



Static Routing & Dynamic Routing Protocol

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Routing Concepts

Functions of a Router

Connect Devices

Initial Configuration of a Router

Routing Decisions

Routing Operation

The Routing Table

Static Routing

Static Routing Implementation

Configure Static and Default Routes

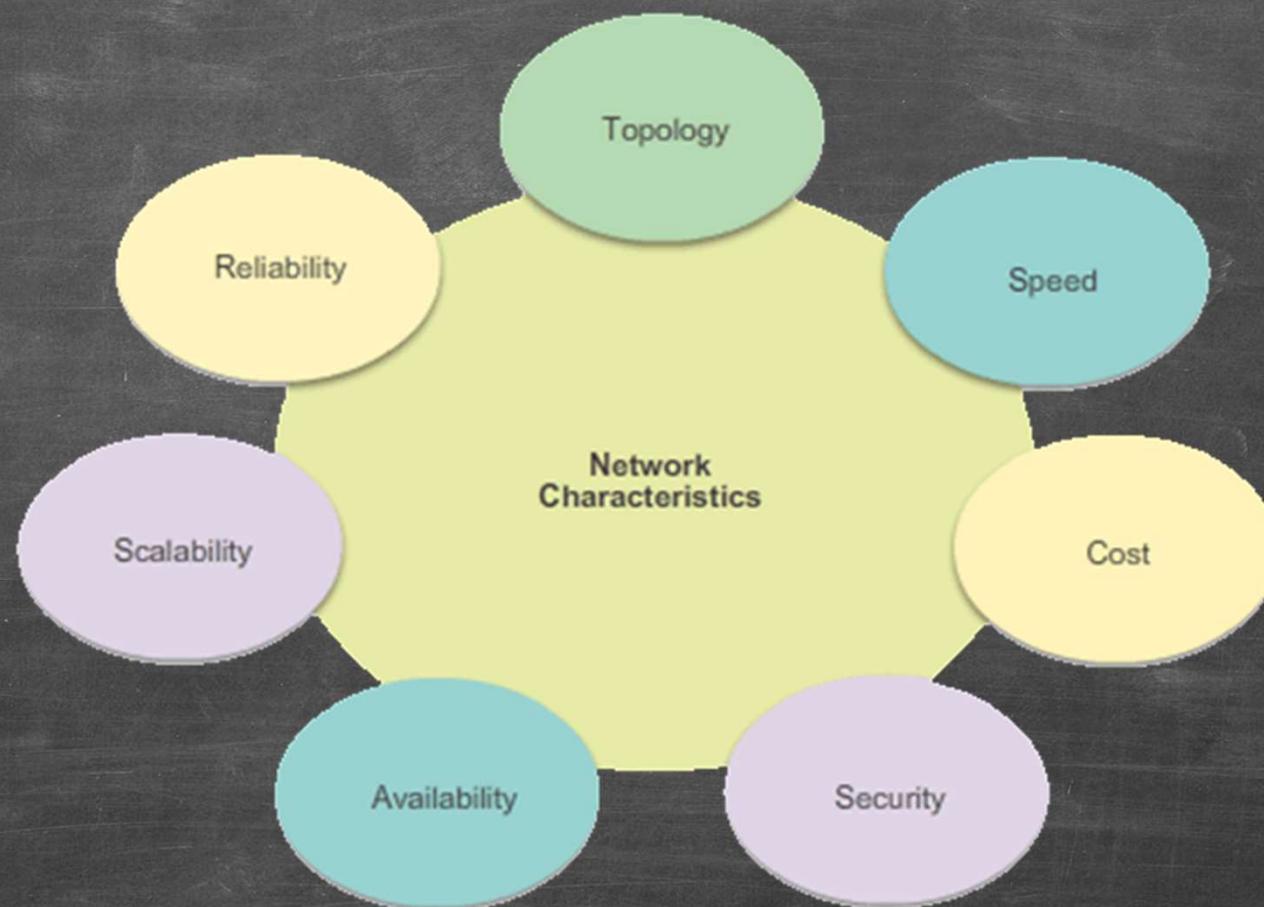
Review of CIDR and VLSM

Summary and Floating Static Routes

Troubleshoot Static and Default Route Issues

Functions of a Router

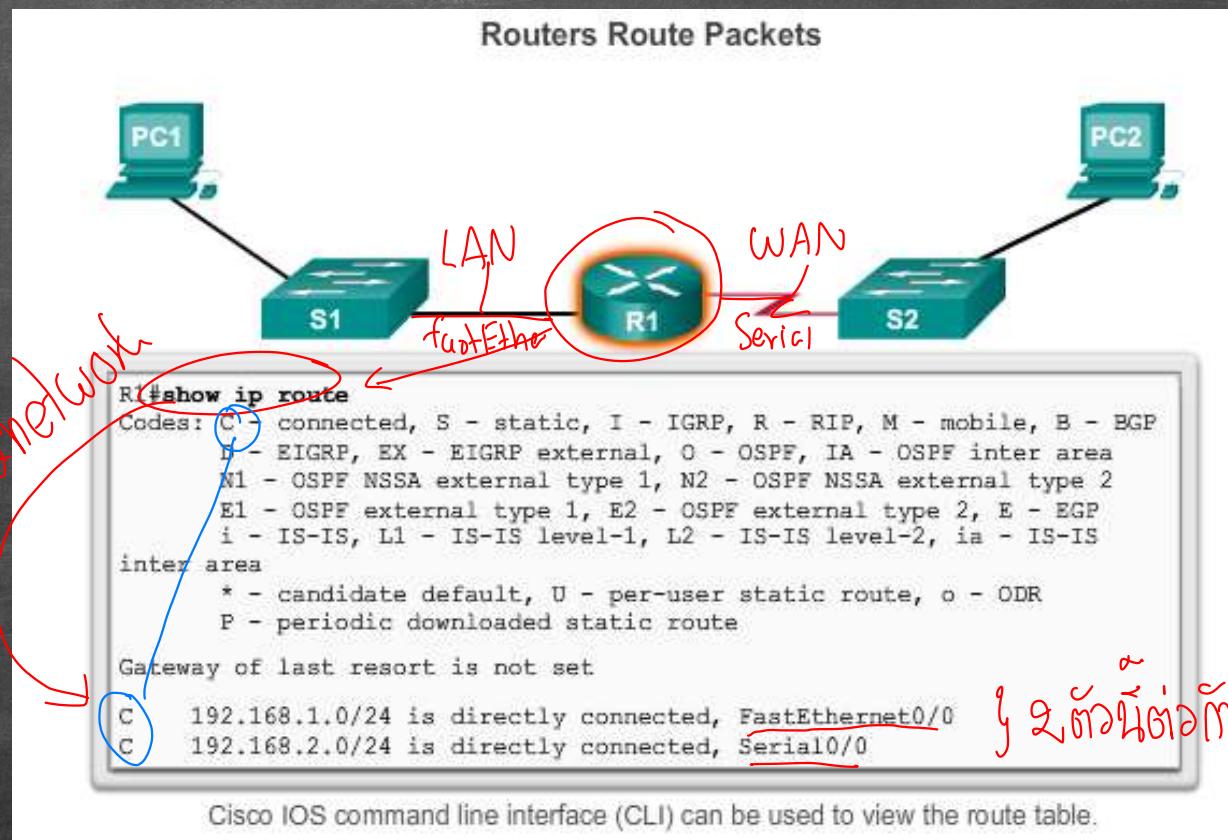
- Characteristics of a Network



Functions of a Router

କୁଳାଙ୍ଗରାଜରାଜ୍ୟ

- Why Routing?
 - The router is responsible for the routing of traffic between networks.



Functions of a Router

- Routers are Computers → ဧທ່າງດີເຊັນໄວ້ຮູ້ອະນຸຍິ່ງ

ກ່າວຍໍາມະນຸຍາ

- Routers are specialized computers containing the following required components to operate:

- Central processing unit (CPU)
- Operating system (OS) - Routers use Cisco IOS
- Memory and storage (RAM, ROM, NVRAM, Flash, hard drive)

} component

- Routers utilize the following memory:

ios ມີເລືອດຕົວໃນຍ່

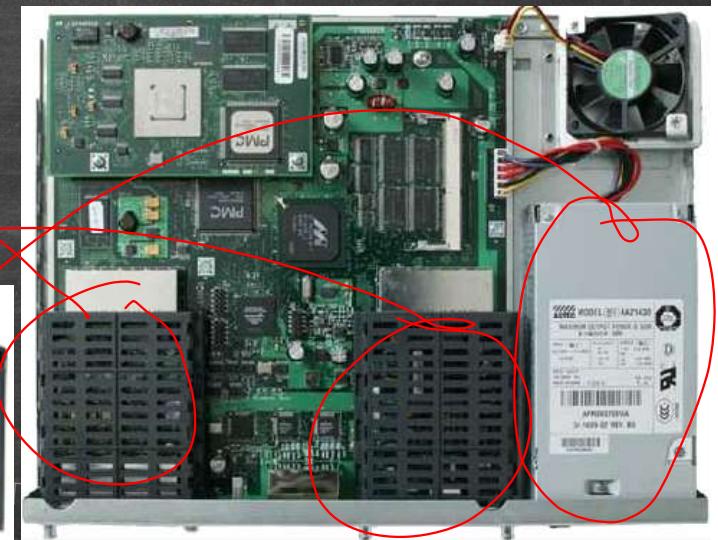
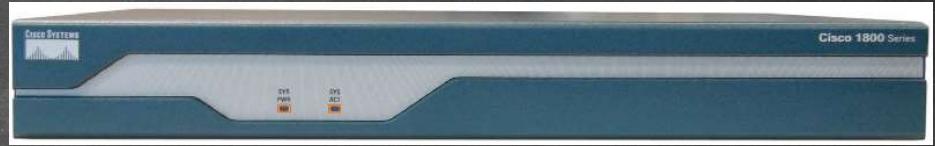
Memory	Volatile / Non-Volatile	Stores
RAM	Volatile	<ul style="list-style-type: none"> • Running IOS • Running configuration file • IP routing and ARP tables • Packet buffer
ROM	Non-Volatile	<ul style="list-style-type: none"> • Bootup instructions • Basic diagnostic software • Limited IOS
NVRAM	Non-Volatile	<ul style="list-style-type: none"> • Startup configuration file
Flash	Non-Volatile	<ul style="list-style-type: none"> • IOS • Other system files

instruction
ກໍາມົນດີ

} RAMemory ຕ້າງກຳນົດຈຳ

Functions of a Router

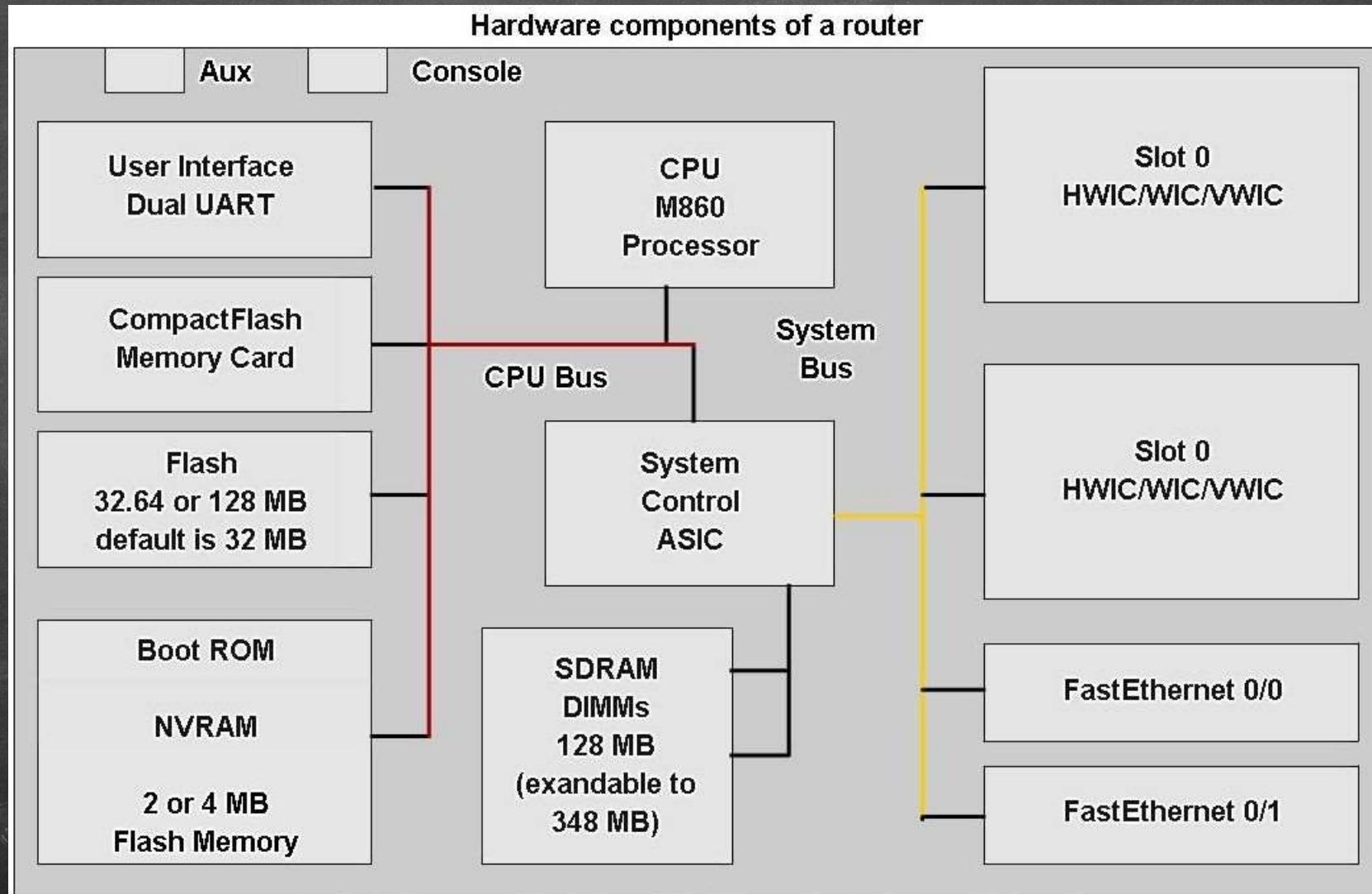
- Router components and their functions”
 - CPU - Executes operating system instructions
 - Random access memory (RAM) - Contains the running copy of configuration file. Stores routing table. RAM contents lost when power is off
 - Read-only memory (ROM) - Holds diagnostic software used when router is powered up. Stores the router's bootstrap program.
 - Non-volatile RAM (NVRAM) - Stores startup configuration. This may include IP addresses (Routing protocol, Hostname of router)
 - Flash memory - Contains the operating system (Cisco IOS)
 - Interfaces - There exist multiple physical interfaces that are used to connect network. Examples of interface types:
 - Ethernet / fast Ethernet interfaces
 - Serial interfaces
 - Management interfaces



