

# CS 305 Lab Tutorial

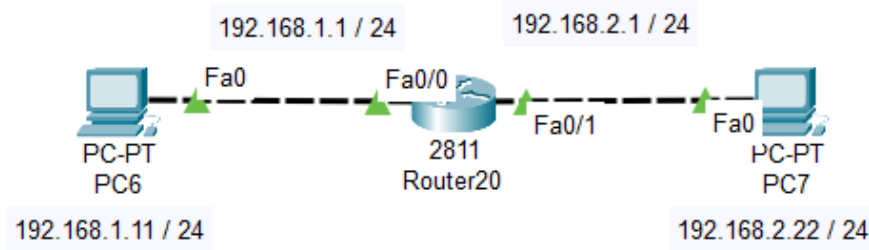
## Lab10 Route

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

# Topic

- Subnet, Gateway
- Route-table, Route aggregation
- Practice
  - Build network on simulator
  - Configure
  - Test

# Subnet



Q: How many sub-net in the network? what are their net-id?

A: 2

Q: Does 192.168.1.1/24 and 192.168.1.11/24 belongs to the same sub-net?

A: Yes

Q: Does 192.168.2.22/24 and 192.168.1.11/24 belongs to the same sub-net?

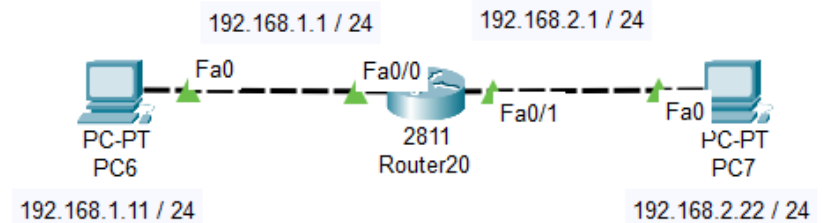
A: NO

Q: How to make PC7 reachable from PC6?

A: using Router to forward the IP packets from one subnet to the other subnet.

# Default Gateway

What are the right configs to make PC7 reachable from PC6?



PC6

Physical Config **Desktop** Programming Attributes **1**

```
Command Prompt

FastEthernet0 Connection:(default port)

Connection-specific DNS Suffix...:
Link-local IPv6 Address . . . . . : FE80::202:16FF:FE9E:A297
IPv6 Address . . . . . : ::
IPv4 Address . . . . . : 192.168.1.11
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . : 192.168.1.1
```

PC6

Physical Config **Desktop** Programming Attributes **3**

```
Command Prompt

C:\>ipconfig /all

FastEthernet0 Connection:(default port)

Connection-specific DNS Suffix...:
Physical Address . . . . . : 0009.7C67.3C2B
Link-local IPv6 Address . . . . . : FE80::209:7CFF:FE67:3C2B
IPv6 Address . . . . . : ::
IPv4 Address . . . . . : 192.168.1.11
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . : 192.168.2.1
```

PC7

Physical Config **Desktop** Programming Attributes **2**

```
Command Prompt

C:\>ipconfig

FastEthernet0 Connection:(default port)

Connection-specific DNS Suffix...:
Link-local IPv6 Address . . . . . : FE80::260:5CFF:FECD:80E6
IPv6 Address . . . . . : ::
IPv4 Address . . . . . : 192.168.2.22
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . : 192.168.1.1
```

PC7

Physical Config **Desktop** Programming Attributes **4**

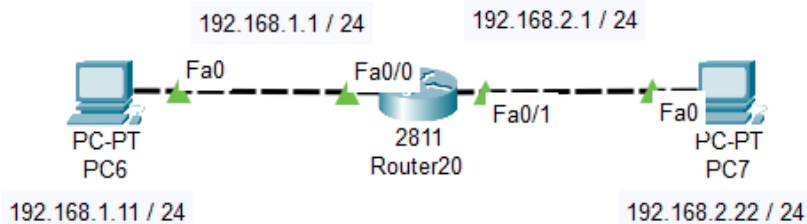
```
Command Prompt

C:\>ipconfig

FastEthernet0 Connection:(default port)

Connection-specific DNS Suffix...:
Link-local IPv6 Address . . . . . : FE80::260:5CFF:FECD:80E6
IPv6 Address . . . . . : ::
IPv4 Address . . . . . : 192.168.2.22
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . : 192.168.2.1
```

# Connected Route(1)



- using “**show ip route**” command on router to find its route-table.
- “**connected route**” is generated by default while the IP address of interface is assigned.
- what's the function of route-table ?

