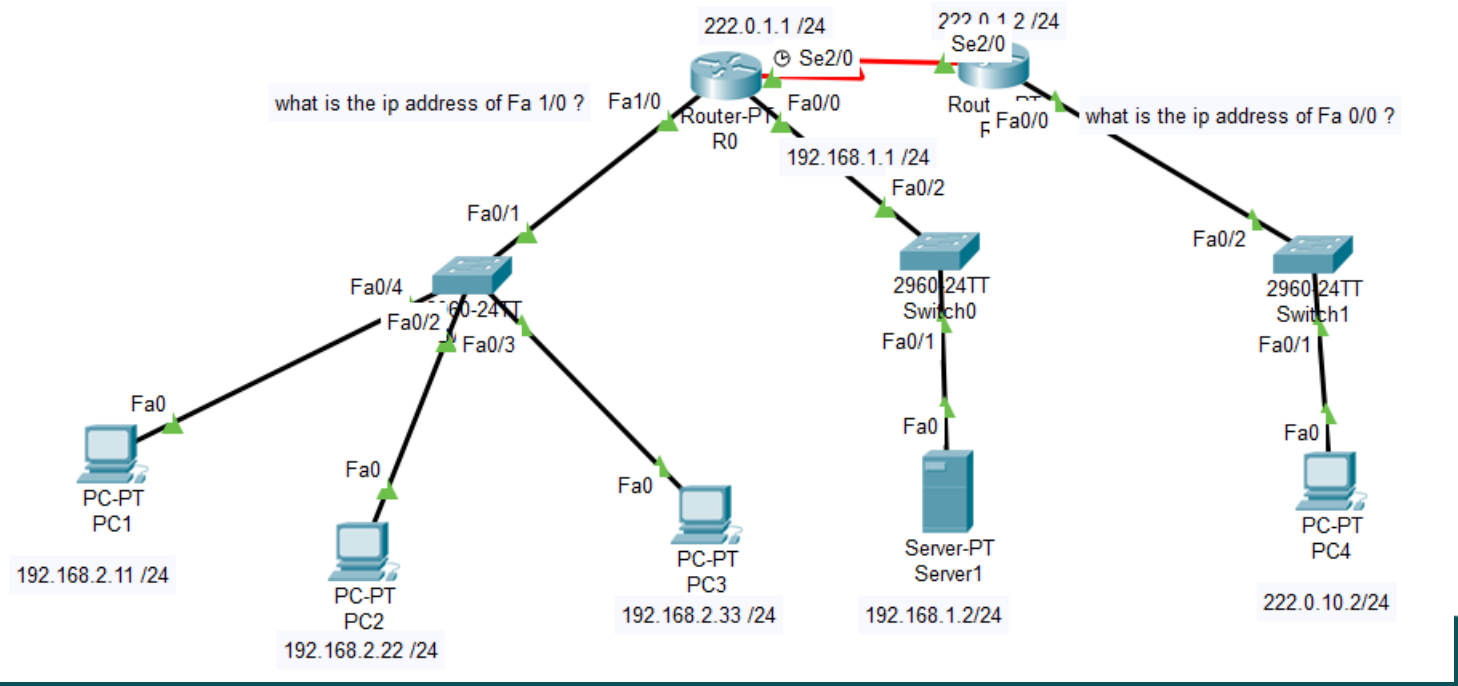
② **fa0/0 of R1** is the gateway of **LAN 222.0.10.0/24**. Please set its IP address.