Functions of a Router

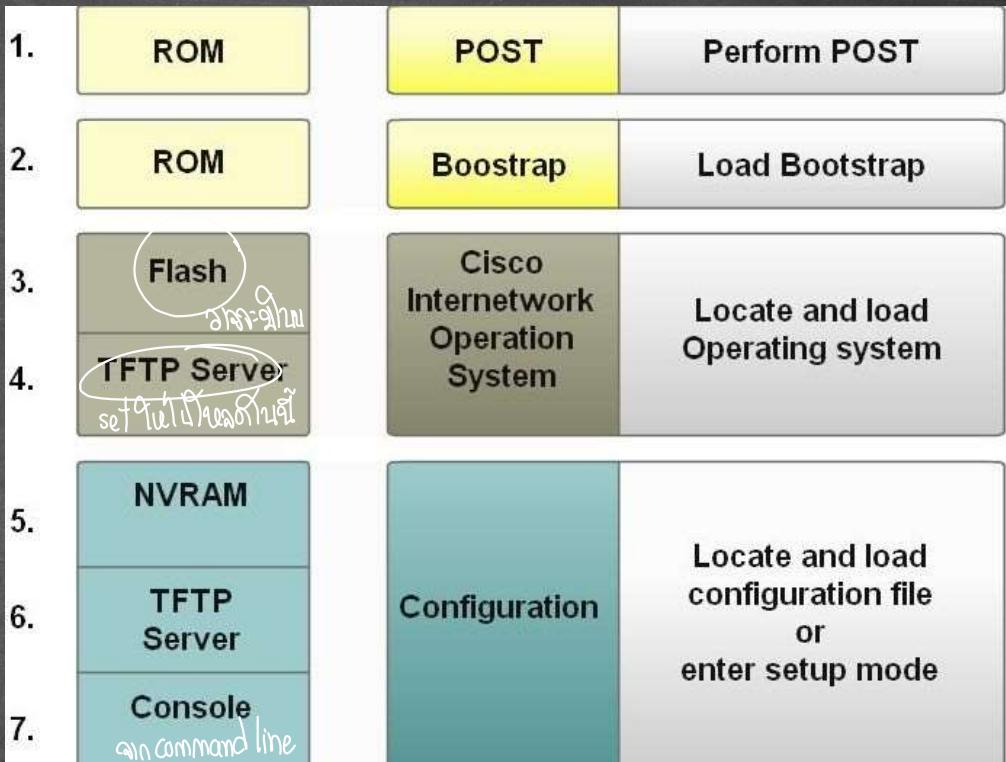
Router components

កំណត់របៀបទាំងភាព និងការងារ



Functions of a Router

- મનોજ કુમાર
- Router as a Computer
 - Major phases to the router boot-up process
 - Test router hardware
 - Power-On Self Test (POST)
 - Execute bootstrap loader
 - Locate & load Cisco IOS software
 - Locate IOS
 - Load IOS
 - Locate & load startup configuration file or enter setup mode
 - Bootstrap program looks for configuration file



```
System Bootstrap, Version 12.3(8r)T8, RELEASE SOFTWARE (fc1)
Cisco 1841 (revision 5.0) with 114688K/16384K bytes of memory.
```

```
Self decompressing the image :
===== [OK]
```

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```
--- System Configuration Dialog ---
```

```
Continue with configuration dialog? [yes/no]: no
```

Functions of a Router

```
Router#show version
Cisco Internetwork Operating System Software
IOS (tm) C2600 Software (C2600-I-M), Version 12.2(28), RELEASE SOFTWARE (fc5)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2005 by cisco Systems, Inc.
Compiled Wed 27-Apr-04 19:01 by miwang
Image text-base: 0x8000808C, data-base: 0x80A1FECC

Bootstrap version
ROM: System Bootstrap, Version 12.1(3z)T2, RELEASE SOFTWARE (fc1)
CDATA[Copyright (c) 2000 by cisco Systems, Inc.
ROM: C2600 Software (C2600-I-M), Version 12.2(28), RELEASE SOFTWARE (fc5)
System returned to ROM by reload
System image file is "flash:c2600-i-mz.122-28.bin"

Model and CPU
cisco 2621 (MPC860) processor (revision 0x200) with 60416K/5120K bytes of memory.

Amount of RAM
Processor board ID JAD05190MTZ (4292891495)
M860 processor: part number 0, mask 49
Bridging software.
X.25 software, Version 3.0.0.

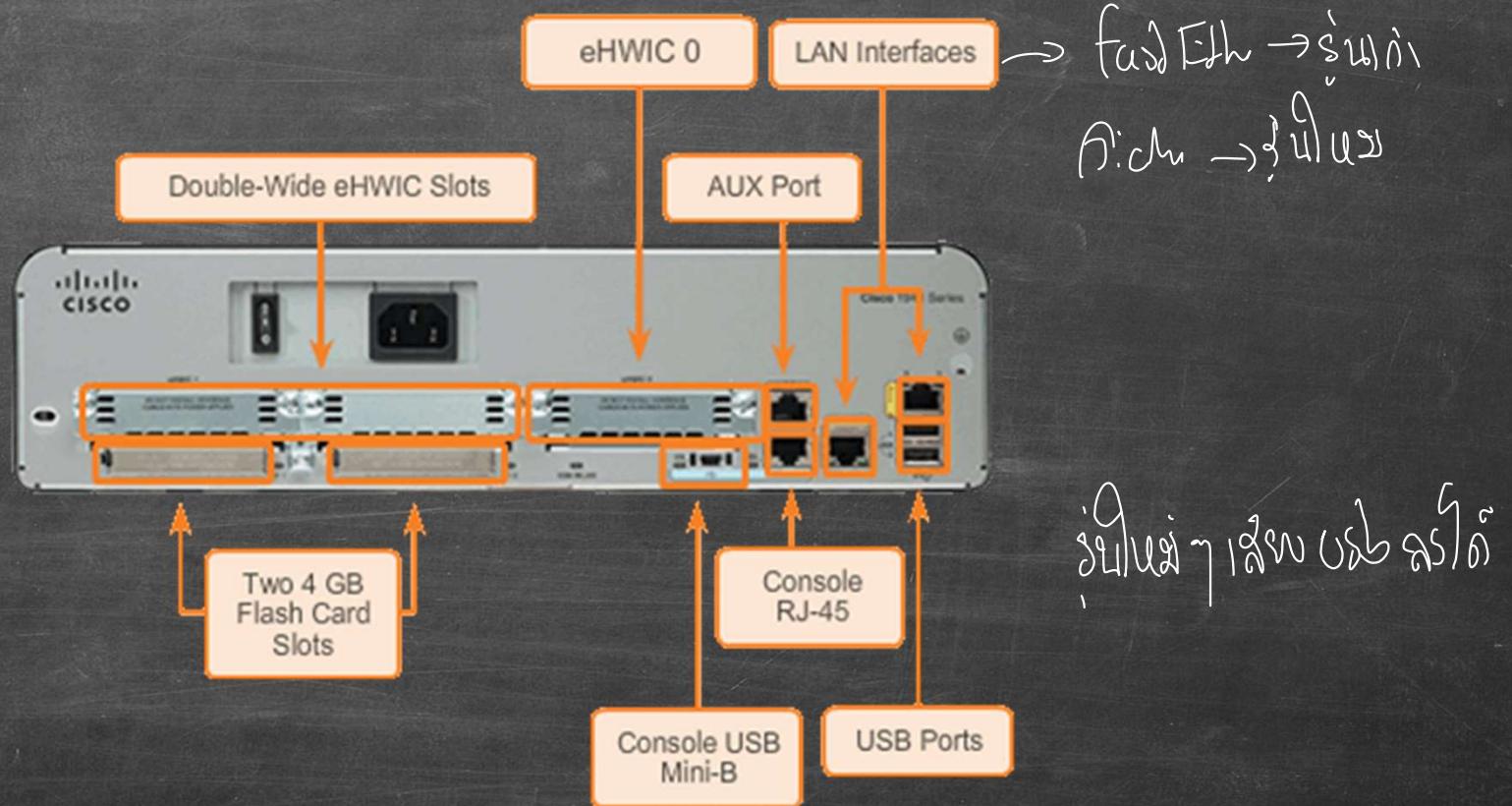
Number and type of interfaces
2 FastEthernet/IEEE 802.3 interface(s)
2 Low-speed serial(sync/async) network interface(s)

Amount of NVRAM
32K bytes of non-volatile configuration memory.

