CS 305 Lab Tutorial
Lab11 Routing

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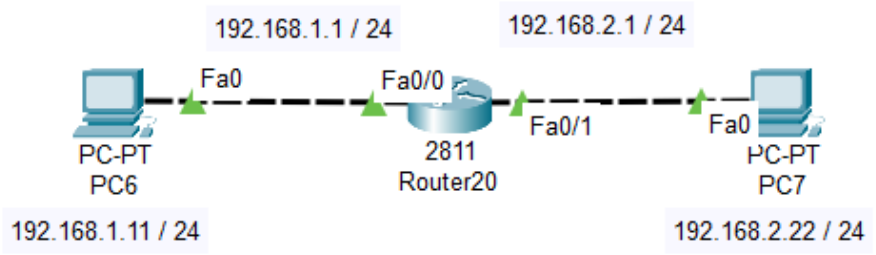
Topic

- Subnet, Gateway
- Routing 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 and 192.168.1.11 belongs to the same sub-net?
A: Yes

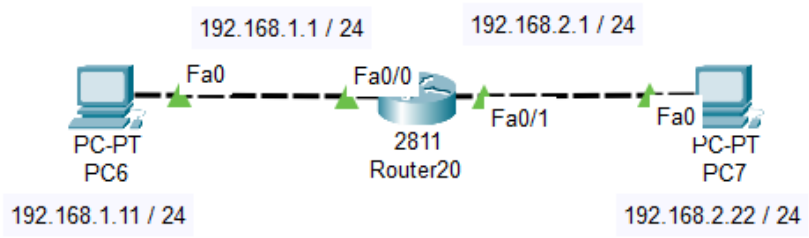
Q: Does 192.168.2.22 and 192.168.1.11 belongs to the same sub-net?

A: NO

Q: How to make PC7 reachable from PC6?

A: Using router to forward the IP packets from different subnets.

Gateway



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

PC6

1

Physical Config Desktop Programming Attributes

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
```

PC7

2

Physical Config Desktop Programming Attributes

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
```

PC6

3

Physical Config Desktop Programming Attributes

Command Prompt

```
C:\>ipconfig

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
```

PC7

4

Physical Config Desktop Programming Attributes

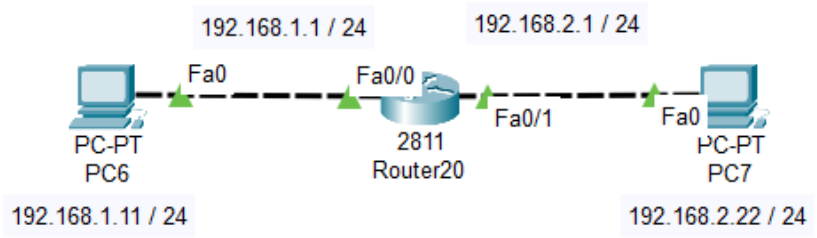
Command Prompt

```
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)



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

Router20

Physical Config CLI Attributes

IOS Command Line Interface

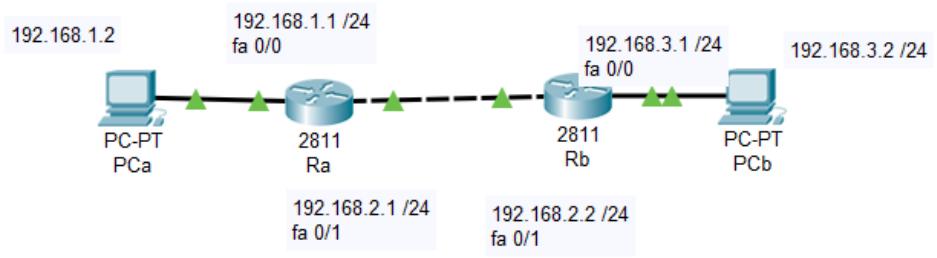
```
Router>en
Router#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external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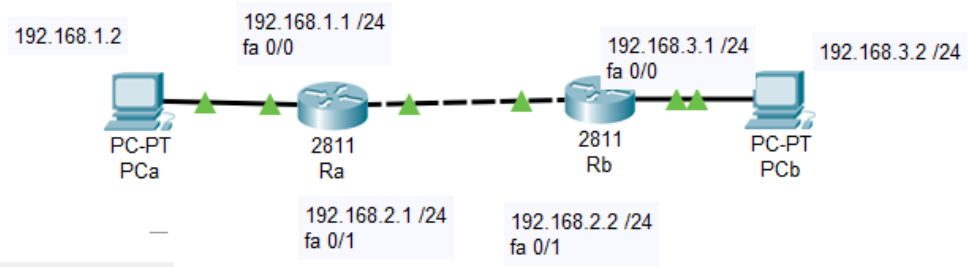