Router20

Physical Config CLI Attributes

IOS Command Line Interface

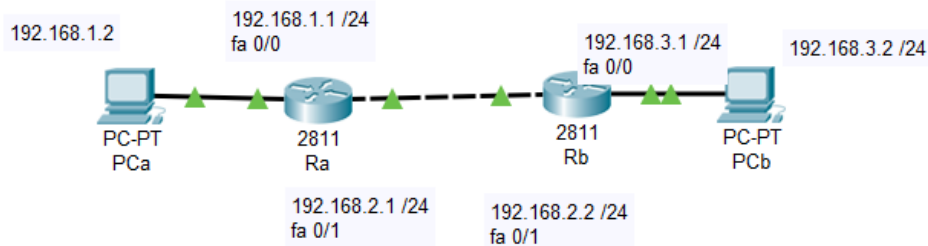
```
Router>en
Router#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external 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

```
C    192.168.1.0/24 is directly connected, FastEthernet0/0
C    192.168.2.0/24 is directly connected, FastEthernet0/1
```

Router#

# Connected Route(2)



- Is fa0/1 interface of Rb reachable from PCb?
- Is fa0/1 interface of Ra reachable from PCb?
- Is fa0/0 interface of Ra reachable from PCb?
- Is PCb reachable from PCa?
- How to make them reachable?

Ra#show ip route

Codes: C - connected, S - static, I - IGRP, 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

```
C 192.168.1.0/24 is directly connected, FastEthernet0/0
C 192.168.2.0/24 is directly connected, FastEthernet0/1
```

Ra#

Rb#show ip route

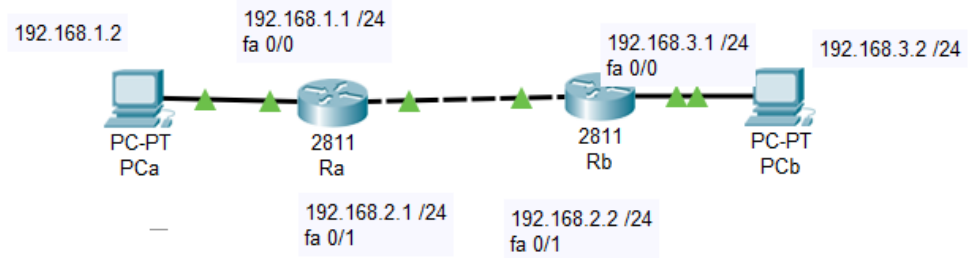
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP  
 D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
 N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
 E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP  
 i - IS-IS, L1 - IS-IS level-1, 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

```
C 192.168.2.0/24 is directly connected, FastEthernet0/1
C 192.168.3.0/24 is directly connected, FastEthernet0/0
```

Rb#

# Static Route(1)



Rb

Physical Config CLI Attributes

IOS Command Line Interface

```
Enter configuration commands, one per line. End with CNTL/Z.
Rb(config)#ip ro
Rb(config)#ip route ?
  A B C D  Destination prefix
Rb(config)#ip route 192.168.1.0 255.255.255.0 192.168.2.1
Rb(config)#exit
Rb#
%SYS-5-CONFIG_I: Configured from console by console

Rb#show ip route
Codes: C - connected, S - static, I - IGRP, 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

S    192.168.1.0/24 [1/0] via 192.168.2.1
C    192.168.2.0/24 is directly connected, FastEthernet0/1
C    192.168.3.0/24 is directly connected, FastEthernet0/0

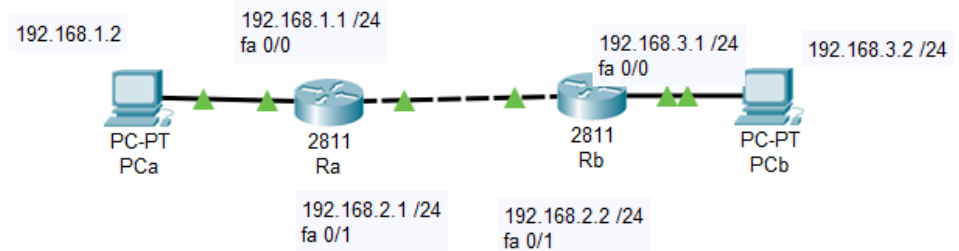
Rb#
```

using “**ip route x.x.x.x m.m.m.m i.i.i.i**”  
to add static route in the router.

“**x.x.x.x**” is the subnet id, “**m.m.m.m**”  
is the subnet mask, “**i.i.i.i**” is the IP  
address of **next-hop** while forward IP  
packet.

After add static route to Ra, is PCa  
reachable from PCb?

# Static Route(2)



Ra

Physical Config CLI Attributes

IOS Command Line Interface