Amount of Flash
16384K bytes of processor board System flash (Read/Write)
Configuration register is 0x2102
Router#
```

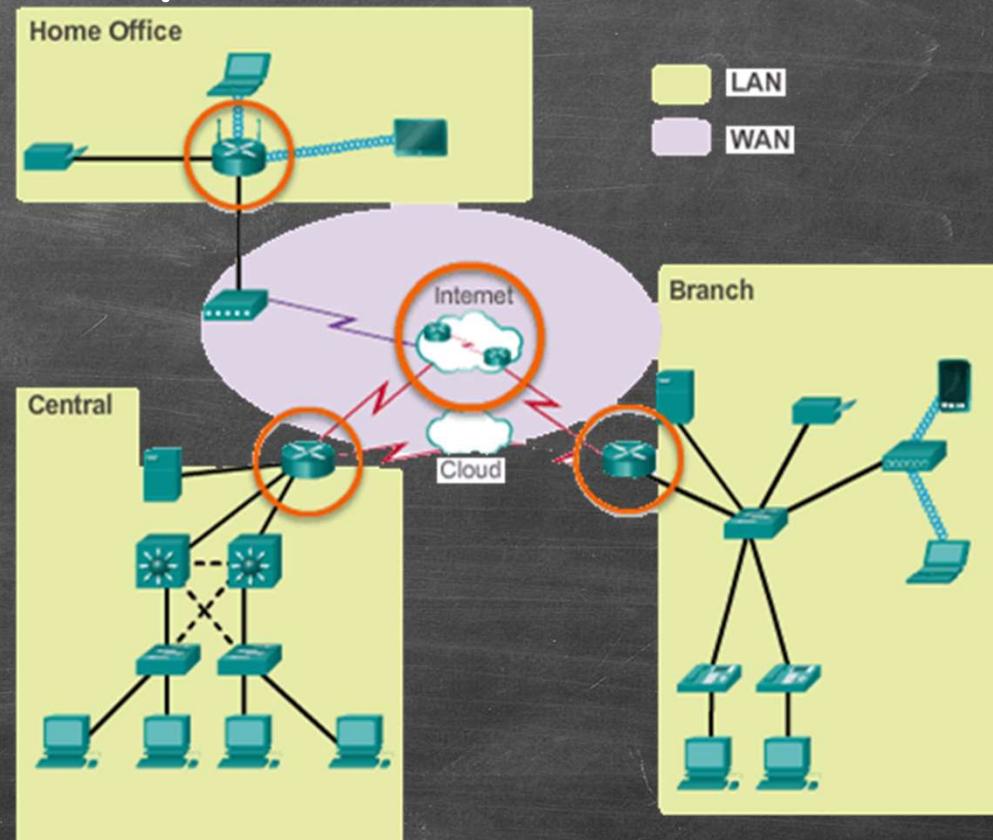
Functions of a Router

- Routers are Computers
 - Routers use specialized ports and network interface cards to interconnect to other networks



Functions of a Router

- Routers Interconnect Networks
 - Routers can connect multiple networks.
 - Routers have multiple interfaces, each on a different IP network.

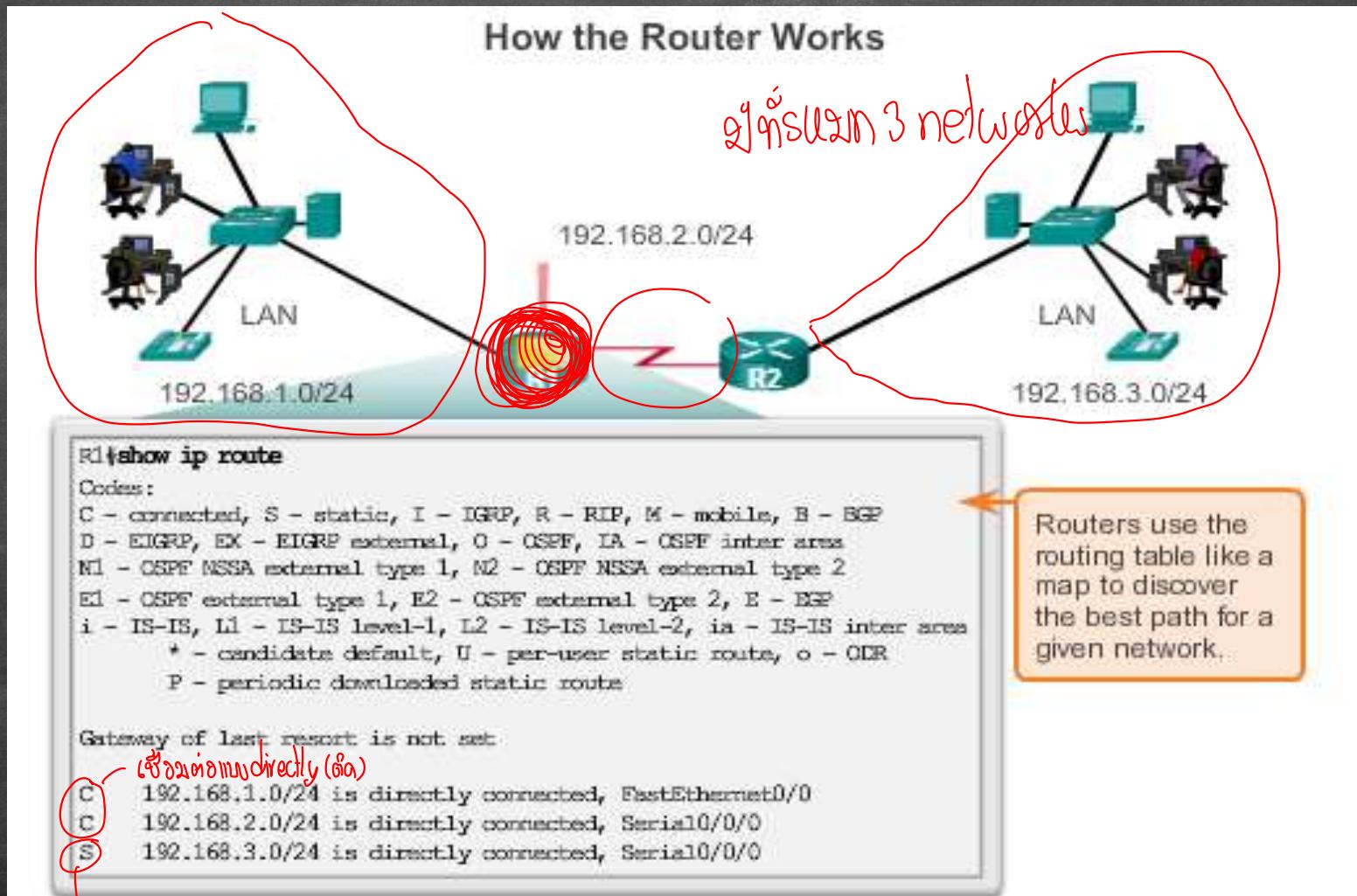


Functions of a Router

- Routers Choose Best Paths ເລື່ອນໄຫວຕົກທີ່ດັ່ງນີ້ → ວິທີໃນ routing table
 - Determine the best path to send packets
 - Uses its routing table to determine path
 - Forward packets toward their destination ສະແດງຜັດ ມາຈຸດໃນ routing table
 - Forwards packet to interface indicated in routing table.
 - Encapsulates the packet and forwards out toward destination.
→ ດຳວັດໃຫຍ່ໄປໃນ ອົບໄວ້ → static, dynamic
 - Routers use static routes and dynamic routing protocols to learn about remote networks and build their routing tables.
ເອັນໄຫວນີ້ ເຮັດວຽກ

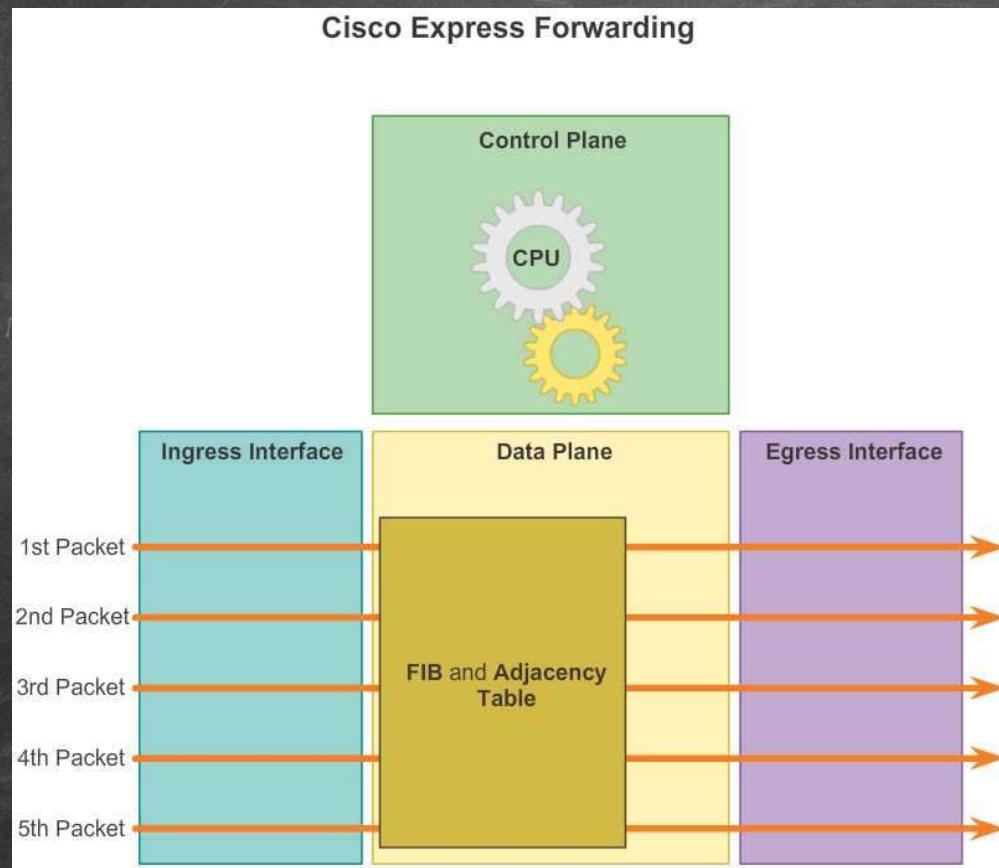
Functions of a Router

- Routers Choose Best Paths



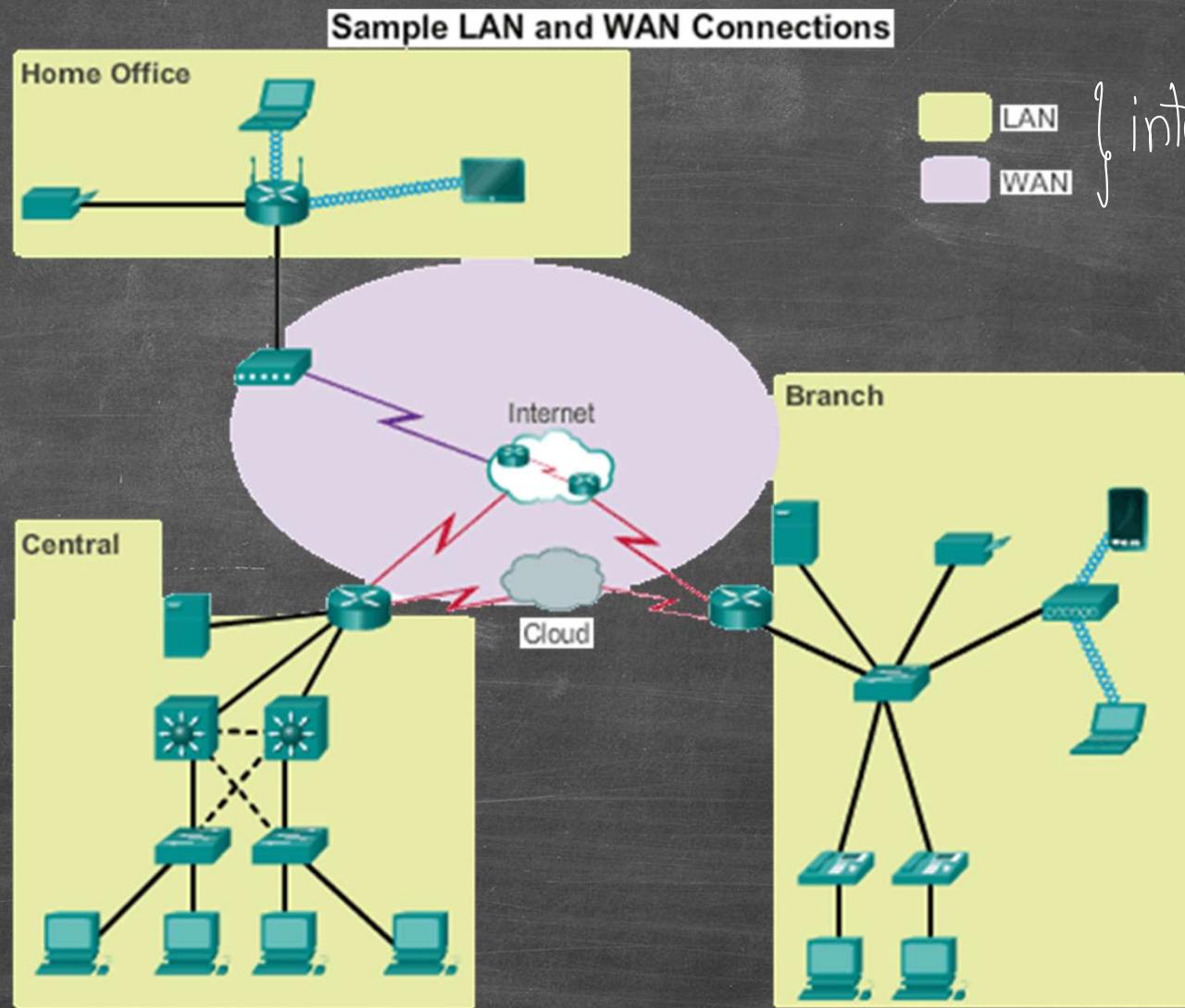
Functions of a Router

• Packet Forwarding Methods



- **Process switching** - An older packet forwarding mechanism still available for Cisco routers.
→ Version දැක්වා ඇත්තේ → පැහැදිලිව පෙන්වනු ලබයි. සෑම පැහැදිලිව පෙන්වනු ලබයි.
 - **Fast switching** - A common packet forwarding mechanism which uses a fast-switching cache to store next hop information.
→ CPU නිස්ස් පෙන්වනු ලබයි.
 - **Cisco Express Forwarding (CEF)** - The most recent, fastest, and preferred Cisco IOS packet-forwarding mechanism. Table entries are not packet-triggered like fast switching but change-triggered.

Connect Devices



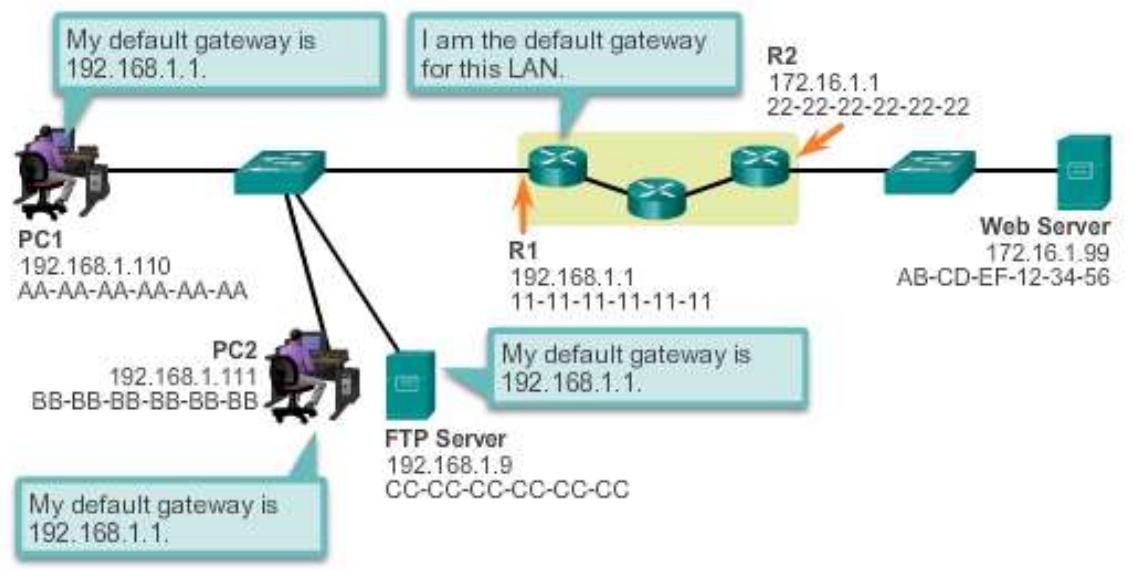
Connect Devices

- Default Gateways

- To enable network access devices must be configured with the following IP address information

- IP address - Identifies a unique host on a local network.
 - Subnet mask - Identifies the host's network subnet.
 - Default gateway -
Identifies the router a packet is sent to when the destination is not on the same local network subnet.

Destination MAC Address	Source MAC Address	Source IP Address	Destination MAC Address	Data
11-11-11-11-11-11	AA-AA-AA-AA-AA-AA	192.168.1.110	172.16.1.99	



Connect Devices

၁၂၀၈၂၇ config မေး၏။

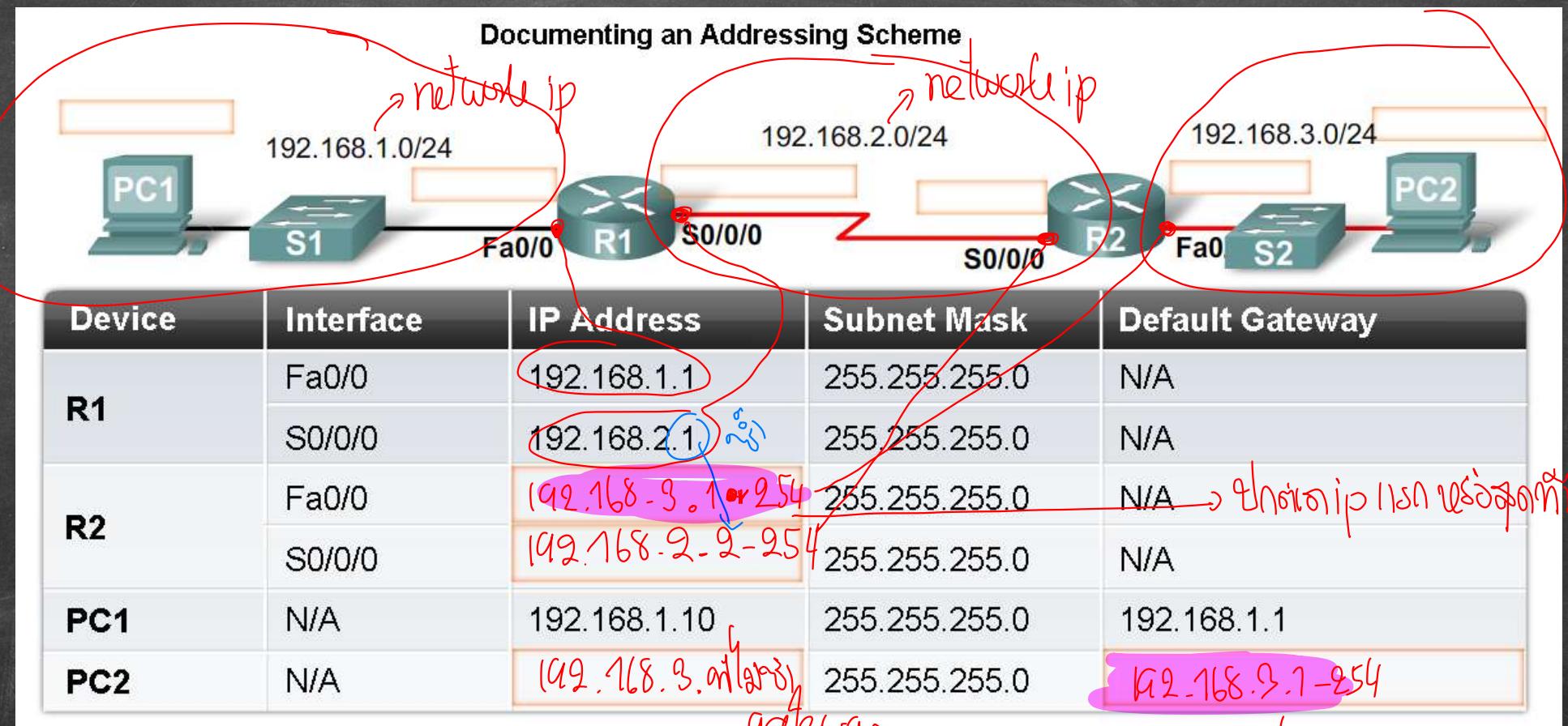
နှုန်း၏ doc → diagram,
address

- Document Network Addressing
 - Network Documentation should include at least the following in a topology diagram and addressing table:
 - Device names
 - Interfaces
 - IP addresses and subnet mask
 - Default gateways

Connect Devices

- Document Network Addressing

សារព័ត៌មានអង្គភាព