Static Route(1)



Rb

Physical Config CLI Attributes

IOS Command Line Interface

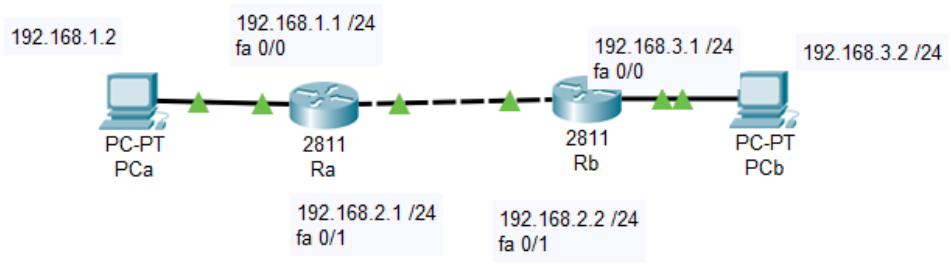
```
Enter configuration commands, one per line.  End with CNTL/Z.
Rb(config)#ip ro
Rb(config)#ip route ?
  A.B.C.D  Destination prefix
Rb(config)#ip route 192.168.1.0 255.255.255.0 192.168.2.1
Rb(config)#exit
Rb#
%SYS-5-CONFIG_I: Configured from console by console

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
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter ar
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EG
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-I
       * - 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 ...

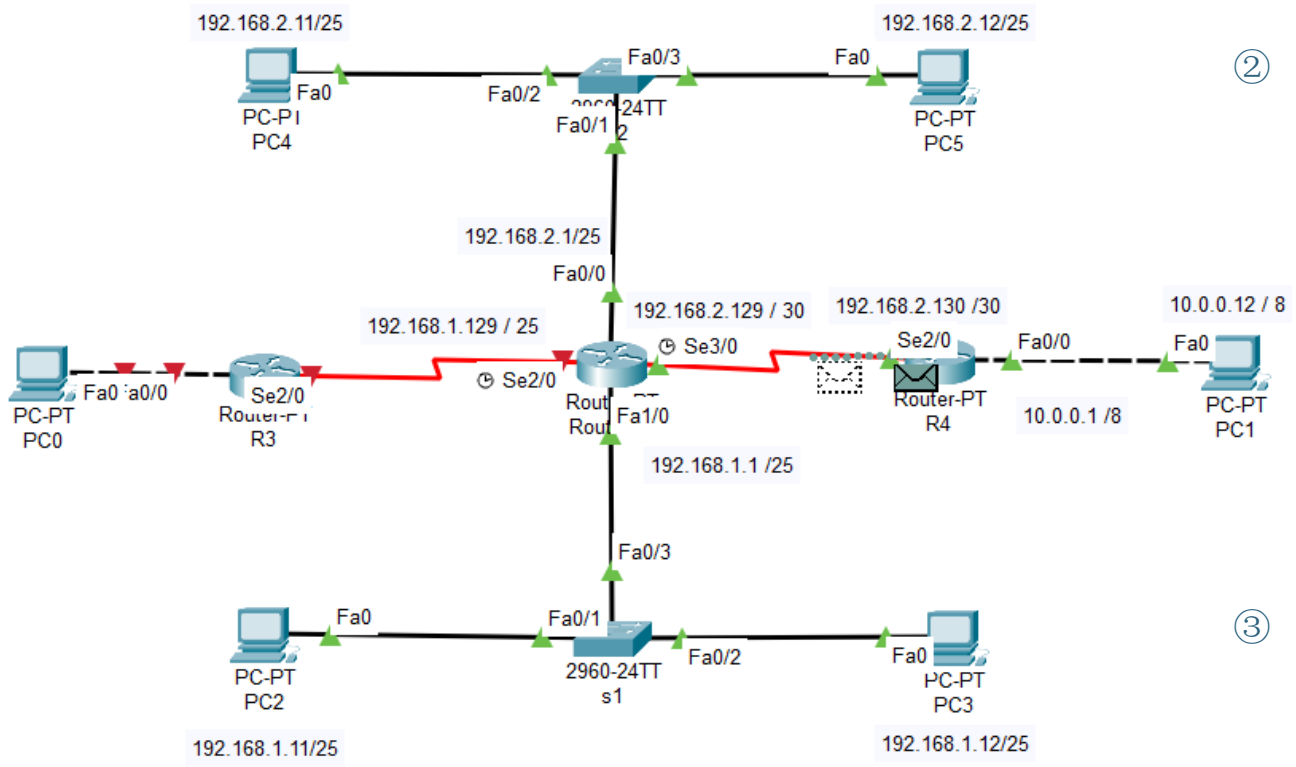
Make 4 subnets be aggregated to 1

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

- 172.16.**129**.0/24
  - 172.16.**1000_0001**.0 /24
- 172.16.**130**.0/24
  - 172.16.**1000_0010**.0 / 24
- 172.16.**132**.0/24
  - 172.16.**1000_0100**.0 / 24