③ Configure the router

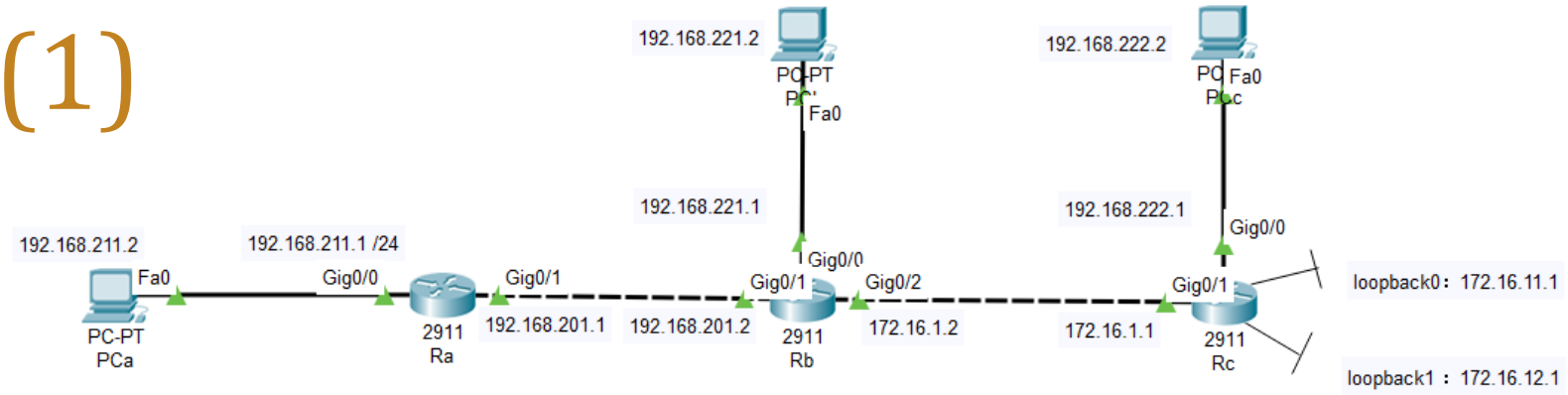
I. By using **static routing**, **192.168.2.0/24** network segment interacts with **222.0.10.0/24** network segment.

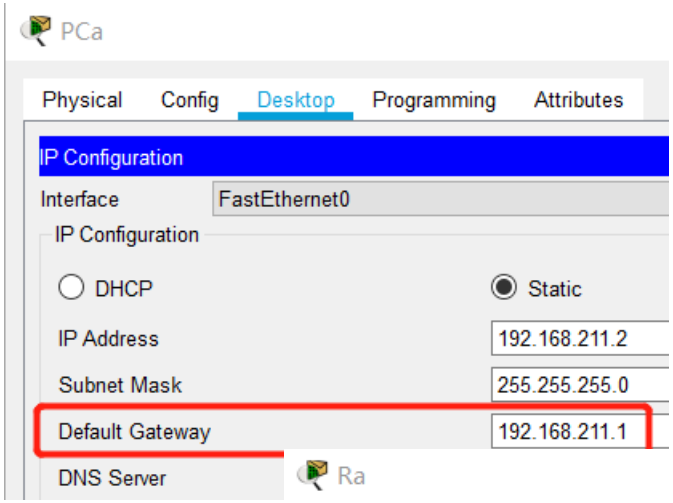
II. Internal IP address **range 192.168.2.11 to 192.168.2.33 dynamically maps** to external available addresses **222.0.1.10 to 222.0.1.15** through **NAT**

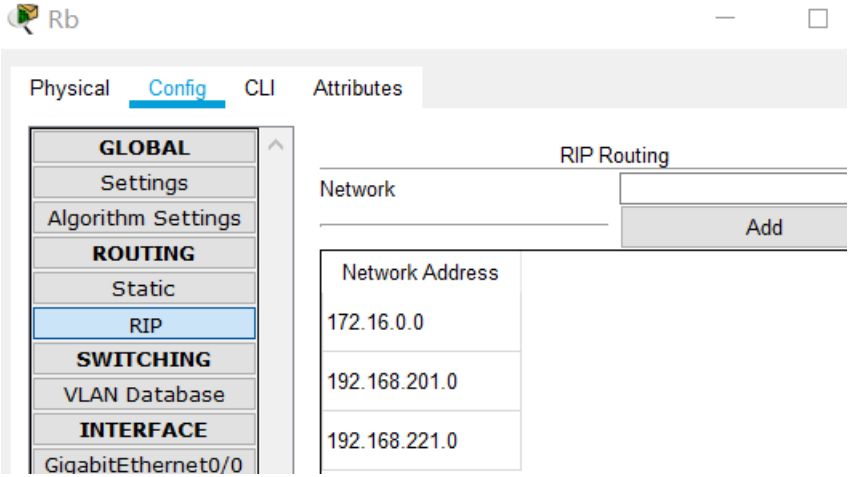
III. Web server 192.168.1.2/24 maps to external available address **222.0.1.3/24** through NAT static mapping, so that PC4 can access the server through external IP address.