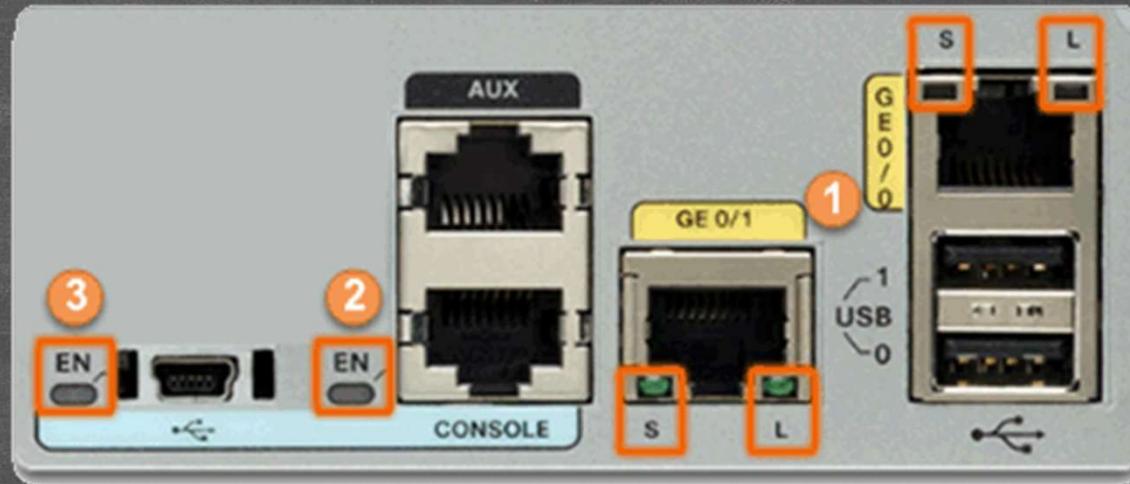
Connect Devices

- Enable IP on a Host
— Statically Assigned IP address - host is manually assigned the IP address, subnet mask and default gateway. DNS server IP address can also be assigned.
 - Used to identify specific network resources such as network servers and printers
 - Can be used in very small networks with few hosts.
— Dynamically Assigned IP Address - IP Address information is dynamically assigned by a server using Dynamic Host Configuration Protocol (DHCP)
 - Most hosts acquire their IP address information through DHCP
 - DHCP services can be provided by Cisco routers

Connect Devices

- Device LEDs

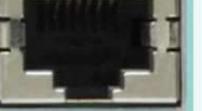
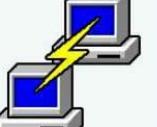
CISCO 1941 LEDs



#	Port	LED	Color	Description
1	GE0/0 and GE0/1	S (Speed)	1 blink + pause	Port operating at 10 Mb/s
			2 blink + pause	Port operating at 100 Mb/s
			3 blink + pause	Port operating at 1000 Mb/s
		L (Link)	Green	Link is active
			Off	Link is inactive
2	Console	EN	Green	Port is active
			Off	Port is inactive
3	USB	EN	Green	Port is active
			Off	Port is inactive

Connect Devices

- Console Access → *Serial port ↔ router*
 - Console access requires:
 - Console cable - RJ-45-to-DB-9 console cable
 - Terminal emulation software - Tera Term, PuTTY, HyperTerminal

Ports and Cables			
Port on Computer	Cable Required	Port on ISR	Terminal Emulation
 Serial Port	 Console Cable	 CONSOLE	 Tera Term
 USB Type-A Port	 USB-to-RS-232 Serial Port Adapter  Console Cable	 RJ-45 Console Port	 PuTTY
	 USB Type-A to USB Type-B (Mini-B) Cable	 USB Type-B (Mini-B USB) Console Port	

Basic Settings on a Router

- Configure Basic Router Settings

- Name the device : **hostname name**

qis secret password

- Secure management access : **enable secret password**

- Configure a banner : **banner motd # text #** → ໜ້າຕົວກິດ

- Configured an Interface : **interface type slot/port**

↓ Fast, Gi, Se, ...

- address and subnet mask : **ip address x.x.x.x y.y.y.y**

- Activated : **no shutdown**

↓ minimum ip address

- serial cable end labeled DCE : **clock rate 56000** → 56kbit/s

DTE

- Configure a Loopback Interface

- interface loopback number** → 0, 1, 2, 3, 000

- ip address x.x.x.x y.y.y.y** min ip

↓ (by default) interface 0 of router ຖັນຍຸ

↓ no shutdown

Verify Connectivity of Directly Connected Networks

- Verify Interface Settings

a manual save after config.

- Show commands to verify operation and configuration of interface.

show ip interface brief

show ip route

show running-config

}

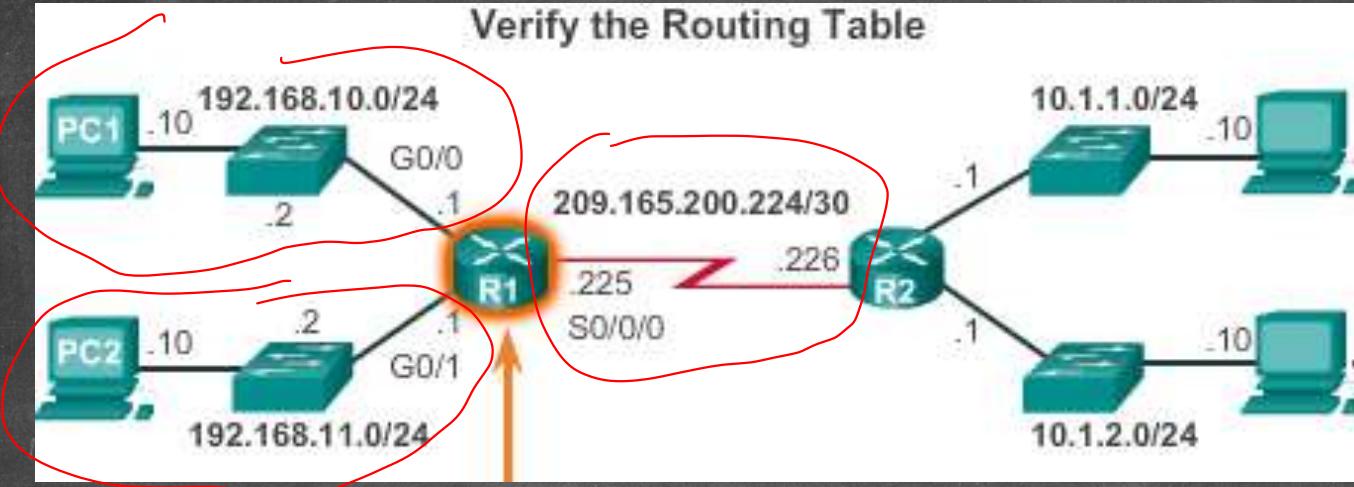
- Show commands to gather more detailed interface information.

show interfaces

show ip interface

Verify Connectivity of Directly Connected Networks

show running-config



Gateway of last resort is not set