```
scp          Scp commands
ssh          Configure ssh options
tcp         Global TCP parameters

Ra(config)#ip route 192.168.3.0 255.255.255.0 192.168.2.2
Ra(config)#
Ra(config)#exit
Ra#
%SYS-5-CONFIG_I: Configured from console by console

Ra#show ip route
Codes: C - connected, S - static, I - IGRP, 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

C    192.168.1.0/24 is directly connected, FastEthernet0/0
C    192.168.2.0/24 is directly connected, FastEthernet0/1
S    192.168.3.0/24 [1/0] via 192.168.2.2

Ra#
```

Rb

Physical Config CLI Attributes

IOS Command Line Interface

```
Enter configuration commands, one per line. End with CNTL/Z.
Rb(config)#ip ro
Rb(config)#ip route ?
  A B C D Destination prefix
Rb(config)#ip route 192.168.1.0 255.255.255.0 192.168.2.1
Rb(config)#exit
Rb#
%SYS-5-CONFIG_I: Configured from console by console

Rb#show ip route
Codes: C - connected, S - static, I - IGRP, 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

S    192.168.1.0/24 [1/0] via 192.168.2.1
C    192.168.2.0/24 is directly connected, FastEthernet0/1
C    192.168.3.0/24 is directly connected, FastEthernet0/0