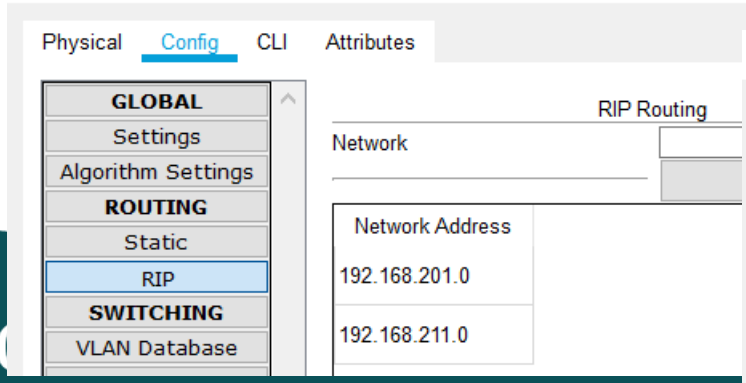


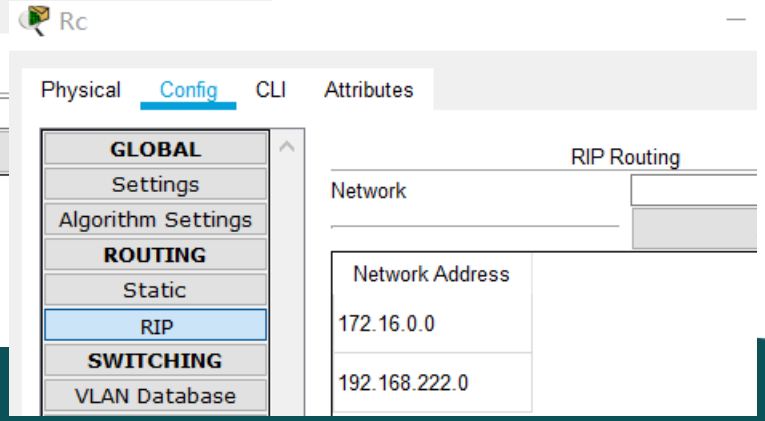
RIP(1)


192.168.221.2
PC-PT
PC'
Fa0
192.168.222.2
PC
Fa0
PC
192.168.221.1
192.168.222.1
Gig0/0
192.168.211.2
192.168.211.1 /24
Fa0
Gig0/0
Gig0/1
Gig0/0
Gig0/1
Gig0/2
Gig0/1
loopback0: 172.16.11.1
loopback1 : 172.16.12.1
PC-PT
PCa
2911
Ra
192.168.201.1
192.168.201.2
2911
Rb
172.16.1.2
172.16.1.1
2911
Rc


PCa
Physical
Config
Desktop
Programming
Attributes
IP Configuration
Interface
FastEthernet0
IP Configuration
DHCP
Static
IP Address
192.168.211.2
Subnet Mask
255.255.255.0
Default Gateway
192.168.211.1
DNS Server


Rb
Physical
Config
CLI
Attributes
GLOBAL
Settings
Algorithm Settings
ROUTING
Static
RIP
SWITCHING
VLAN Database
INTERFACE
GigabitEthernet0/0
RIP Routing
Network
Add
Network Address
172.16.0.0
192.168.201.0
192.168.221.0


