

Basic Study for Routing

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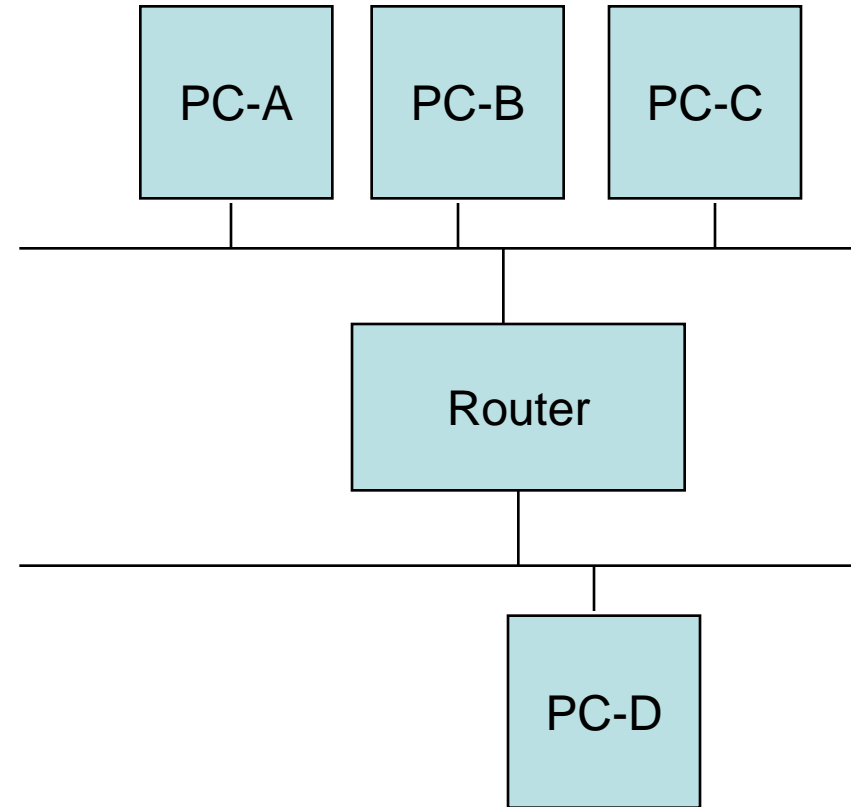
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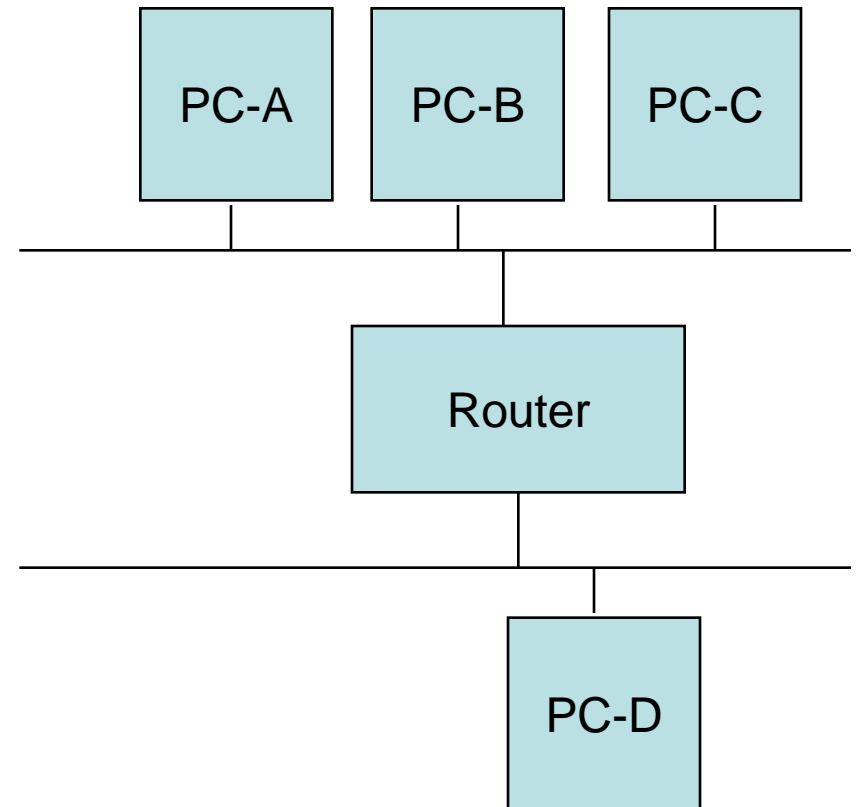
Identifier of destination is necessary for Communication (1)

- PC-A, B and C can communicate with each other directly without Router.
- PC-A, B and C use MAC address to identify each other.



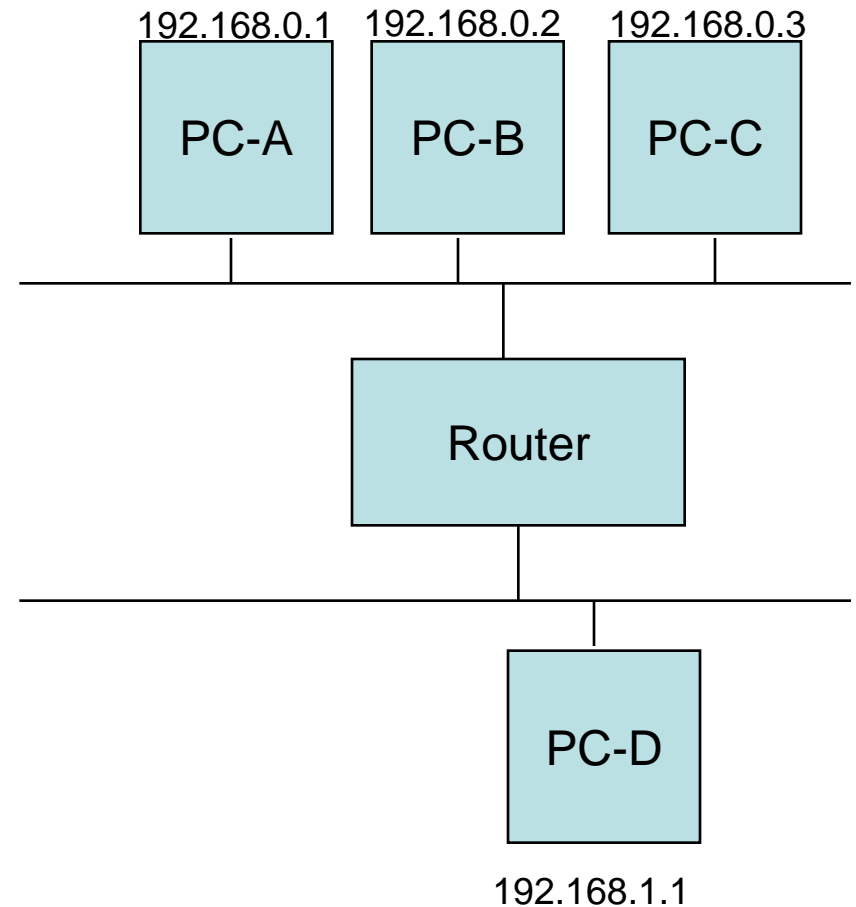
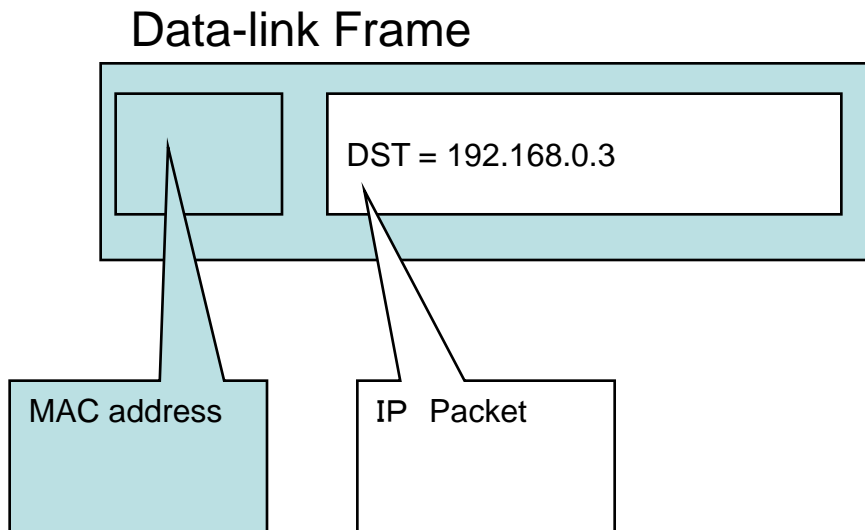
Identifier of destination is necessary for Communication (2)

- PC-A and D need Router to communicate each other.
- PC-A and D should know each address to communicate.