```

C 192.168.10.0/24 is variably subnetted, 2 subnets, 2 masks
L   192.168.10.0/24 is directly connected, GigabitEthernet0/0
L   192.168.10.1/32 is directly connected, GigabitEthernet0/0
C 192.168.11.0/24 is variably subnetted, 2 subnets, 2 masks
L   192.168.11.0/24 is directly connected, GigabitEthernet0/1
L   192.168.11.1/32 is directly connected, GigabitEthernet0/1
209.165.200.0/24 is variably subnetted, 2 subnets, 2 masks
C 209.165.200.224/30 is directly connected, Serial0/0/0
L 209.165.200.225/32 is directly connected, Serial0/0/0
Router#
```

Gateway of last resort is not set

```

C 192.168.10.0/24 is directly connected, FastEthernet0/0
C 192.168.11.0/24 is directly connected, FastEthernet0/1
209.165.200.0/30 is subnetted, 1 subnets
C     209.165.200.224 is directly connected, Serial0/0
Router#
```

```

interface GigabitEthernet0/0
 ip address 192.168.10.1 255.255.255.0
 duplex auto
 speed auto
!
interface GigabitEthernet0/1
 ip address 192.168.11.1 255.255.255.0
 duplex auto
 speed auto
!
interface GigabitEthernet0/2
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial0/0/0
 ip address 209.165.200.225 255.255.255.252
!
interface Serial0/0/1
 no ip address
 clock rate 2000000
 shutdown
!
```

Interface	IP-Address	OK?	Method	Status	Protocol
GigabitEthernet0/0	192.168.10.1	YES	manual	up	
GigabitEthernet0/1	192.168.11.1	YES	manual	up	
GigabitEthernet0/2	unassigned	YES	unset	administratively down	down
Serial0/0/0	209.165.200.225	YES	manual	up	up
Serial0/0/1	unassigned	YES	unset	administratively down	down
Vlan1	unassigned	YES	unset	administratively down	down

show int brief

layer1

layer2

↑ avoid it

Verify Connectivity of Directly Connected Networks

- Filter Show Command Output
 - Use the terminal `length number` command to specify the number of lines to be displayed. A value of 0 (zero) prevents the router from pausing between screens of output.
 - To filter specific output of commands use the `(|)pipe` character after show command. Parameters that can be used after pipe include:
 - section, include, exclude, begin

```
R1#show ip interface brief
Interface          IP-Address      OK? Method Status
Embedded-Service-Engine0/0 unassigned      YES unset administ
GigabitEthernet0/0   192.168.10.1    YES manual up
GigabitEthernet0/1   192.168.11.1    YES manual up
Serial0/0/0          209.165.200.225 YES manual up
Serial0/0/1          unassigned      YES unset administ
```

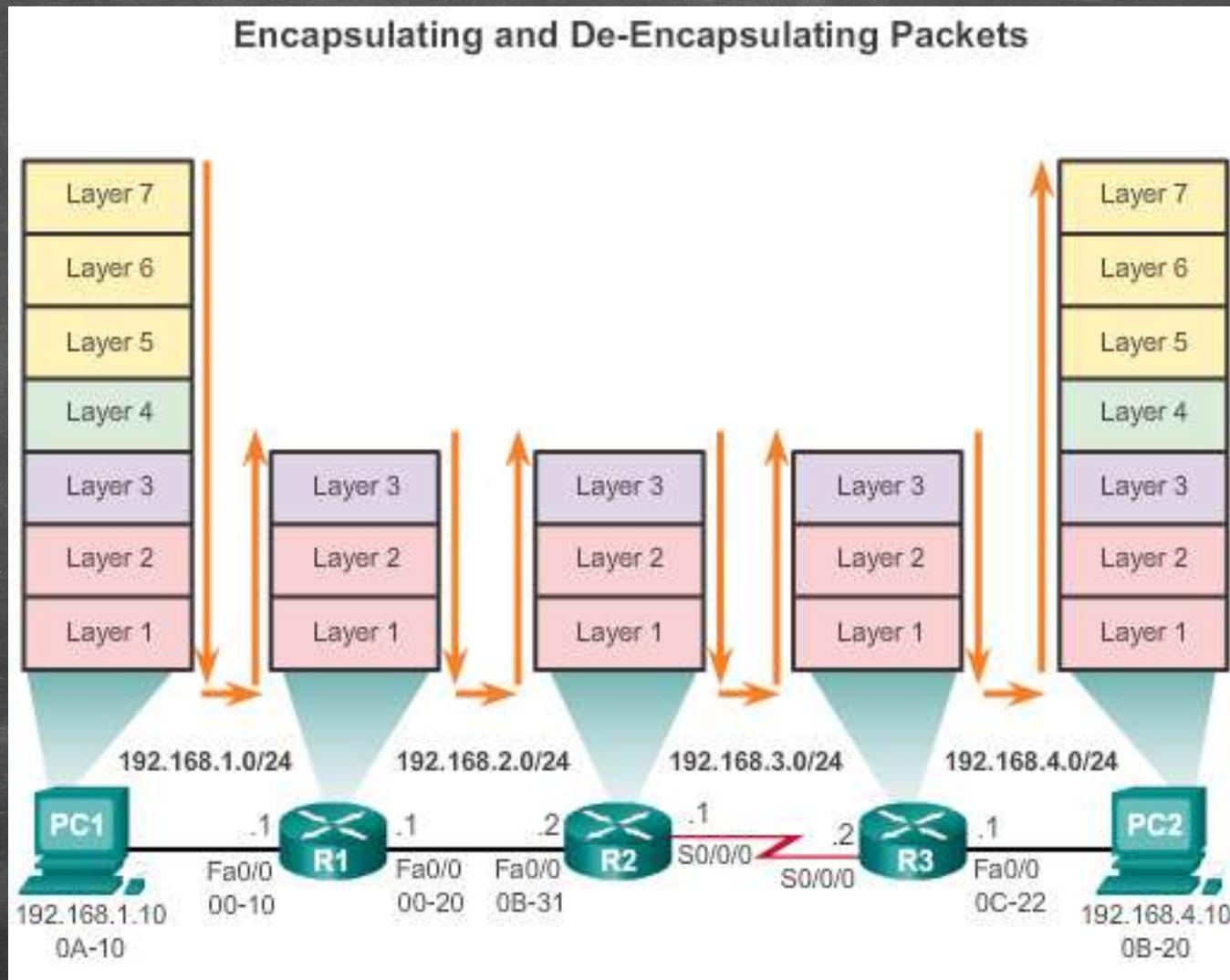
```
R1#show ip interface brief | exclude unassigned
Interface          IP-Address      OK? Method Status
GigabitEthernet0/0   192.168.10.1    YES manual up
GigabitEthernet0/1   192.168.11.1    YES manual up
Serial0/0/0          209.165.200.225 YES manual up
```

```
R1#show ip interface brief
Interface          IP-Address      OK? Method Status
Embedded-Service-Engine0/0 unassigned      YES unset administ
GigabitEthernet0/0   192.168.10.1    YES manual up
GigabitEthernet0/1   192.168.11.1    YES manual up
Serial0/0/0          209.165.200.225 YES manual up
Serial0/0/1          unassigned      YES unset administ
R1#
```