Physical
Config
CLI
Attributes
GLOBAL
Settings
Algorithm Settings
ROUTING
Static
RIP
SWITCHING
VLAN Database
RIP Routing
Network
Network Address
192.168.201.0
192.168.211.0

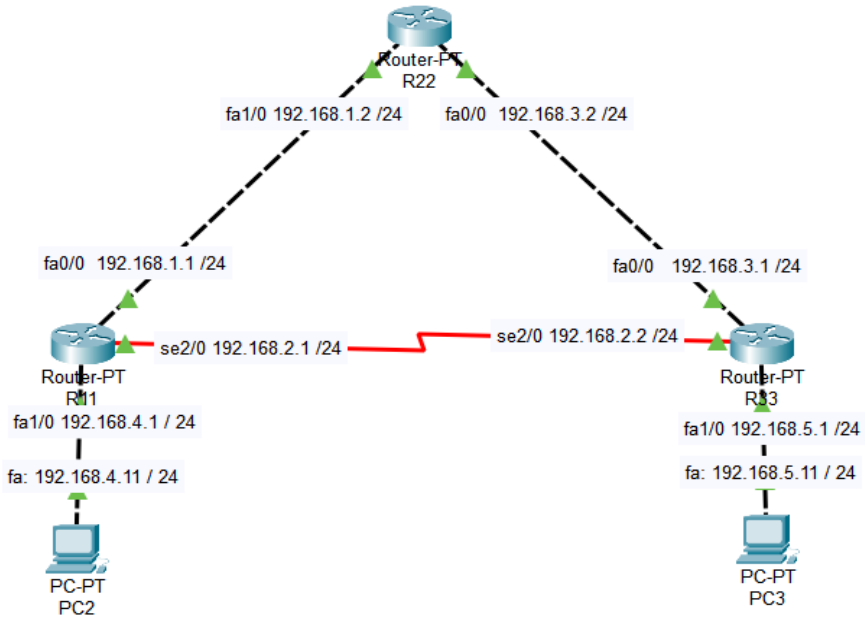

Rc
Physical
Config
CLI
Attributes
GLOBAL
Settings
Algorithm Settings
ROUTING
Static
RIP
SWITCHING
VLAN Database
RIP Routing
Network
Network Address
172.16.0.0
192.168.222.0

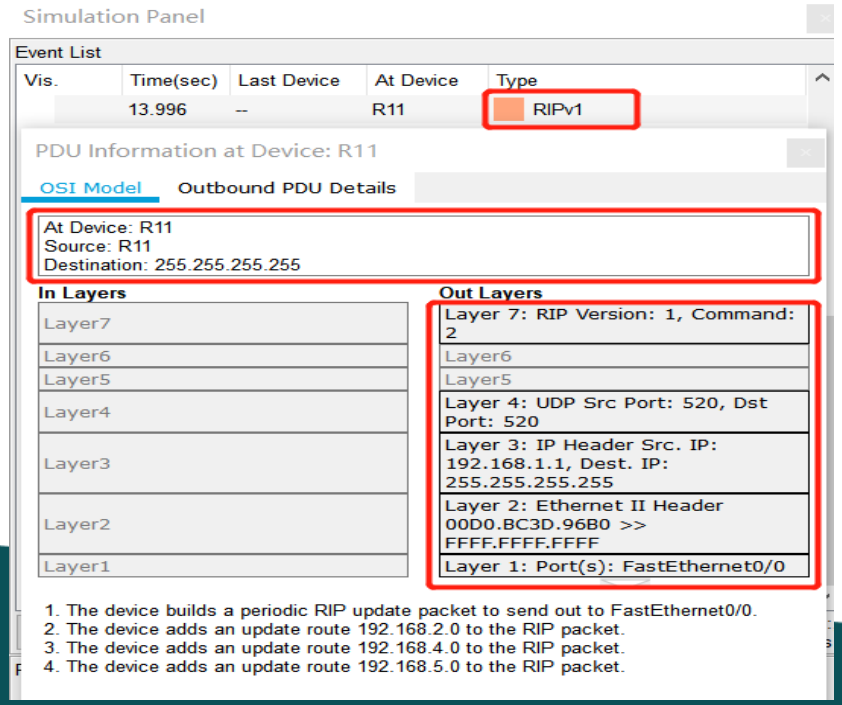
RIP(2)

Q: which router in the network has the following routing-table?