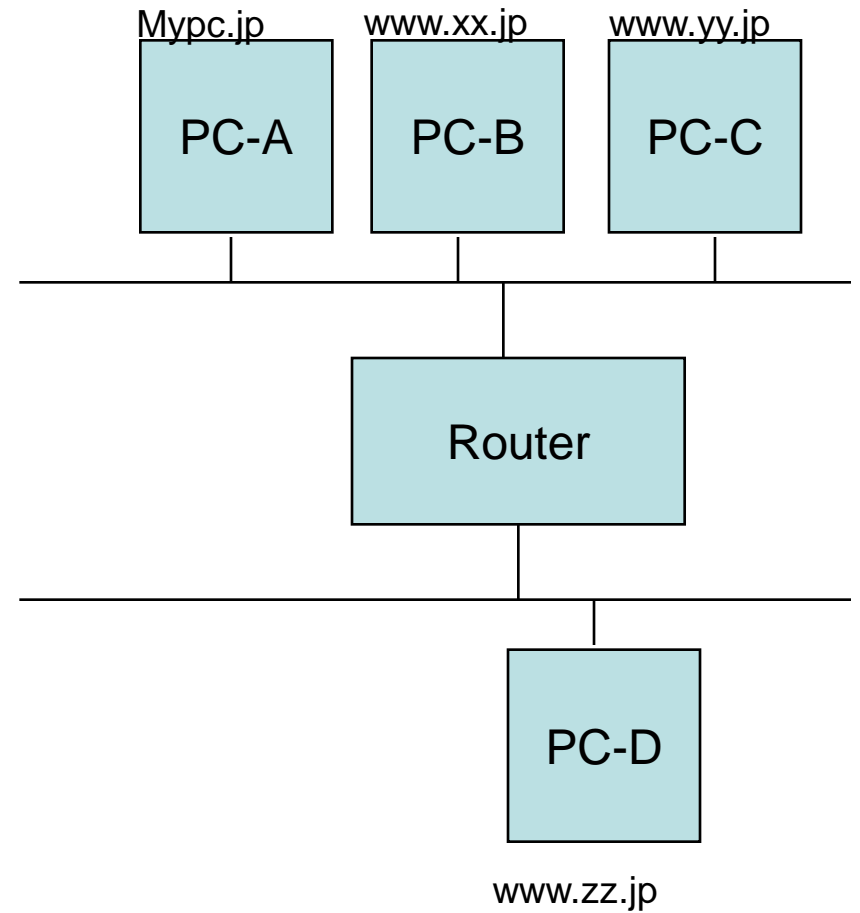
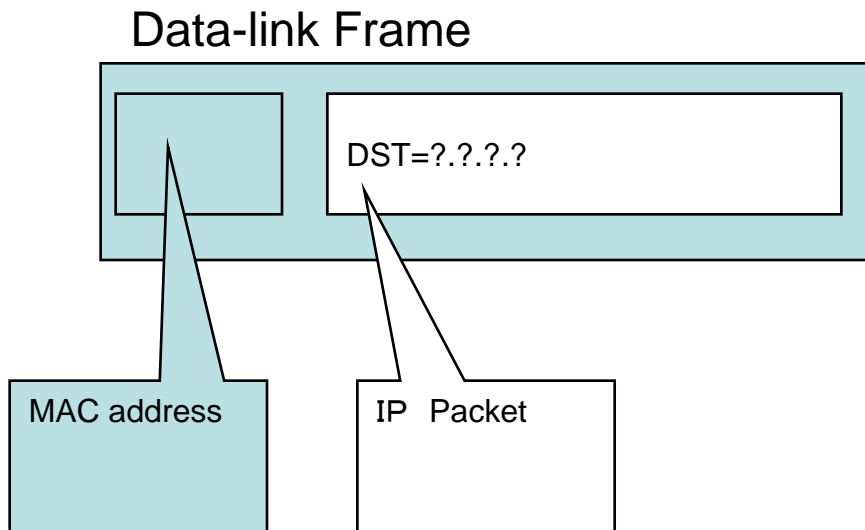
Identifier of destination is necessary for Communication (3)

L3: IP address is necessary.
L2: MAC address is necessary.



Identifier of destination is necessary for Communication (4)

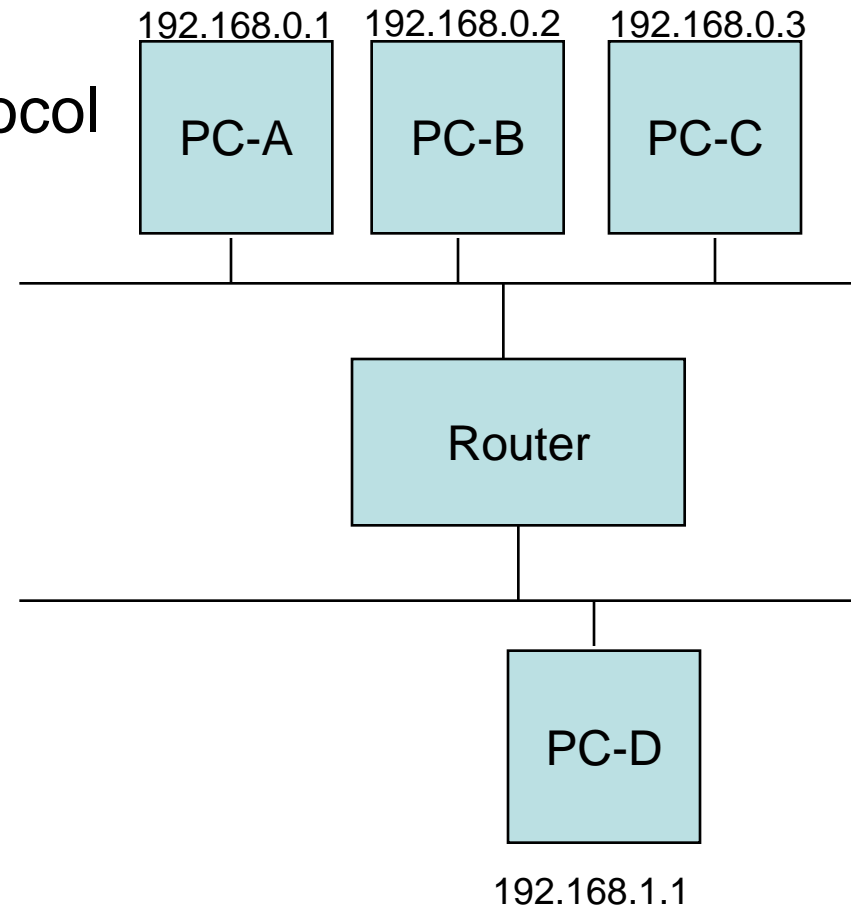
If IP address of destination is un-known,
How to specify IP address?