```
R1#show ip interface brief | include up
GigabitEthernet0/0   192.168.10.1    YES manual up
GigabitEthernet0/1   192.168.11.1    YES manual up
Serial0/0/0          209.165.200.225 YES manual up
R1#
```

Switching Packets between Networks

- Router Switching Functions

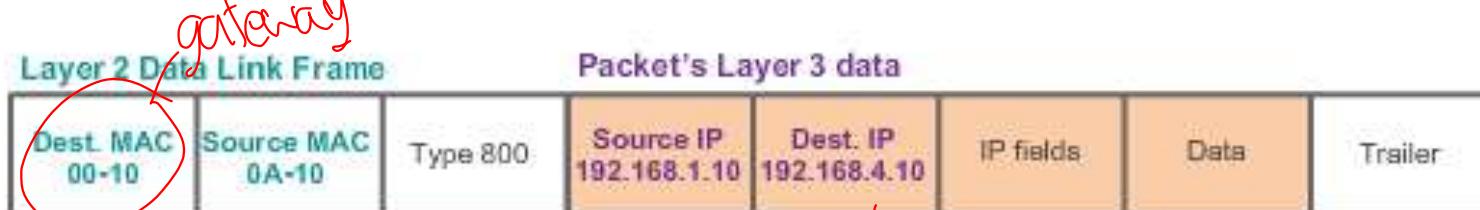
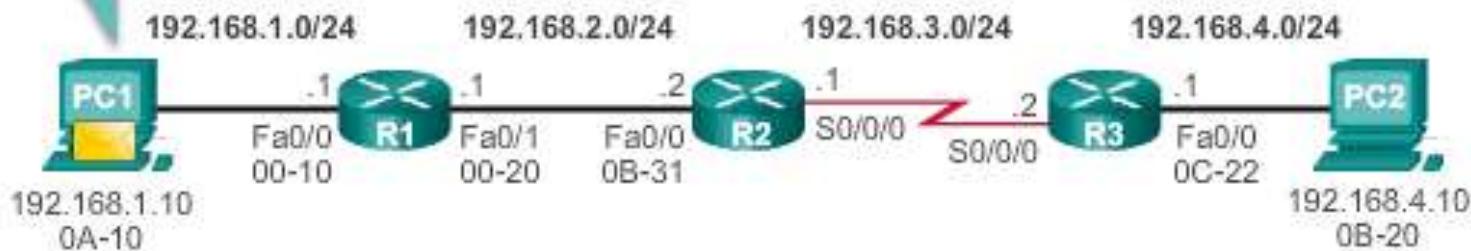


Switching Packets between Networks

- Send a Packet

PC1 Sends a Packet to PC2

Because PC2 is on different network, I will encapsulate the packet and send it to the router on MY network. Let me find that MAC address....



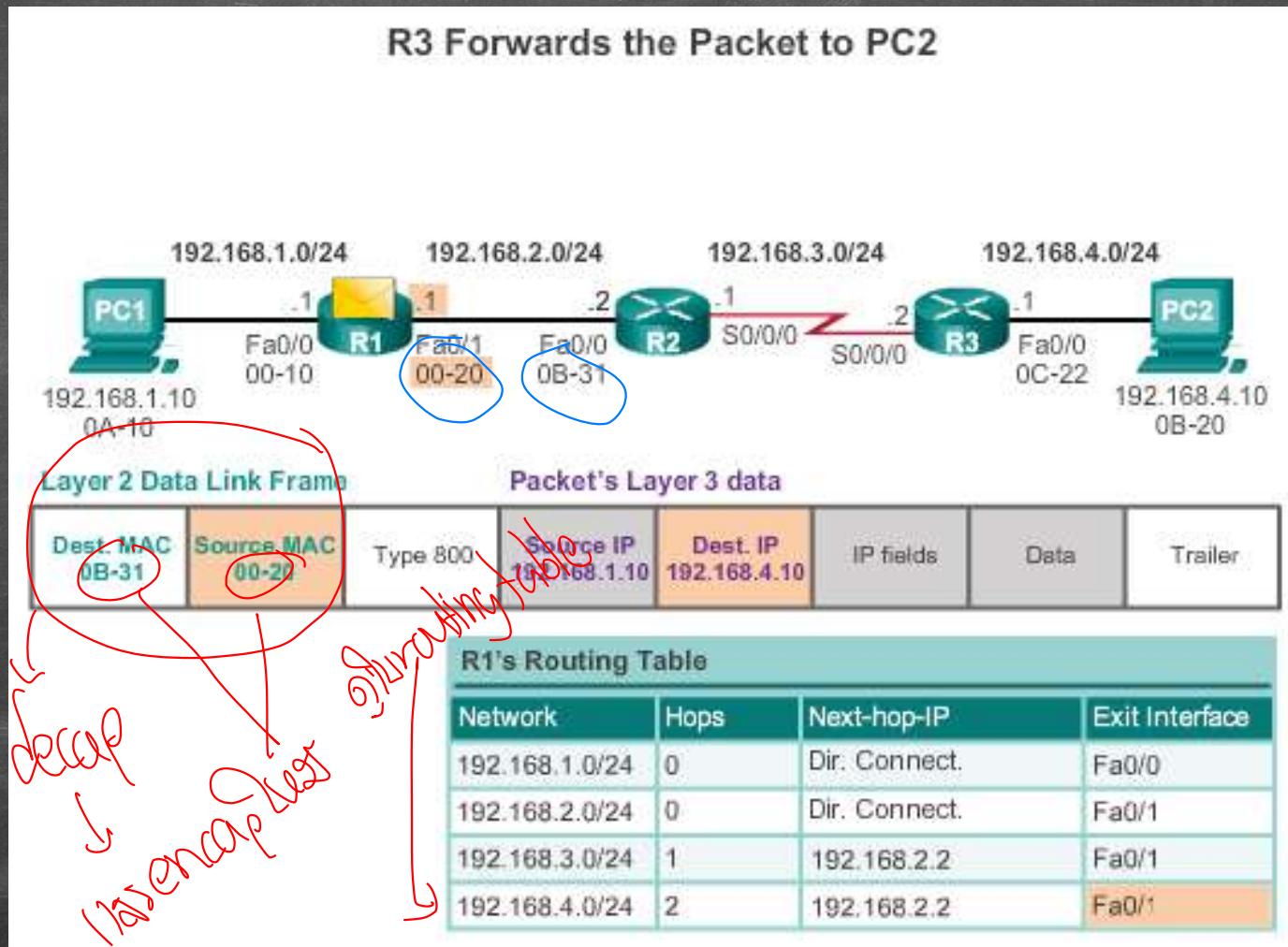
PC1's ARP Cache for R1

IP Address	MAC Address
192.168.1.1	00-10

over network

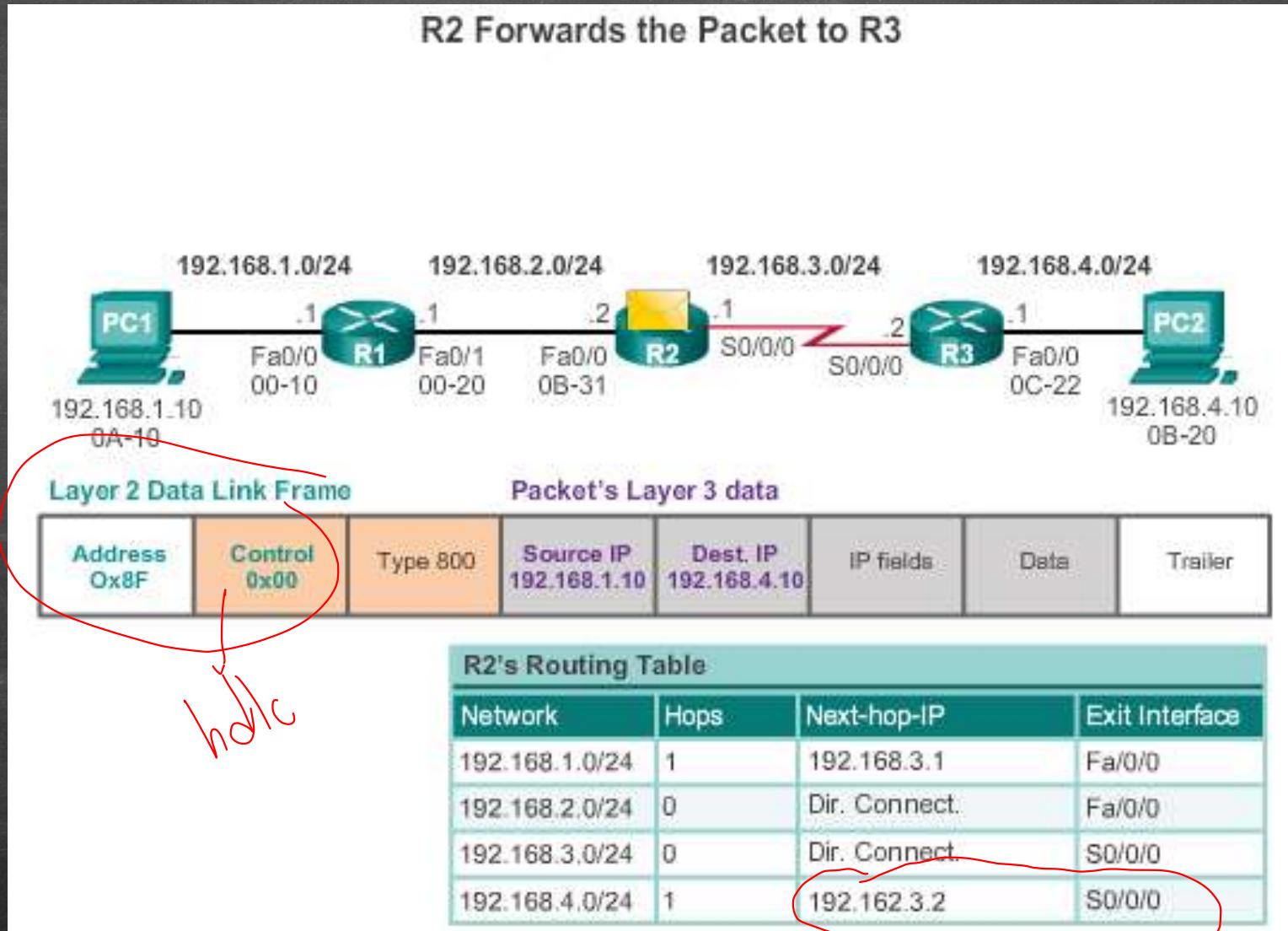
Switching Packets between Networks

- Forward to the Next Hop



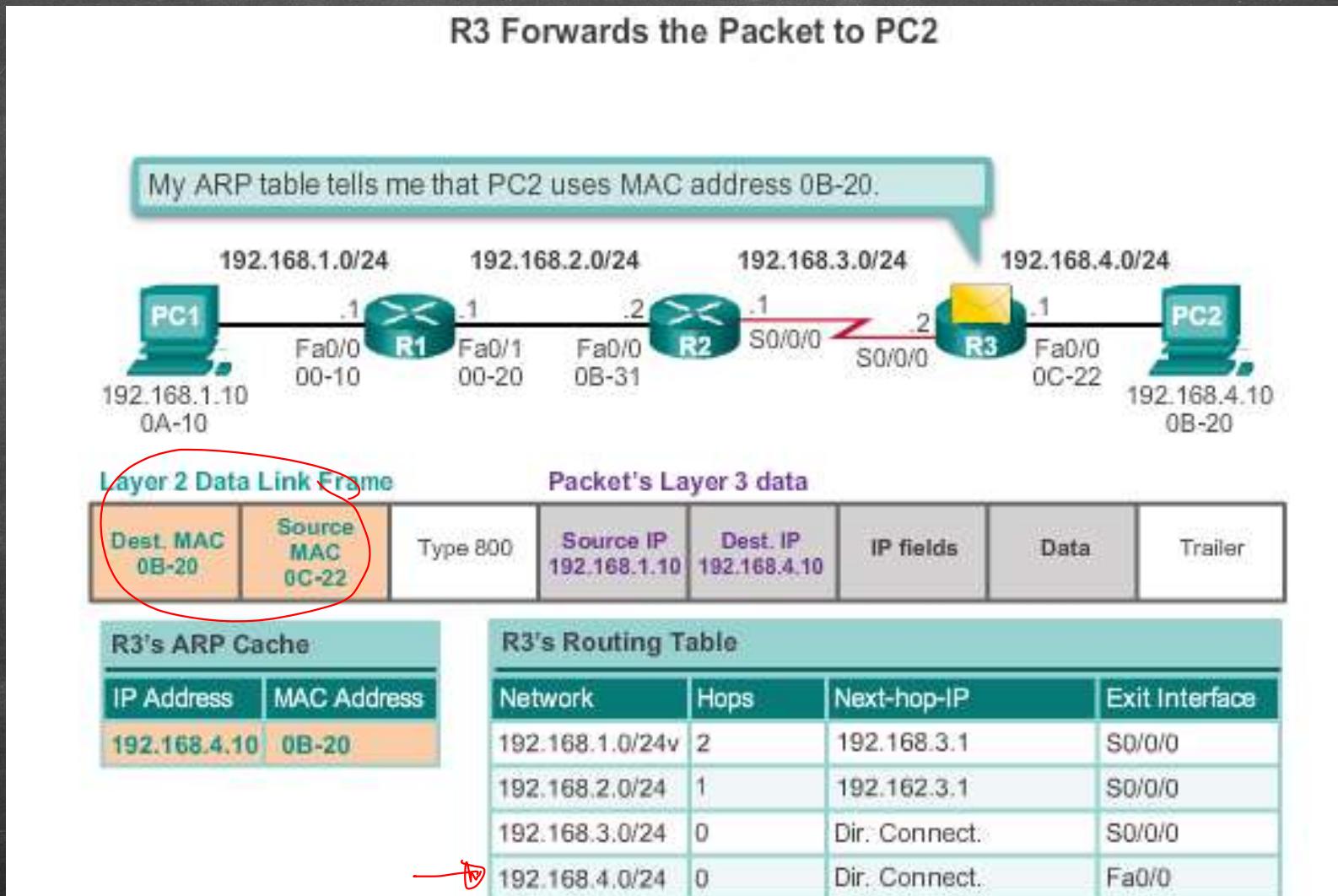
Switching Packets between Networks

- Packet Routing

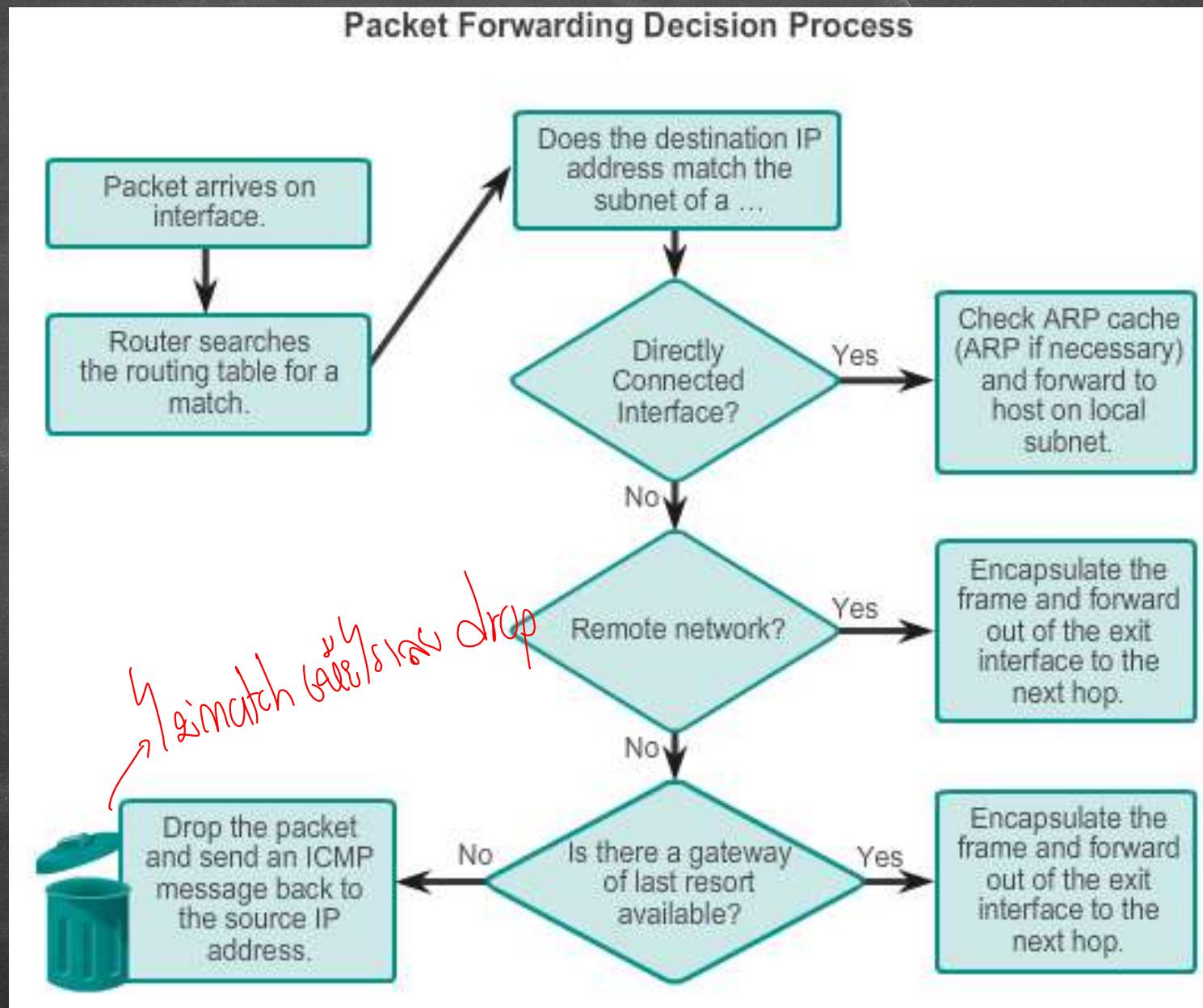


Switching Packets between Networks

- Reach the Destination



Path Determination



နှစ်ခုလေး

Path Determination

សេចក្តីផ្តើម

វិធានៗ (បច្ចុប្បន្ន)

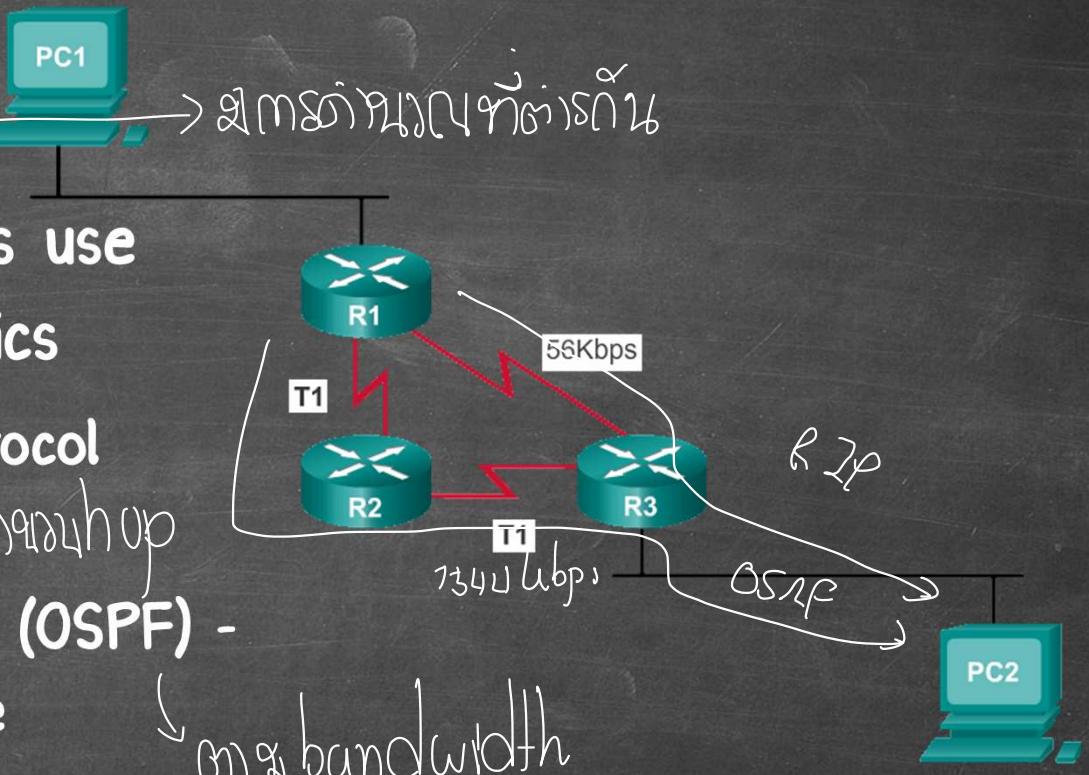
- Best Path : lowest metric → តាមលក្ខណៈមុខរបរក្នុង

— Dynamic routing protocols use their own rules and metrics

- Routing Information Protocol (RIP) - Hop count → តួចចុចរាល់ឡើង

- Open Shortest Path First (OSPF) - Cost based on cumulative bandwidth from source to destination

- Enhanced Interior Gateway Routing Protocol (EIGRP) - Bandwidth, delay, load, reliability