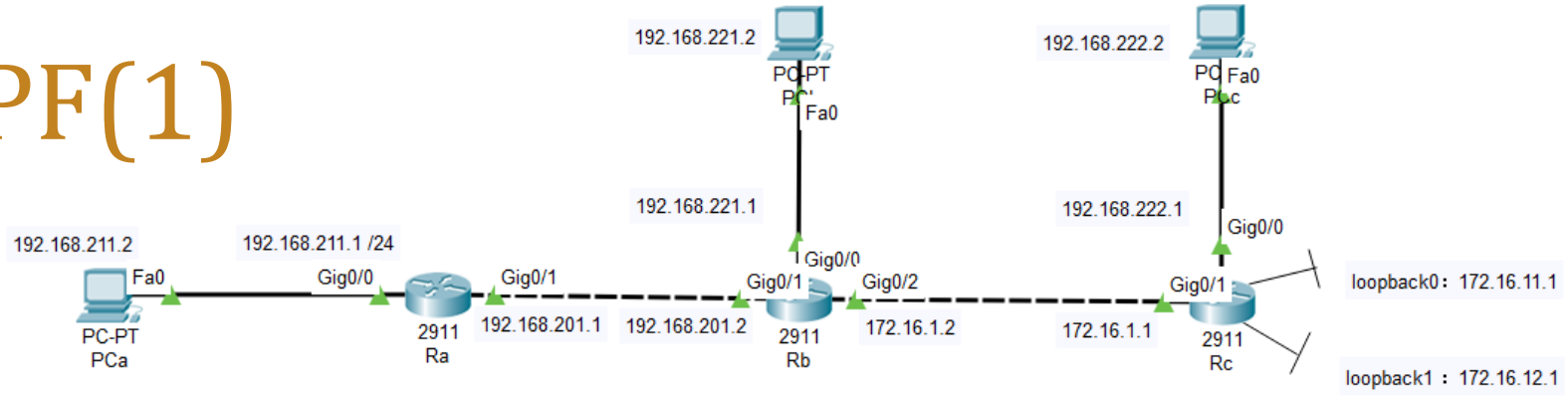
Q: using “ping” on R33 to check if “192.168.1.1” is reachable, while ICMP request packet leaves from R33, what's its routing path? why?

```
R    192.168.1.0/24 [120/1] via 192.168.3.2, 00:00:23, FastEthernet0/0
                    [120/1] via 192.168.2.1, 00:00:18, Serial2/0
C    192.168.2.0/24 is directly connected, Serial2/0
C    192.168.3.0/24 is directly connected, FastEthernet0/0
R    192.168.4.0/24 [120/1] via 192.168.2.1, 00:00:18, Serial2/0
C    192.168.5.0/24 is directly connected, FastEthernet1/0
```





OSPF(1)




```
router ospf 1
 log-adjacency-changes
 network 192.168.211.0 0.0.0.255 area 0
 network 192.168.201.0 0.0.0.255 area 0
```

```
router ospf 1
 log-adjacency-changes
 network 192.168.201.0 0.0.0.255 area 0
 network 192.168.221.0 0.0.0.255 area 0
 network 172.16.1.0 0.0.0.255 area 0
```

```
router ospf 1
 log-adjacency-changes
 network 172.16.1.0 0.0.0.255 area 0
 network 192.168.222.0 0.0.0.255 area 0
 network 172.16.11.0 0.0.0.255 area 0
 network 172.16.12.0 0.0.0.255 area 0
```