ARP: MAC address can be gotten from IP address

ARP: Address Resolution Protocol

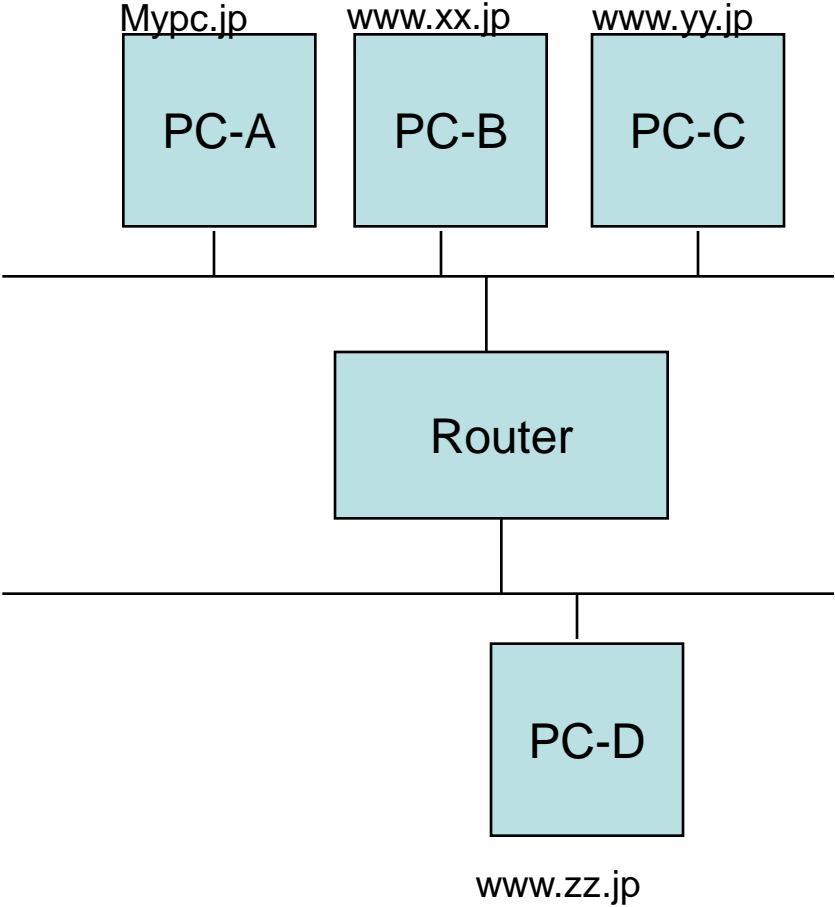
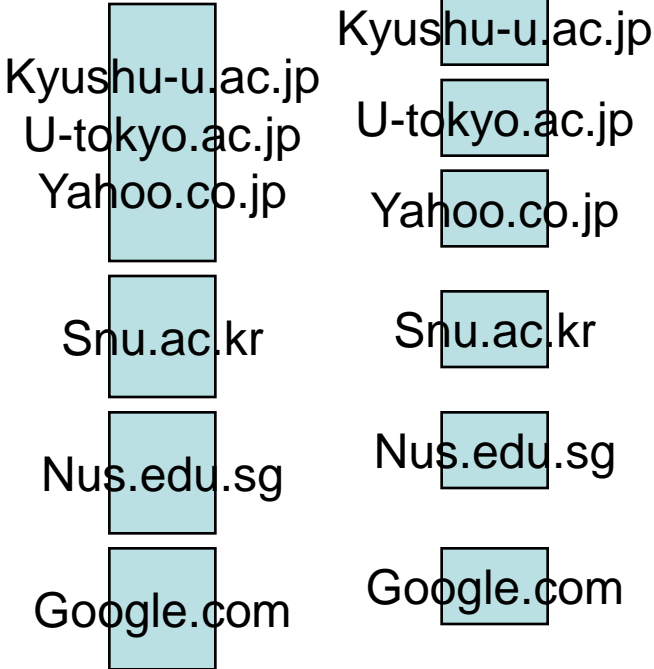
- PC-A sends query for MAC address for PC-C by broadcast.
- PC-C returns the answer by unicast.
- PC-A can know PC-C's MAC address from the reply.
- PC-A can specify PC-C's MAC address for communication.



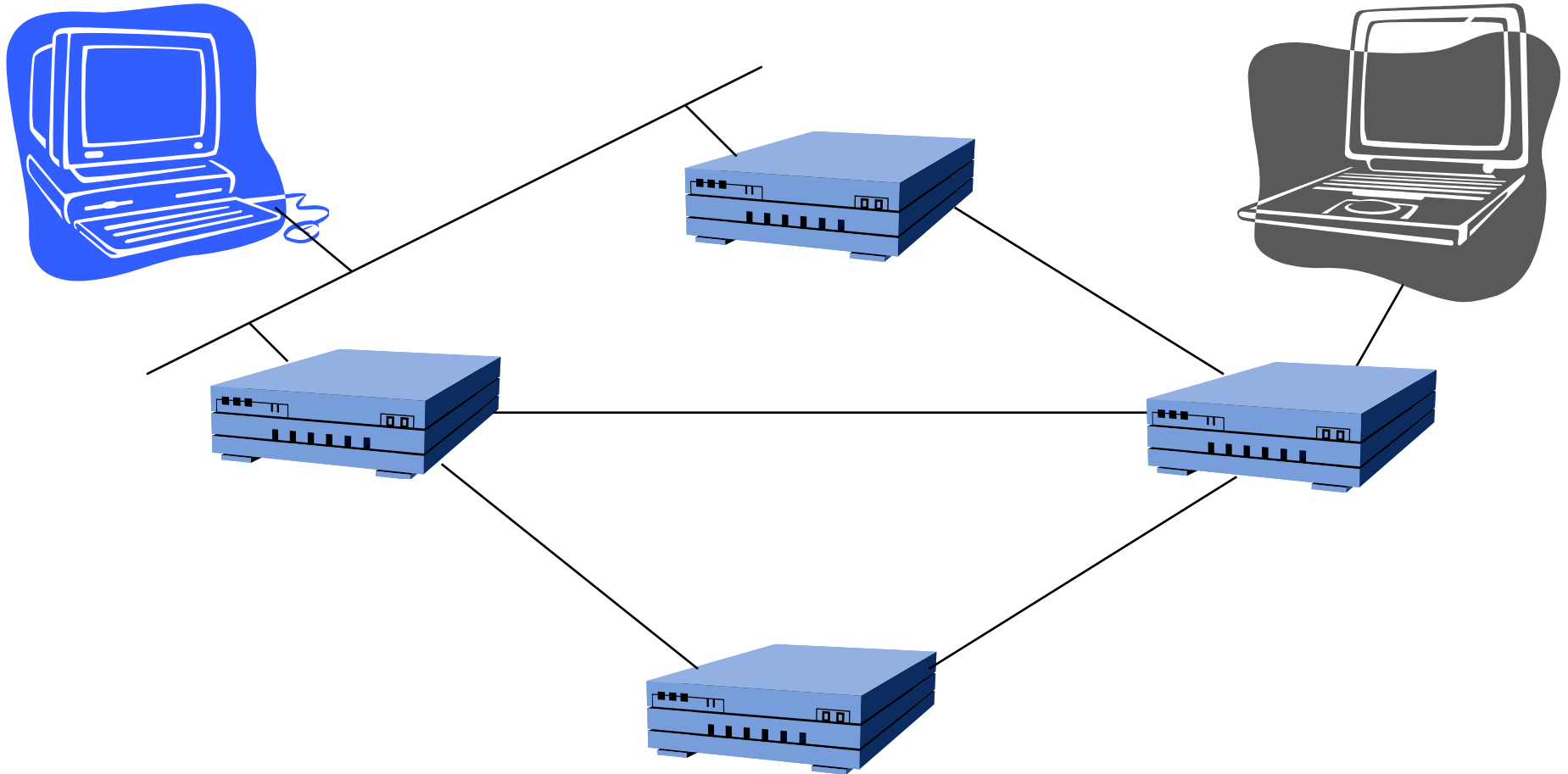
DNS: Domain Name System

- www.cc.kyushu-u.ac.jp
- www.csce.kyushu-u.ac.jp
- www.u-tokyo.ac.jp
- www.snu.ac.kr
- www.nus.edu.sg
- www.yahoo.co.jp
- www.google.com