||| router=protocol(រួម) | ស្ថិកមន្តរ

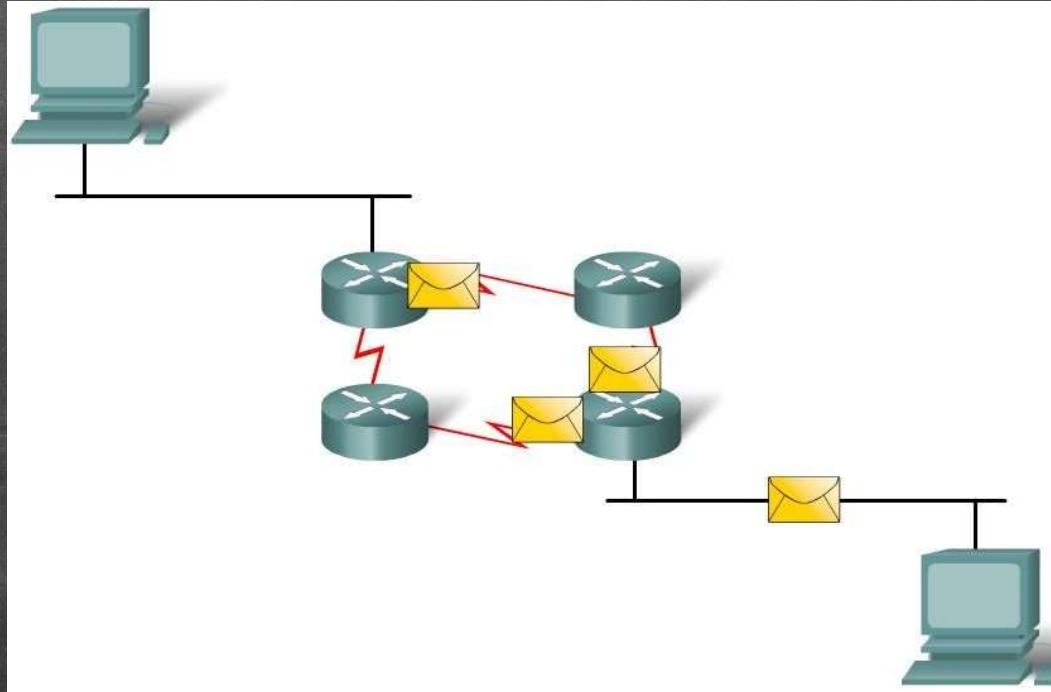
→ មានកែសម្រួល សម្រាប់ផ្ទាល់ការងារ

Path Determination

- Load Balancing

— When a router has two or more paths to a destination with equal cost metrics, then the router forwards the packets using both paths equally.

是最好的路径 \rightarrow 路由器均衡负载
balance



Path Determination

ક්‍රියාකෘතිකාරීතියේ Admin → තුළුම්පූර්ණ → සුදු → ප්‍රත්ස්ථාන

- Administrative Distance (AD) : “trustworthiness”

Default Administrative Distances

වස cisco only

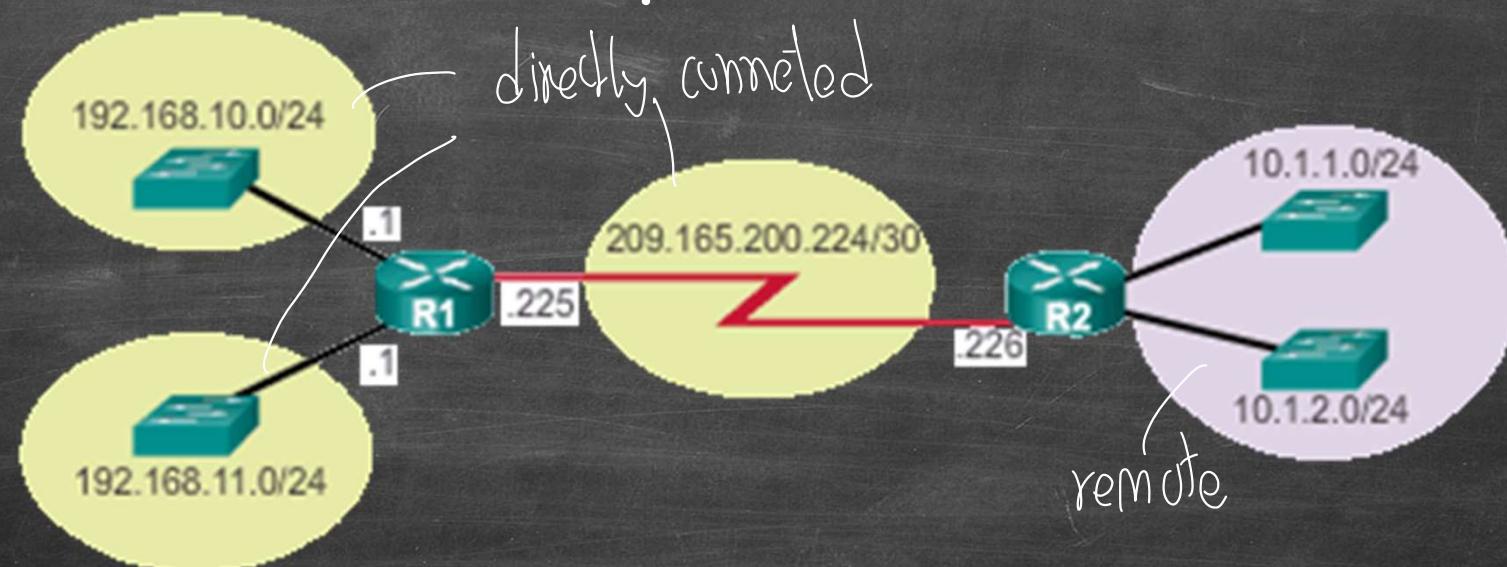
Route Source	Administrative Distance
Connected	0
Static	1
EIGRP summary route	5
External BGP	20
Internal EIGRP	90
IGRP	100
OSPF	110
IS-IS	115
External EIGRP	170
Internal BGP	200

RIP

120

The Routing Table

- Routing Table is a file stored in RAM that contains information about
 - Directly Connected Routes
 - Remote Routes
 - Network or Next hop Associations



The Routing Table

- Routing Table Sources
 - Show ip route command is used to display the contents of the routing table
→ L router จัดให้
 - Link local Interfaces -Added to the routing table when an interface is configured. (displayed in IOS 15 or newer)
 - Directly connected interfaces -Added to the routing table when an interface is configured and active.
 - Static routes - Added when a route is manually configured and the exit interface is active.
→ up to protocol
 - Dynamic routing protocol - Added when EIGRP or OSPF are implemented and networks are identified.

The Routing Table