Ra

Physical | Config | CLI | Attributes

IOS Command Line Interface

```
Ra#show ip rout
Ra#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     172.16.0.0/16 is variably subnetted, 3 subnets, 2 masks
O       172.16.1.0/24 [110/2] via 192.168.201.2, 00:10:00, GigabitEthernet0/1
O       172.16.11.1/32 [110/3] via 192.168.201.2, 00:10:00, GigabitEthernet0/1
O       172.16.12.1/32 [110/3] via 192.168.201.2, 00:10:00, GigabitEthernet0/1
     192.168.201.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.201.0/24 is directly connected, GigabitEthernet0/1
L       192.168.201.1/32 is directly connected, GigabitEthernet0/1
     192.168.211.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.211.0/24 is directly connected, GigabitEthernet0/0
L       192.168.211.1/32 is directly connected, GigabitEthernet0/0
O    192.168.221.0/24 [110/2] via 192.168.201.2, 00:10:00, GigabitEthernet0/1
O    192.168.222.0/24 [110/3] via 192.168.201.2, 00:10:00, GigabitEthernet0/1

Ra#
```

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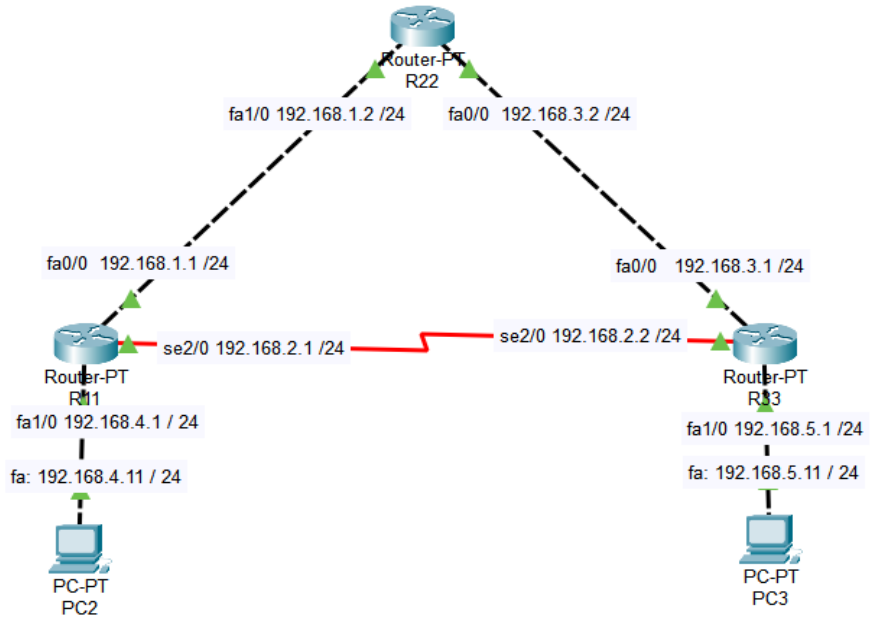
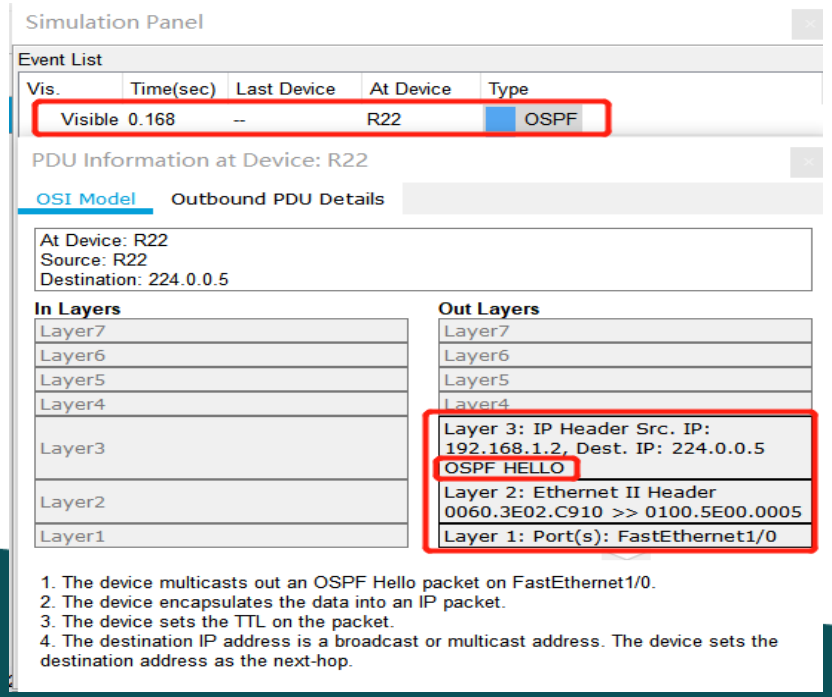
OSPF(2)

```
C    192.168.1.0/24 is directly connected, FastEthernet1/0
O    192.168.2.0/24 [110/65] via 192.168.1.1, 01:51:24, FastEthernet1/0
                    [110/65] via 192.168.3.1, 01:51:24, FastEthernet0/0
C    192.168.3.0/24 is directly connected, FastEthernet0/0
O    192.168.4.0/24 [110/2] via 192.168.1.1, 01:51:34, FastEthernet1/0
O    192.168.5.0/24 [110/2] via 192.168.3.1, 01:51:24, FastEthernet0/0
```