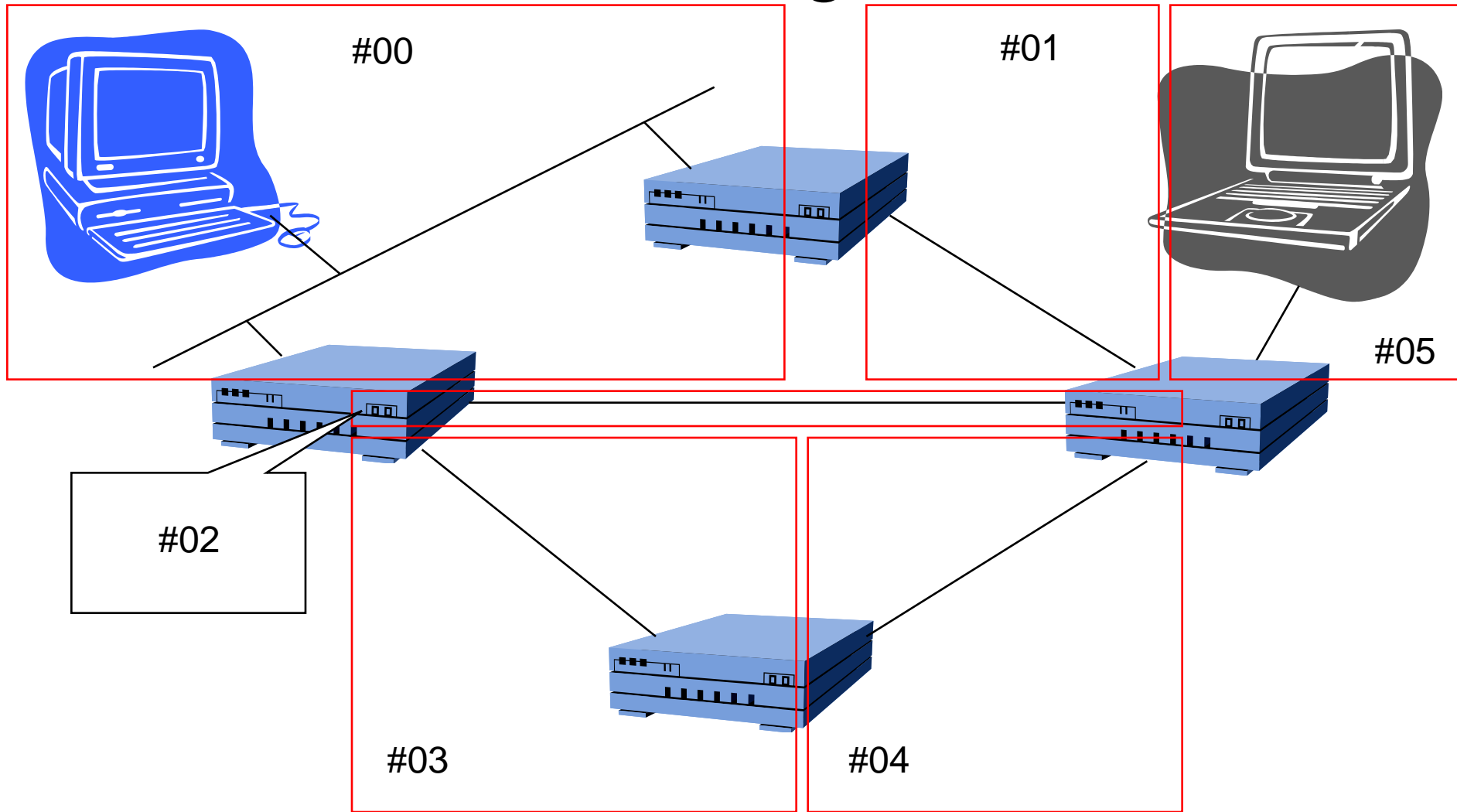
このサーバのIPアドレスだけは既知である。



Addressing of IP

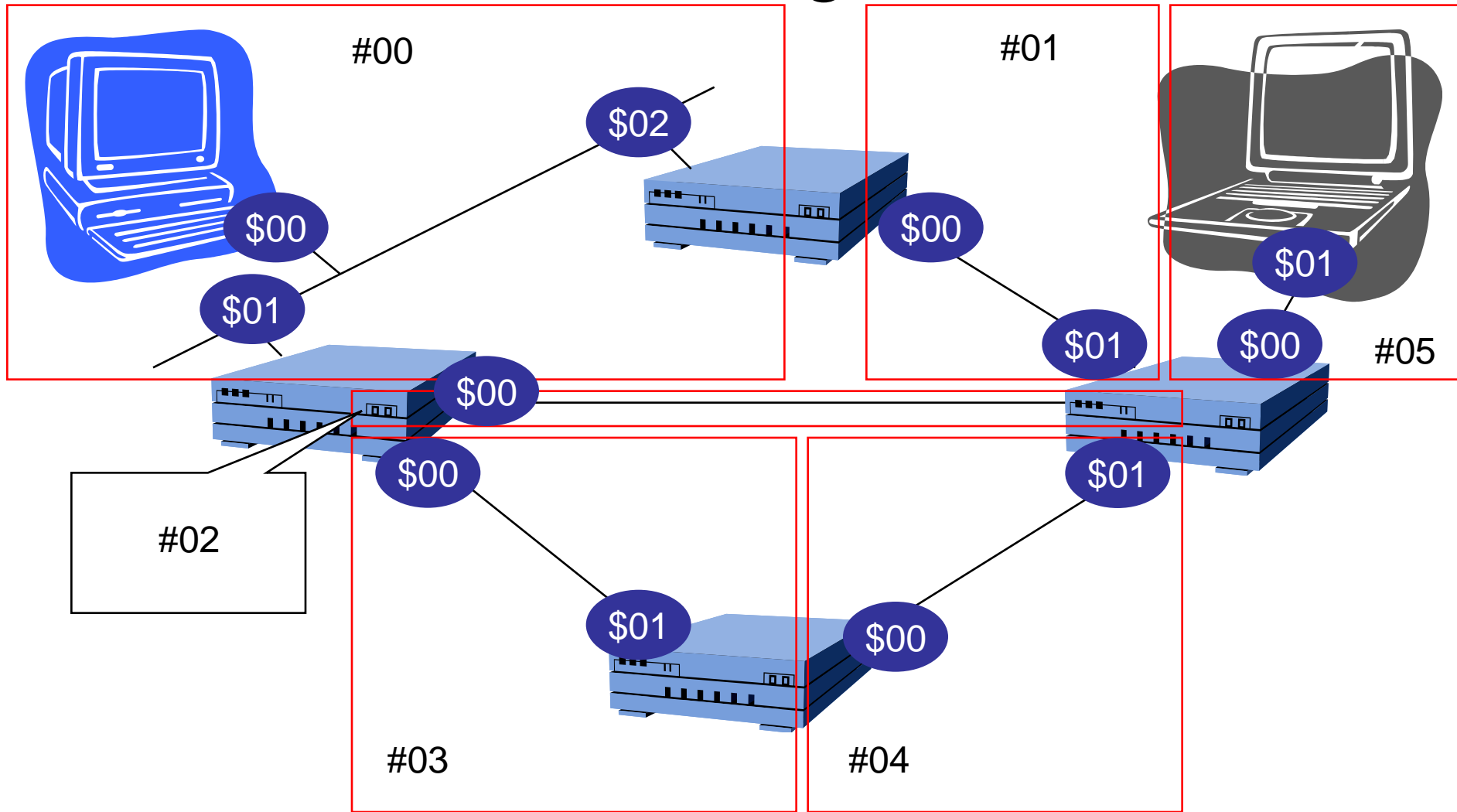


Addressing of IP



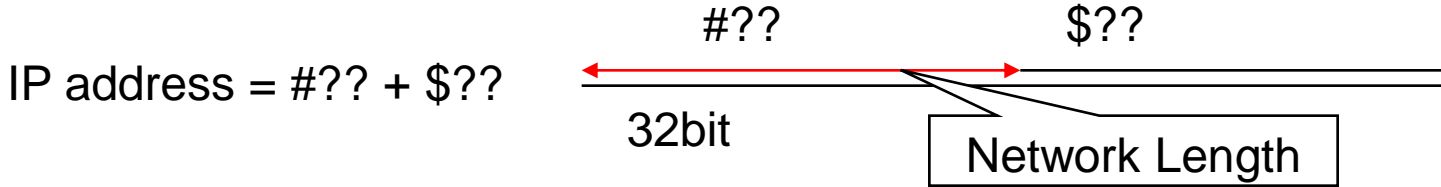
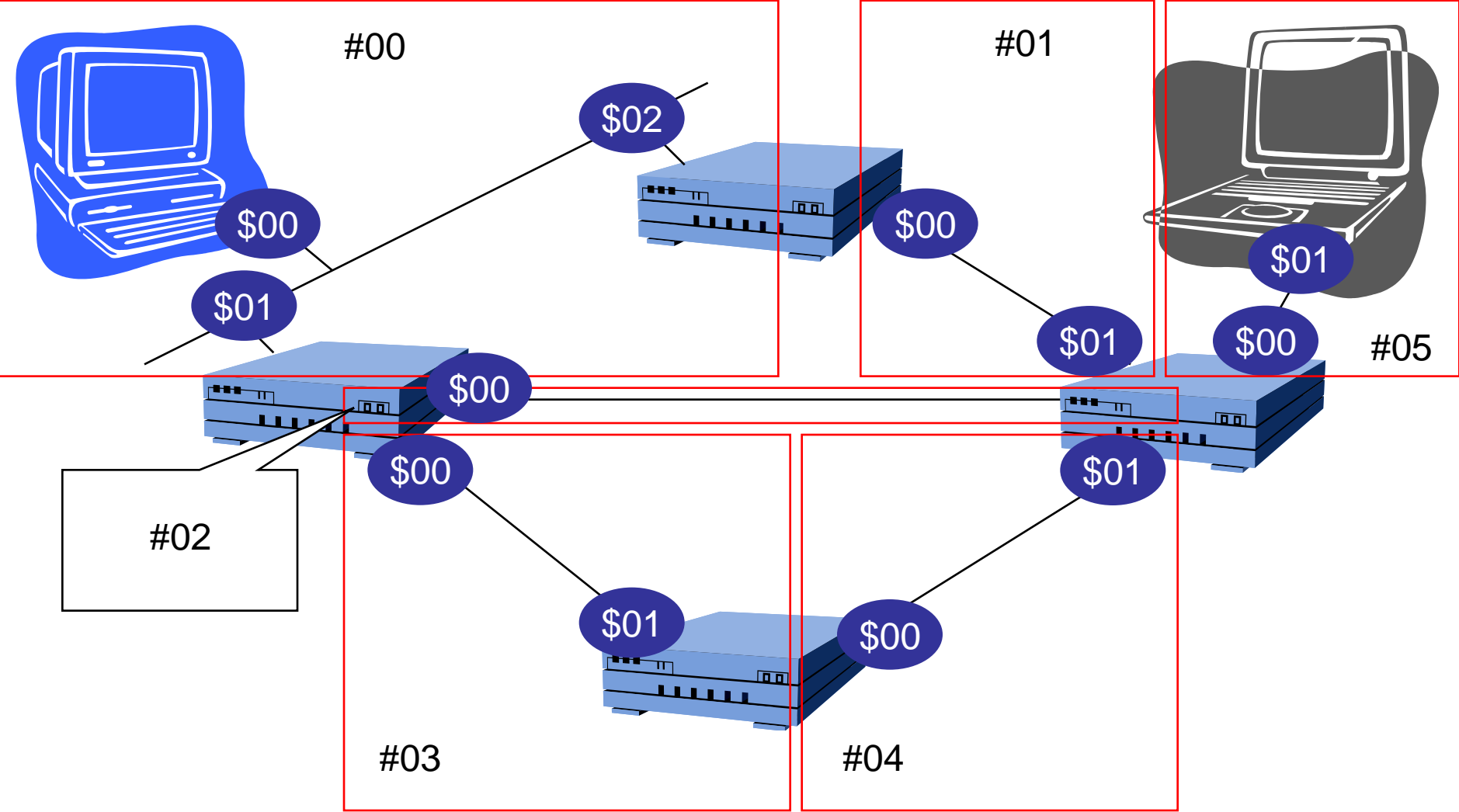
#00~#05: Network Address, which should be unique on the global network.

Addressing of IP



\$00~\$05: Host Address, which should be unique in intranet.

Addressing of IP



Class A,B,C

Class A

0	1000000	101010000000	101000100001
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Class B

1	0000000	10101000	0000101000100001
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Class C

1	1000000	101010000000	101000100001
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Class A

Class A

0	10000000	1010100000000101000100001
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- Network Address
 - 1.0.0.0 – 127.0.0.0
- Host Address
 - 1.0.0.1 – 1.255.255.254

Class B

Class B

1000000010101000	0000101000100001
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- Network Address

 - 128.0.0.0 – 191.255.0.0

- Host Address

 - 128.0.0.1 – 128.0.255.254

Class C

Class C

110000001010100000001010000100001

- Network Address

 - 192.0.0.0 – 223.255.255.0

- Host Address

 - 192.0.0.1 – 192.0.0.254

Classless

(Classless Inter-Domain Routing:CIDR)

Class C

110000001010100000001010	000100001
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Classless

1100000010101000000010	1000100001
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192.168.10.33/22

Class D(for Multicast)