- 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 subnet ID : 21bits (172.16.1000_0)
- Step2: using the bits get from step1 as hig bits of address, complete it with 0 as rest tobe 32bits width. After aggregation, the 4 subnet belongs to 1 subnet : **172.168.128.0 / 21**.

Practice



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; conncet its **serial interface** with other routers.
- configurations should include: interface, rout-table, make route-table as smaller as possible

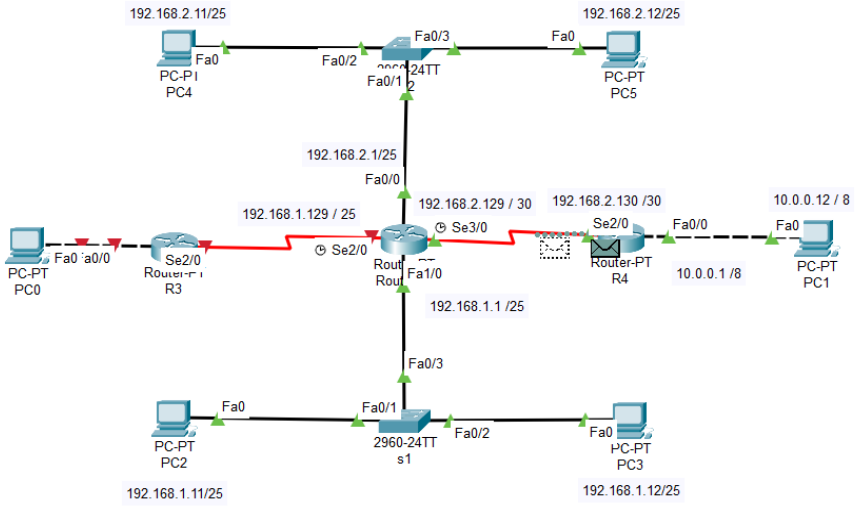
③ 6 **PCs**

- configurations should include: static IP address, subnet Mask and ...

Finish the configuration, make all the PCs in the network reachable from eachother

Practice

- Step1: Finish the configuration to make all the PCs are reachable from each other:
  - How many subnet 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 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 is configured with route aggregation?