Q: which router in the network has the following routing-table?

Q: using “ping” on PC2 to check if PC3 is reachable, while ICMP request packet leaves from PC2, what's its routing path? why?



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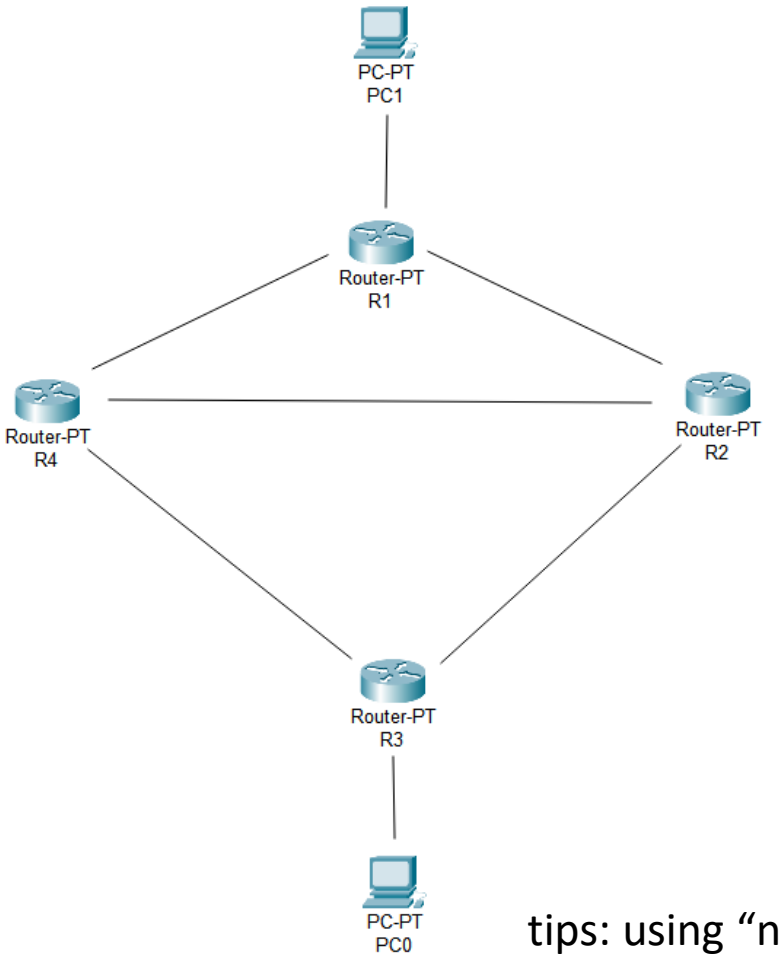
Practice(2)