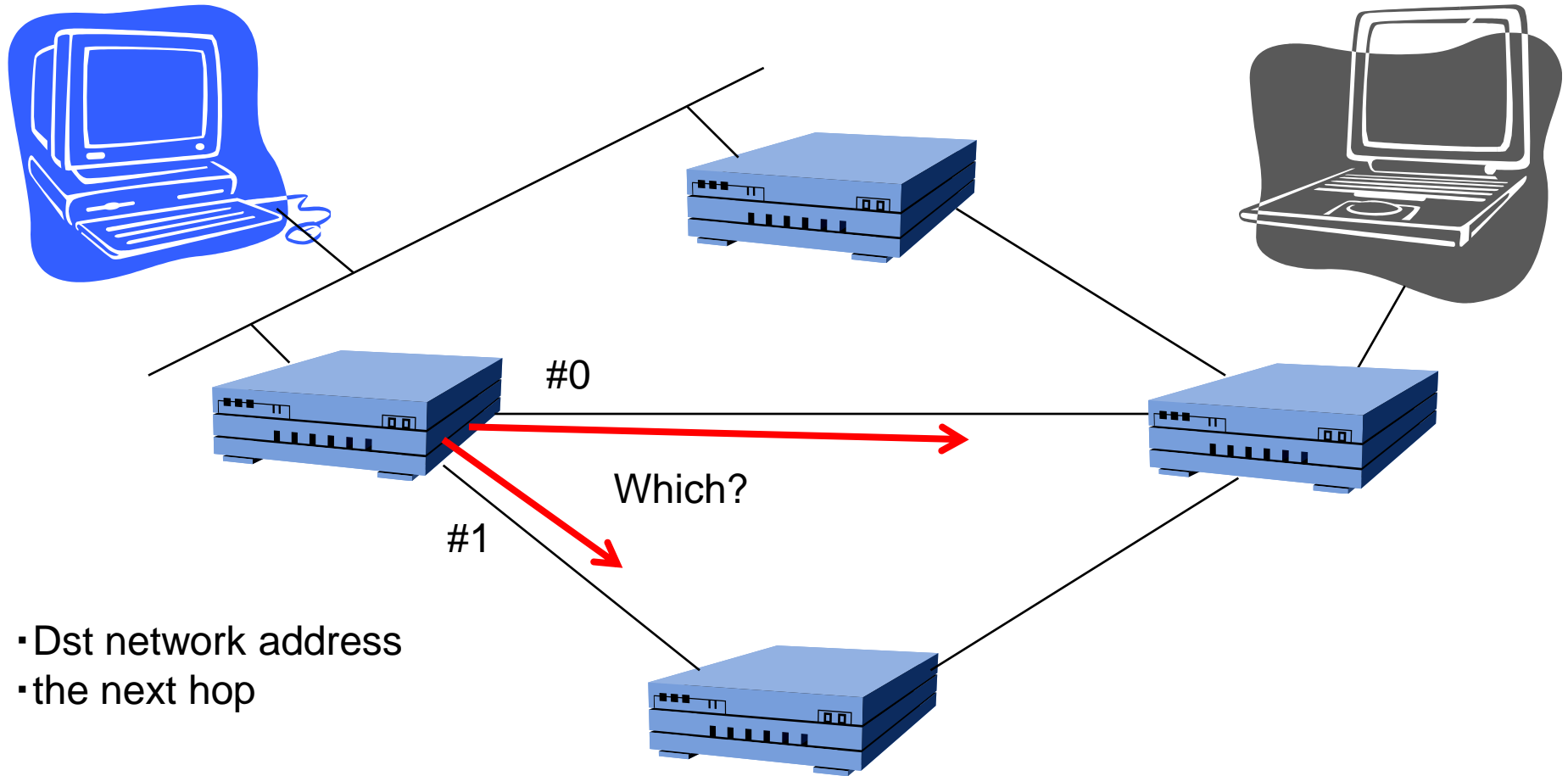
Class D

11100000101010000000101000100001

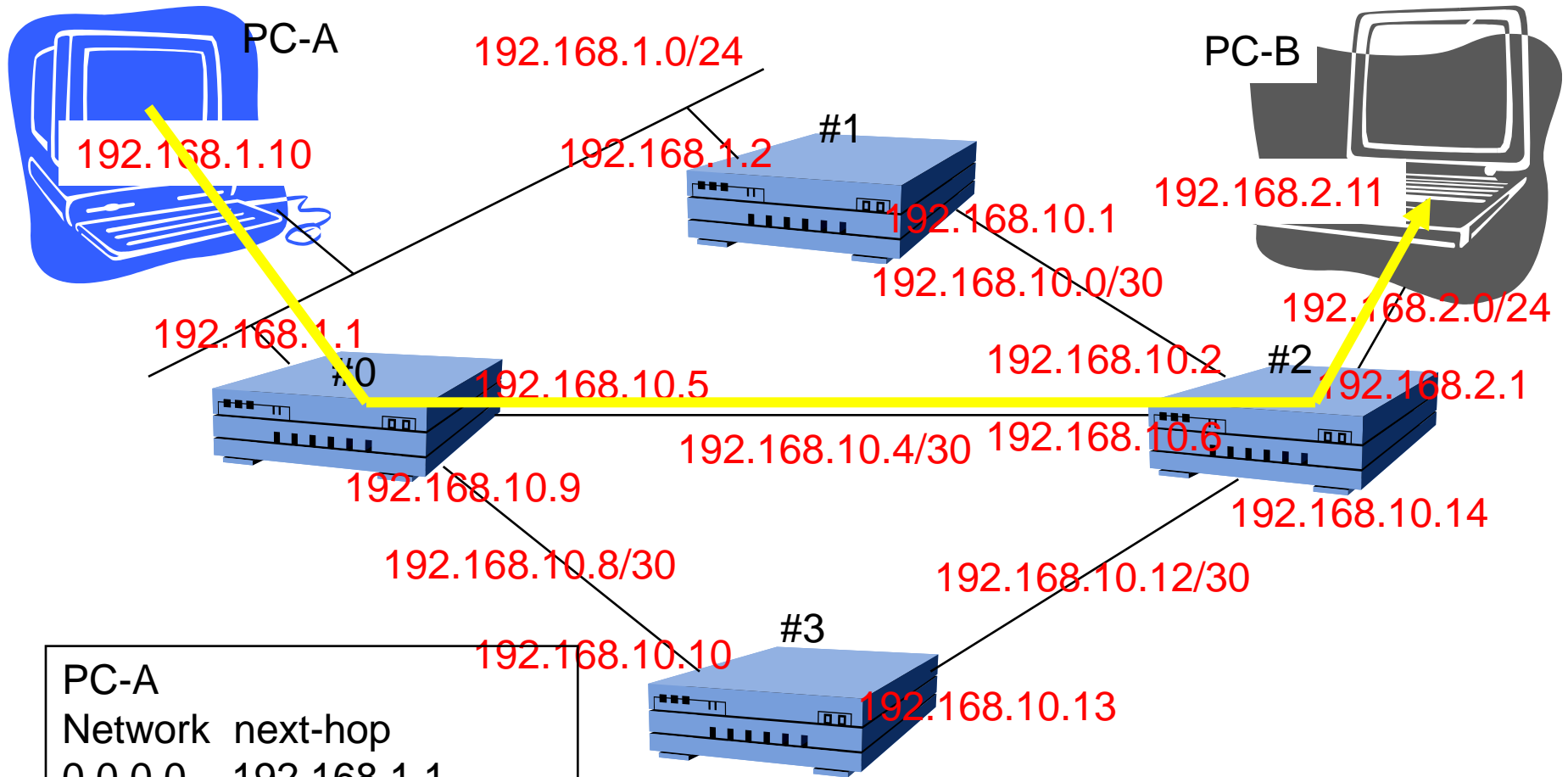
- Network Address

- 224.0.0.0 – 239.255.255.255

Routing

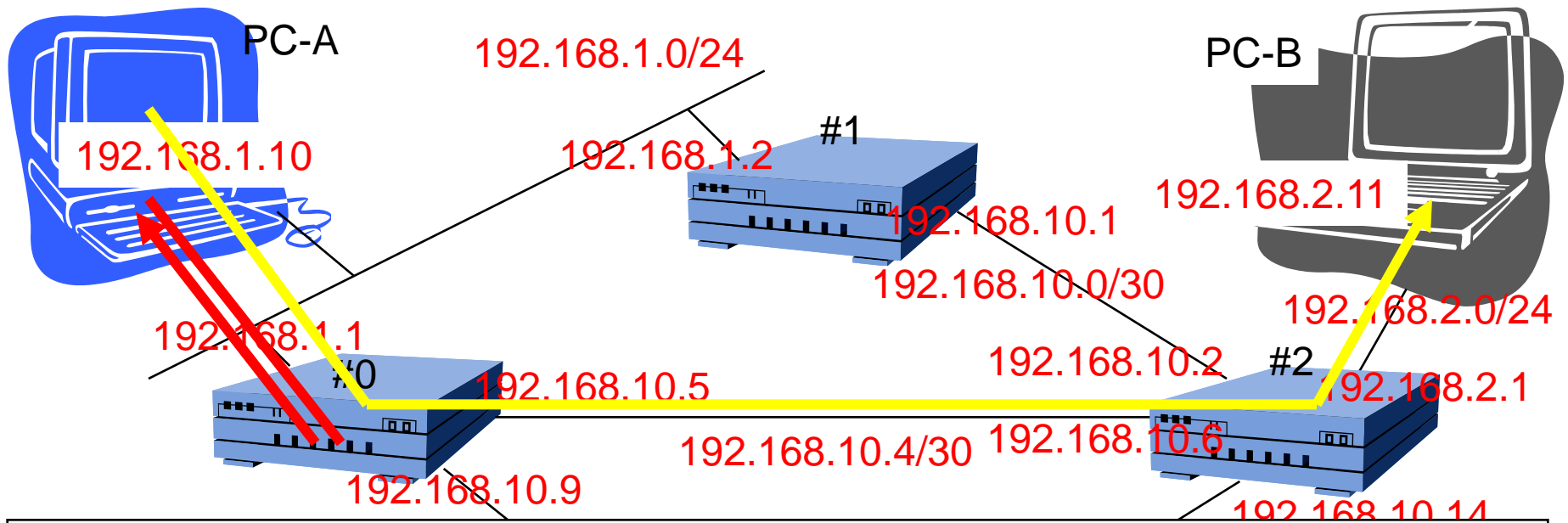


- Dst network address
- the next hop



PC-A	
Network	next-hop
0.0.0.0	192.168.1.1
192.168.2.0/24	192.168.1.1

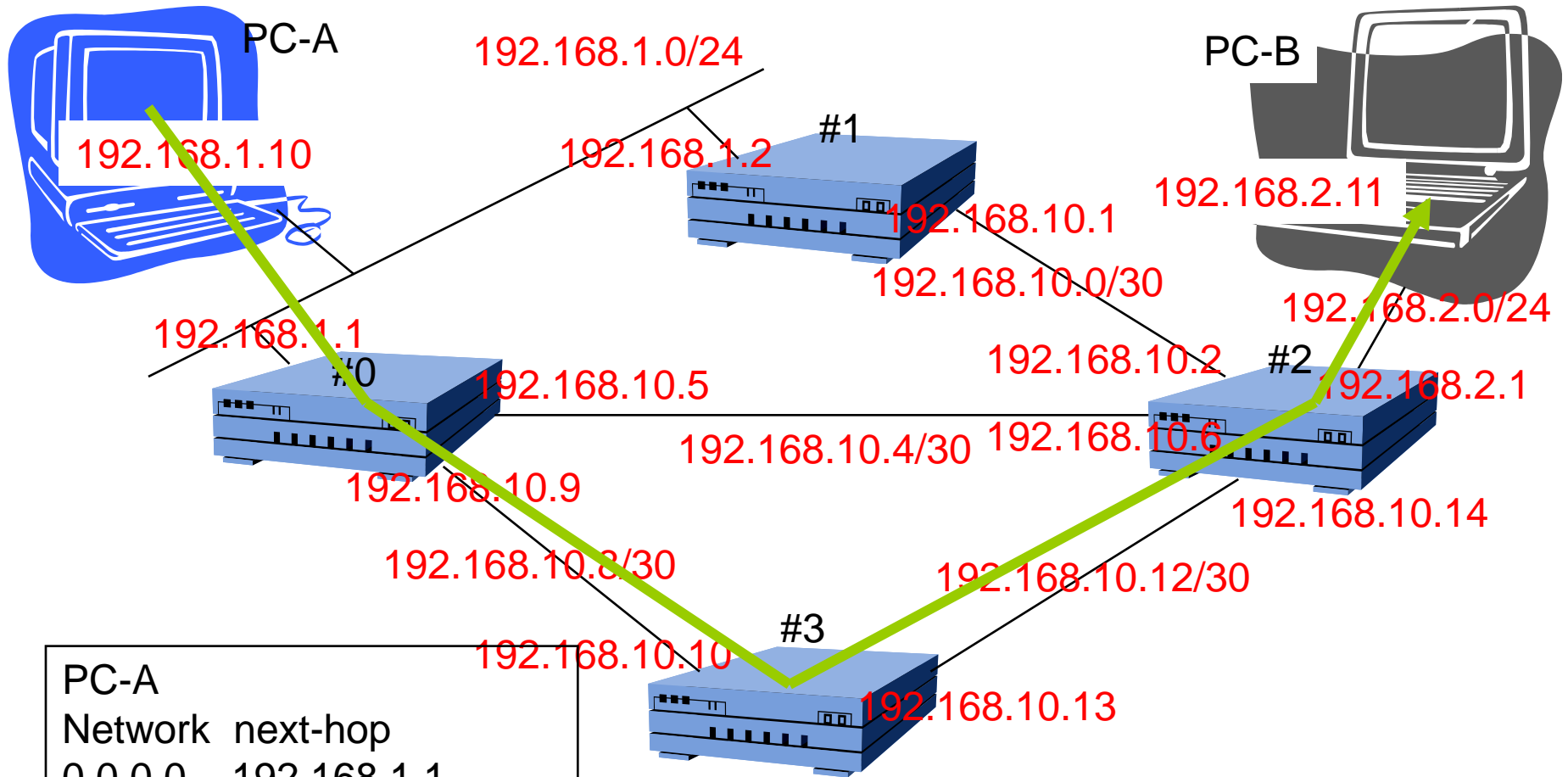
#0	
Network	next-hop
192.168.2.0/24	192.168.10.6
192.168.2.0/24	192.168.10.2



ICMP (Internet Control Management Protocol)
 Echo Reply
 TTL

How to investigate the Routers between 192.168.1.10 and 192.168.2.11

1. Set TTL=254 and send Echo to 192.168.2.11.
2. Router#0 : because TTL becomes 255, stop relay and return error to sender.
3. 192.168.1.10 can know IP address of Router#0.
4. Set TTL=253...