Rb#
```

Is PCa reachable from PCb now?



# Route aggregation

**Why** Route aggregation? smaller route-table, faster forward, more stable ...

**How** to make 4 subnets to be aggregated as 1 subnet

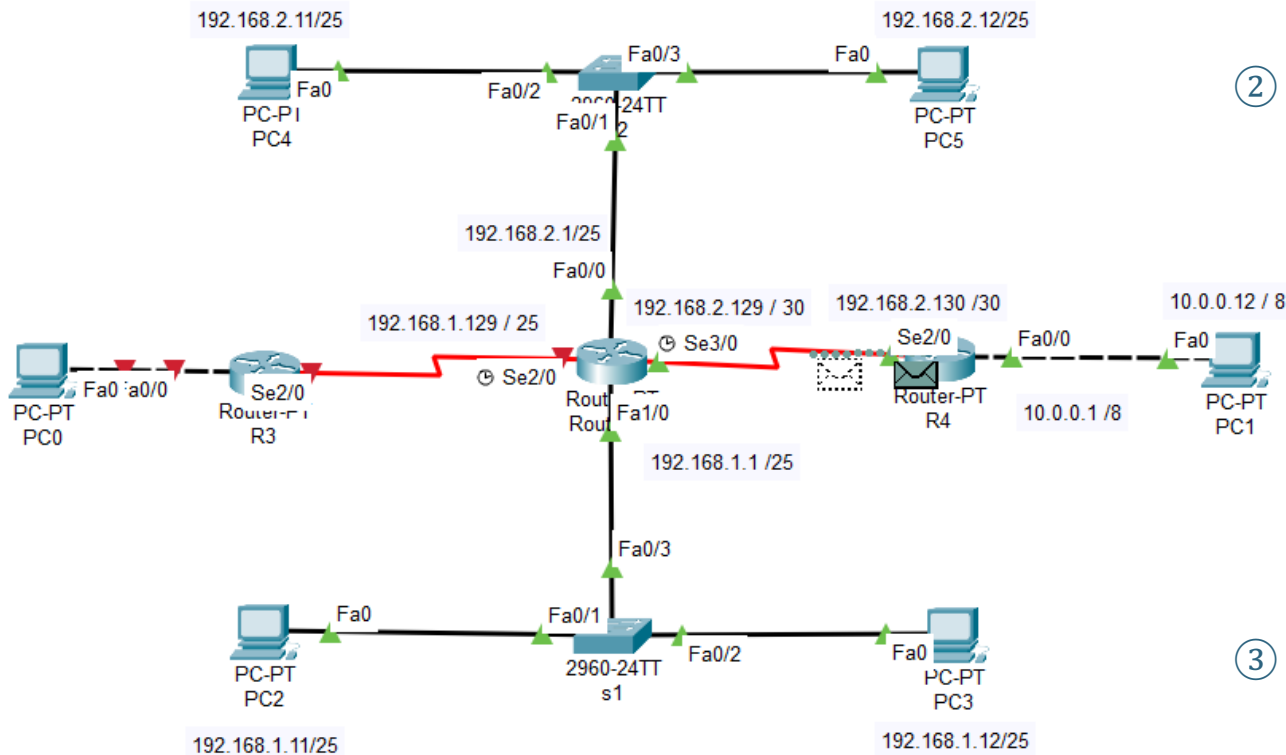
- 172.16.129.0/24
- 172.16.130.0/24
- 172.16.132.0/24
- 172.16.133.0/24

- ① 172.16.129.0/24
  - 172.16.1000\_0001.0 / 24
- ② 172.16.130.0/24
  - 172.16.1000\_0010.0 / 24
- ③ 172.16.132.0/24
  - 172.16.1000\_0100.0 / 24
- ④ 172.16.133.0/24
  - 172.16.1000\_0101.0 / 24

**Step1:** find the Maxim size of same continuous bit from highest bit to lowest bit among the 4 subnets IDs : 21bits (172.16.1000\_0)

**Step2:** using the bits get from step1 as hig bits of address, pad it with 0s to make a new 32bits subnet ID: (172.16.1000\_0000.0) 172.168.128.0 / 21. Now the 4 subnets are aggregated to be 1 subnet : 172.168.128.0 / 21.

# Practise 10.1(1)



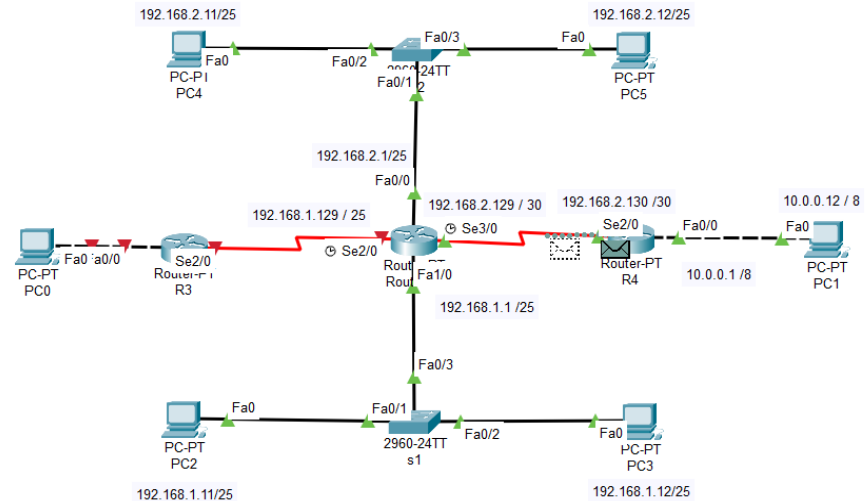
Build the network:

- ① **2 switches**
  - there is no configuration on switches in this practice.
- ② **3 routers**
  - using **PT Route** which has more than two network interfaces.
  - for the middle one, connect its **fast-ethernet interface** with switches; connect its **serial interface** with other routers.
  - configurations should include: interface, route-table, make route-table as smaller as possible
- ③ **6 PCs**
  - configurations include: static IP address, subnet Mask and ...

Finish the configuration, make all the PCs in the network reachable from each other.

# Practise 10.1(2)

- Step1: Finish the configuration to make all the PCs are reachable from each other except PC0:
  - How many subnet are there in this network, what are their net-id?
  - what's the function of gateway in the network? show the configurations about gateway.
  - what's the function of route-table? how many types of routing items are there in the route-table?
- Step2 : Implement the route aggregation in this practice.
  - Is there any possible to make route aggregation? which subnet could be aggregated, where should the route aggregation be configured?



- Step3 : configure the PC0 and R3 to make PC0 reachable in the network(option):
  - after aggregation on Step2, is it possible to make PC0 reachable from other PCs while not changing the route-table which be configured with route aggregation?