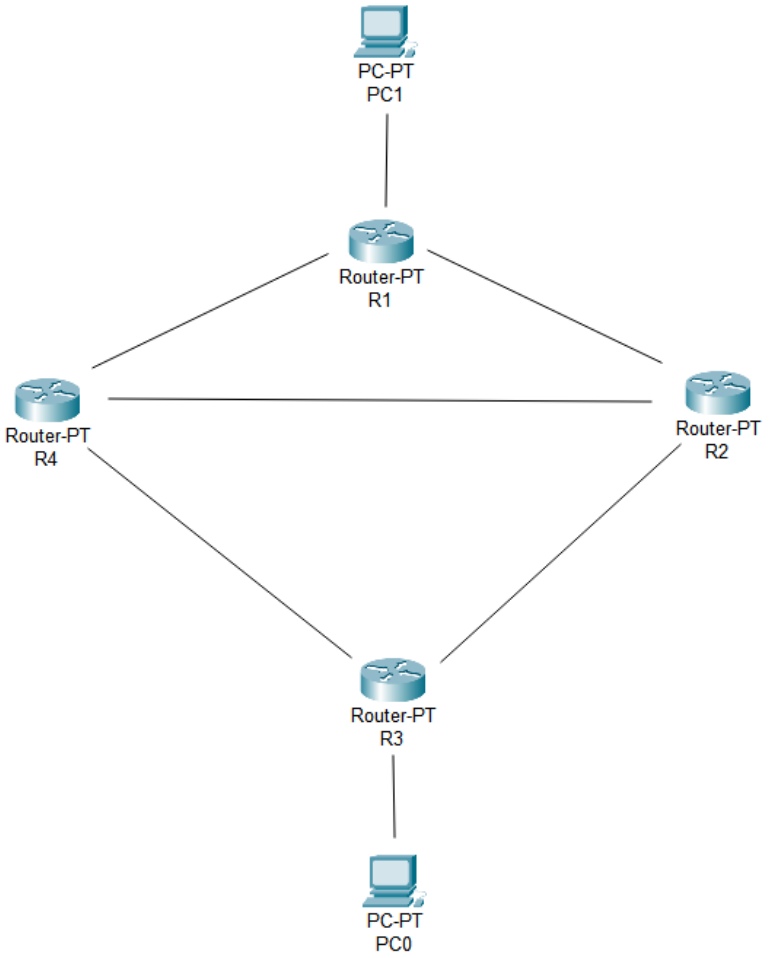


Build the network

- Do the configuration on PCs and the interfaces of Router
  - place notes near the interfaces to displace its IPv4 address.
- Enable and configure RIP protocol on routers
  - make all the nodes(including PCs and Routers) reachable in the network.
  - list the route-table on each router in the network
  - using “ping” on PC1 to check if PC0 is reachable, while ICMP request packet leave from PC1, what's its routing path? Is it the shortest path (here shortest path means minimum hops) between two nodes?

tips: using “no route rip” on router to diable RIP protocol

Practice(2)



Build the network

- Do the configuration on PCs and the interfaces of Router
  - place notes near the interfaces to displace its IPv4 address.
- Enable and configure OSPF protocol on routers
  - make all the nodes(including PCs and Routers) reachable in the network.
  - list the route-table on each router
  - using “ping” on PC1 to check if PC0 is reachable, while ICMP request packet leaves from PC1, what's its routing path? If the routing path is not “R1->R2->R4->R3”, try to make it.
- List the differences between RIP and OSPF protocol(at least 3 aspects) , using this practice to improve it.

Simulation Panel

Event List

Vis.	Time(sec)	Last Device	At Device	Type
	0.000	--	PC1	ICMP
	0.001	PC1	R1	ICMP
	0.002	R1	R2	ICMP
	0.003	R2	R4	ICMP
	0.004	R4	R3	ICMP
Visible	0.005	R3	PC0	ICMP