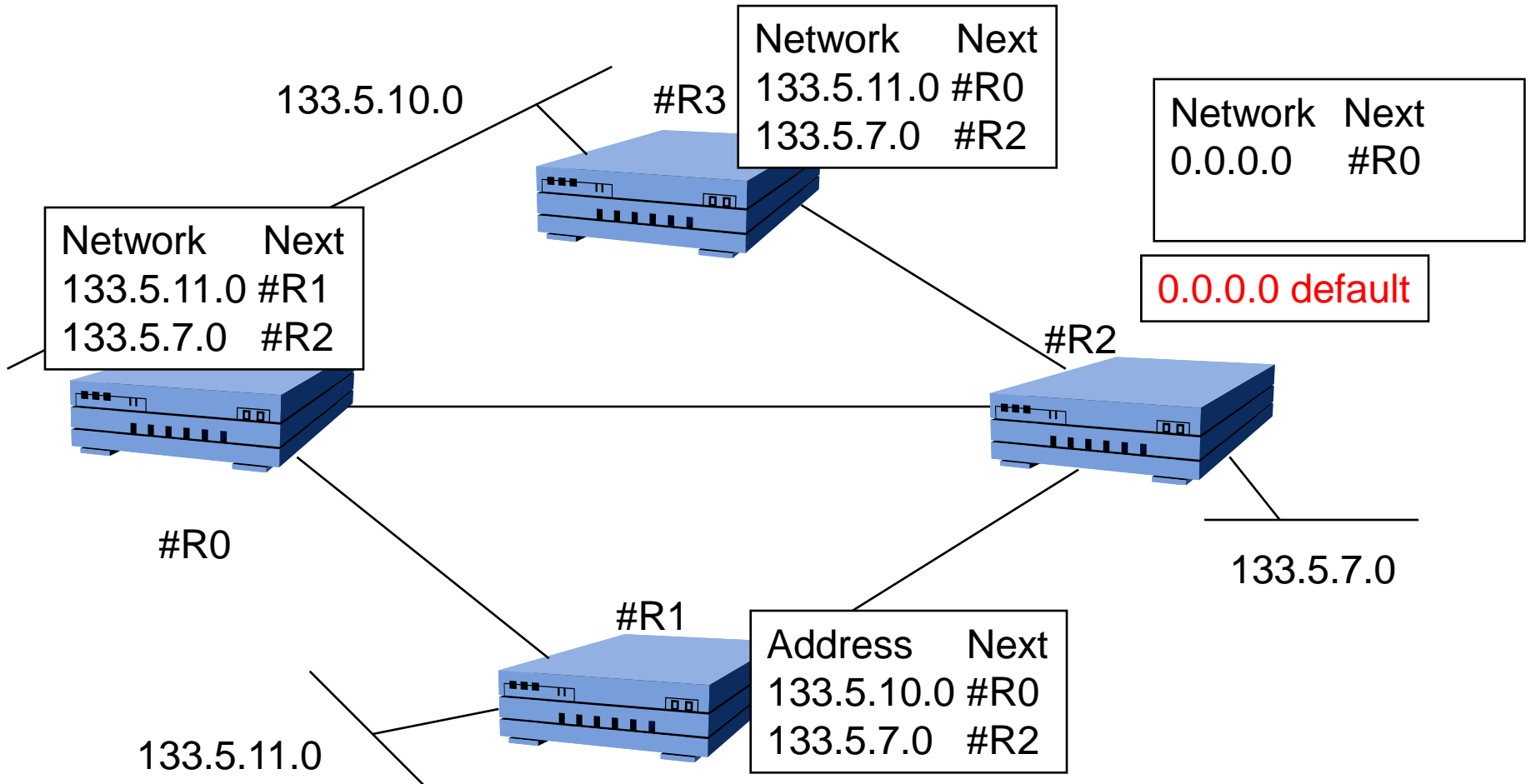


PC-A	
Network	next-hop
0.0.0.0	192.168.1.1
192.168.2.0/24	192.168.1.1

#0	
Network	next-hop
192.168.2.0/24	192.168.10.10

#3	
Network	next-hop
192.168.2.0/24	192.168.10.14

Routing Table



Static and Dynamic

- Static Routing
 - Routing Table is undated by hand.
 - Stable (or Never Change)
 - No Traffic for Routing Protocol
- Dynamic Routing
 - Routing Table is undated automatically.
 - Can adapt to changing of the network statues
 - Can find optimal route
 - Can use the back-up link

Routing Protocol for Dynamic Routing

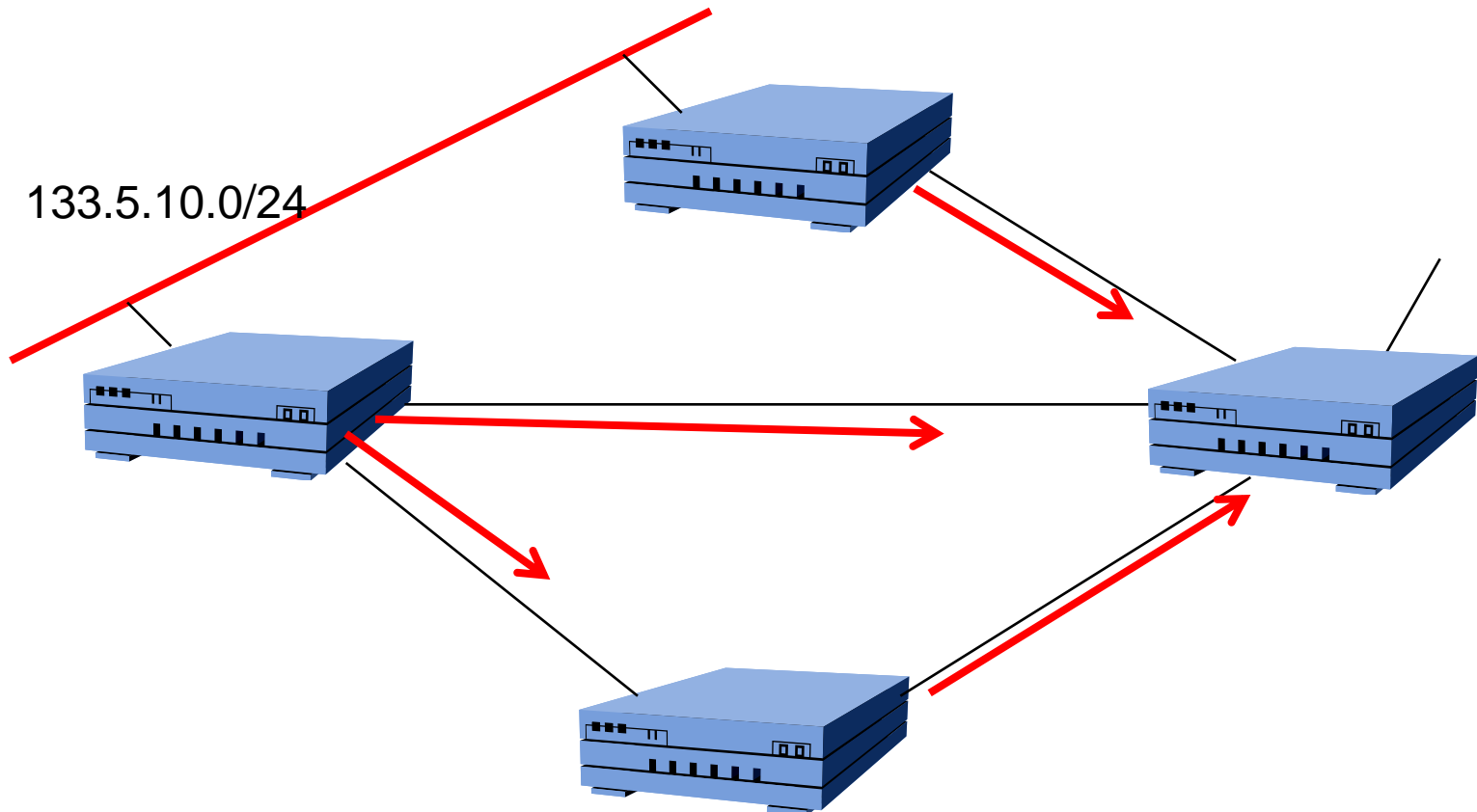
- Routing should be changed as the changing of the network.
 - Too much for hand or hands
- Optimal Routing Path
 - Too complicate for human
- Automatic Back up
 - Too difficult for human

Routing Protocol

- AS (Autonomous System)
 - Is operated autonomous in the organization.
 - 16bit
- IGP (Interior Gateway Protocol)
 - Routing Control inside AS
 - Routing Protocol for small network
 - RIP, OSPF
- EGP (Exterior Gateway Protocol)
 - Routing Control among AS
 - Routing Protocol for big network
 - BGP

Basic Routing Protocol

- Routing: Network address is distributed by announcement from the original.



AS, IGP, EGP

- Automatic Routing table update
 - The update is noticed to network
 - Many packets by the notification may consume the network
- Because there are not so many networks inside AS, the traffic is no problem.
 - IGP
- Because the number of whole network included inside AS might be huge, the traffic should be problem.
 - EGP

AS と EGP

- AS (Autonomous System)
 - Unit of Policy
- EGP (Exterior Gateway Protocol)
 - Routing by the Policy among AS
 - AS can select the preferable Routing Path.
 - AS can control the transit traffic.

Sample of the Routing by Policy