```

Router#sh ip ro
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

D 10.0.0.0/24 is subnetted, 2 subnets
  D 10.1.1.0/24 [90/2172416] via 209.165.200.226, 00:01:51, Serial0/0/0
  D 10.1.2.0/24 [90/2172416] via 209.165.200.226, 00:01:51, Serial0/0/0
C 192.168.10.0/24 is variably subnetted, 2 subnets, 2 masks
L   192.168.10.1/32 is directly connected, GigabitEthernet0/0
L   192.168.11.0/24 is variably subnetted, 2 subnets, 2 masks
C     192.168.11.0/24 is directly connected, GigabitEthernet0/1
L     192.168.11.1/32 is directly connected, GigabitEthernet0/1
C 209.165.200.0/24 is variably subnetted, 2 subnets, 2 masks
C     209.165.200.224/30 is directly connected, Serial0/0/0
L     209.165.200.225/32 is directly connected, Serial0/0/0

```

Router#

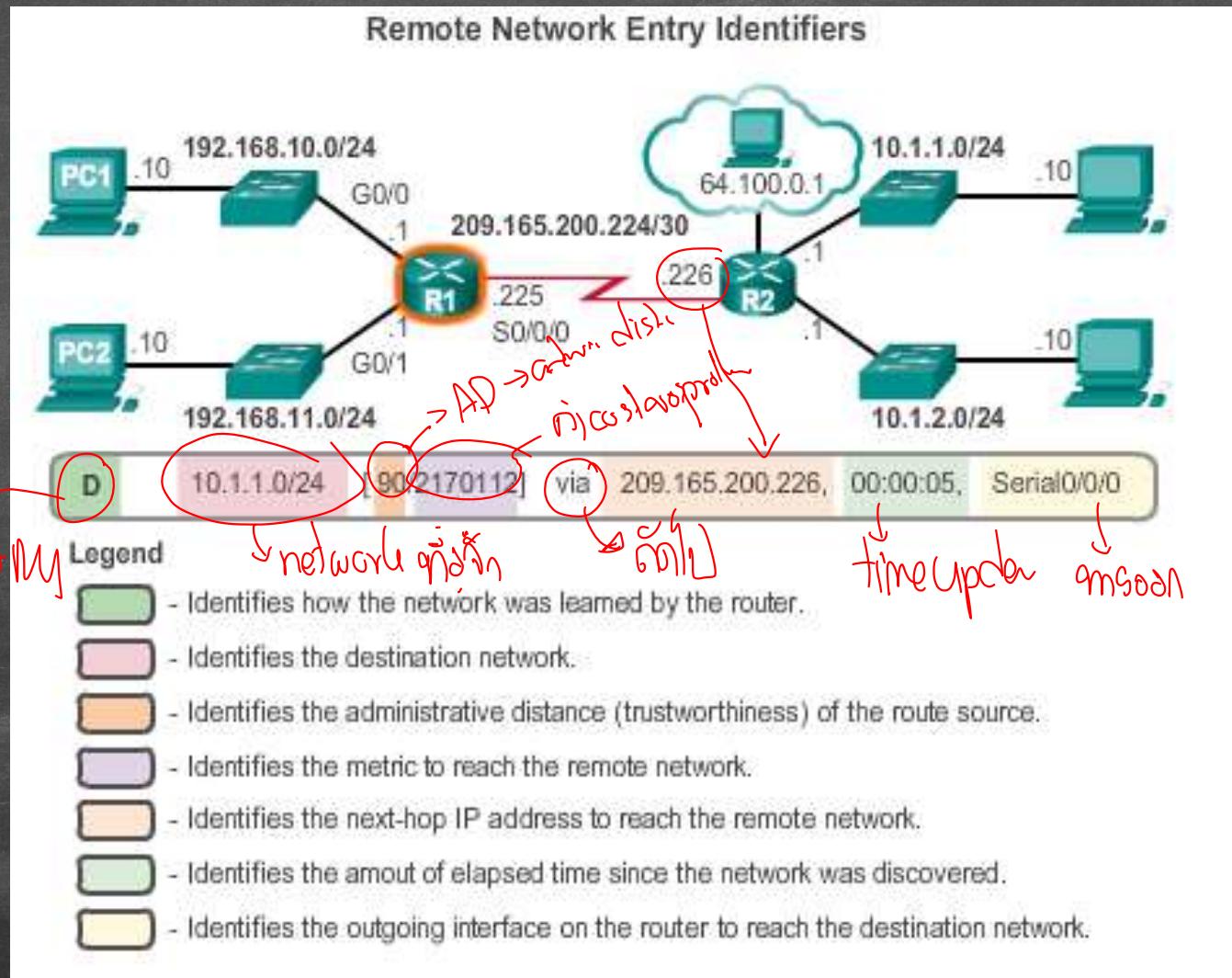
With this red

next hop interface

exit interface

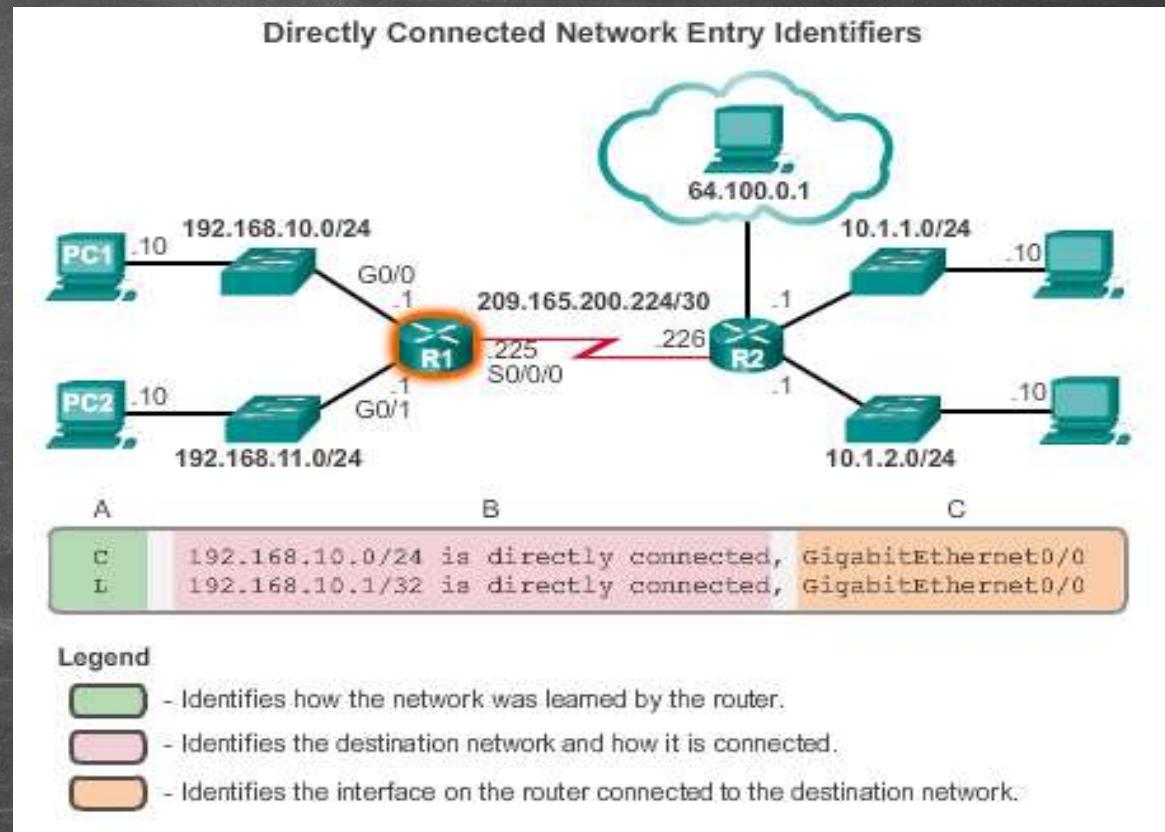
The Routing Table

- Remote Network Routing Entries



Directly Connected Routes

- A newly deployed router, without any configured interfaces, has an empty routing table.
- An active, configured directly connected interface creates two routing table entries
 - Link Local (L)
 - Directly Connected (C)



link local → ip interface

Routing

- Reach Remote Networks
 - A router can learn about remote networks in one of two ways:
 - Manually - Remote networks are manually entered into the route table using static routes.
 - Dynamically - Remote routes are automatically learned using a dynamic routing protocol.

ມີກຳລົງ
ໃຫຍ່
ຢ່າງຍິນຍຸ

ໃຫຍ່ຢ່າງຍິນຍຸ
ຢ່າງຍິນຍຸ

Routing

- Static Routing
- Dynamic Routing Protocols
 - Exterior Routing Protocols
 - BGP
 - Interior Gateway Routing Protocols
 - RIP - Routing Information Protocol
 - OSPF - Open Shortest Path First
 - EIGRP - Enhanced Interior Gateway Routing Protocol
 - IS-IS - Intermediate System-to-Intermediate System

Static Routing → โฉนดของ router

- Advantages
- Disadvantages
- When to Use Static Routes



Types of Static Routes

- Static Route Applications

ອັນດີ
sub network

- Static Routes are often used to:

- Connect to a specific network

- Provide a Gateway of Last Resort for a stub network

- Reduce the number of routes advertised by summarizing several contiguous networks as one static route ລາຍລະອຽດ routing (ບົນດືອ)

- Create a backup route in case a primary route link fails

↳ ເຕັມ backup → ຢູ່ລວມກຳ

Types of Static Routes

- **Standard Static Route**

↪ ក្នុងរាជ្យ និងក្រុង មានរាជ្យដែលពិនិត្យបាន

- **Default Static Route**

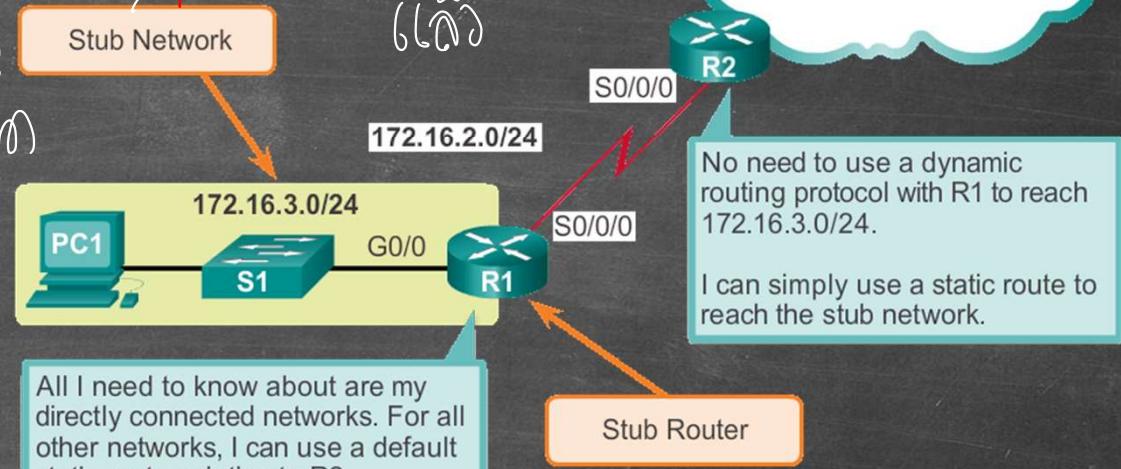
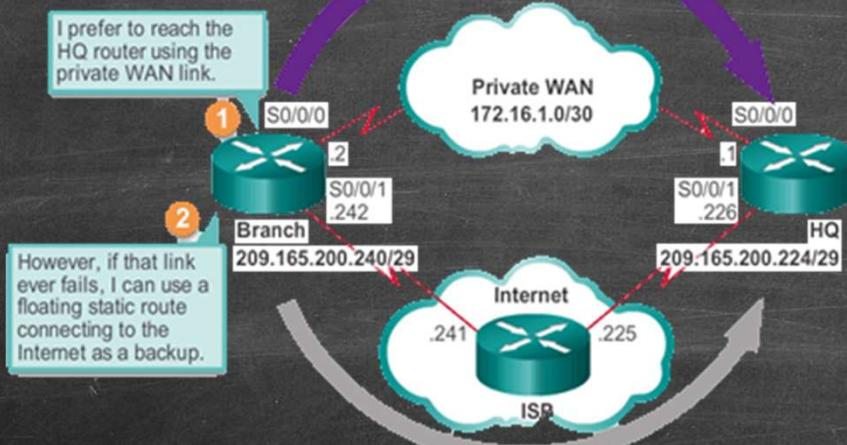
↪ ជូនចិត្តទៅ Standard 4 CM

- **Summary Static Route**

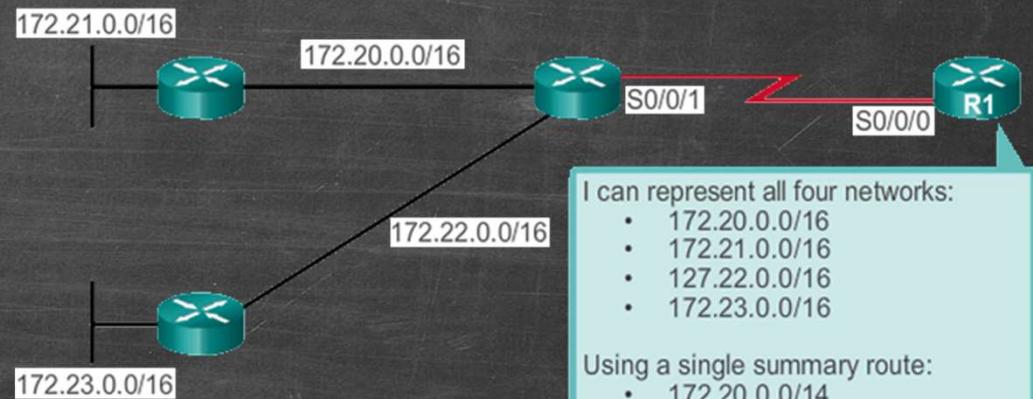
↪ ស្ថិតិយោន្ត នូវប្រព័ន្ធប្រចាំប្រអប់

- **Floating Static Route**

Configuring a Backup Route



ការគ្រប់គ្រង ព័ត៌មាន នៃក្រុងប្រព័ន្ធ
និងក្នុងរាជ្យ ដើម្បីបង្កើតការងារ



Configure IPv4 Static Routes

standard static route

ip route Command Syntax

```
Router(config)#ip route network-address subnet-mask  
{ip-address | exit-intf}
```

Parameter	Description
network-address	Destination network address of the remote network to be added to the routing table.
subnet-mask	<ul style="list-style-type: none">Subnet mask of the remote network to be added to the routing table.The subnet mask can be modified to summarize a group of networks.
ip-address	<ul style="list-style-type: none">Commonly referred to as the next-hop router's IP address.Typically used when connecting to a broadcast media (i.e., Ethernet).Commonly creates a recursive lookup.
exit-intf	<ul style="list-style-type: none">Use the outgoing interface to forward packets to the destination network.Also referred to as a directly attached static route.Typically used when connecting in a point-to-point configuration.

Configure IPv4 Static Routes

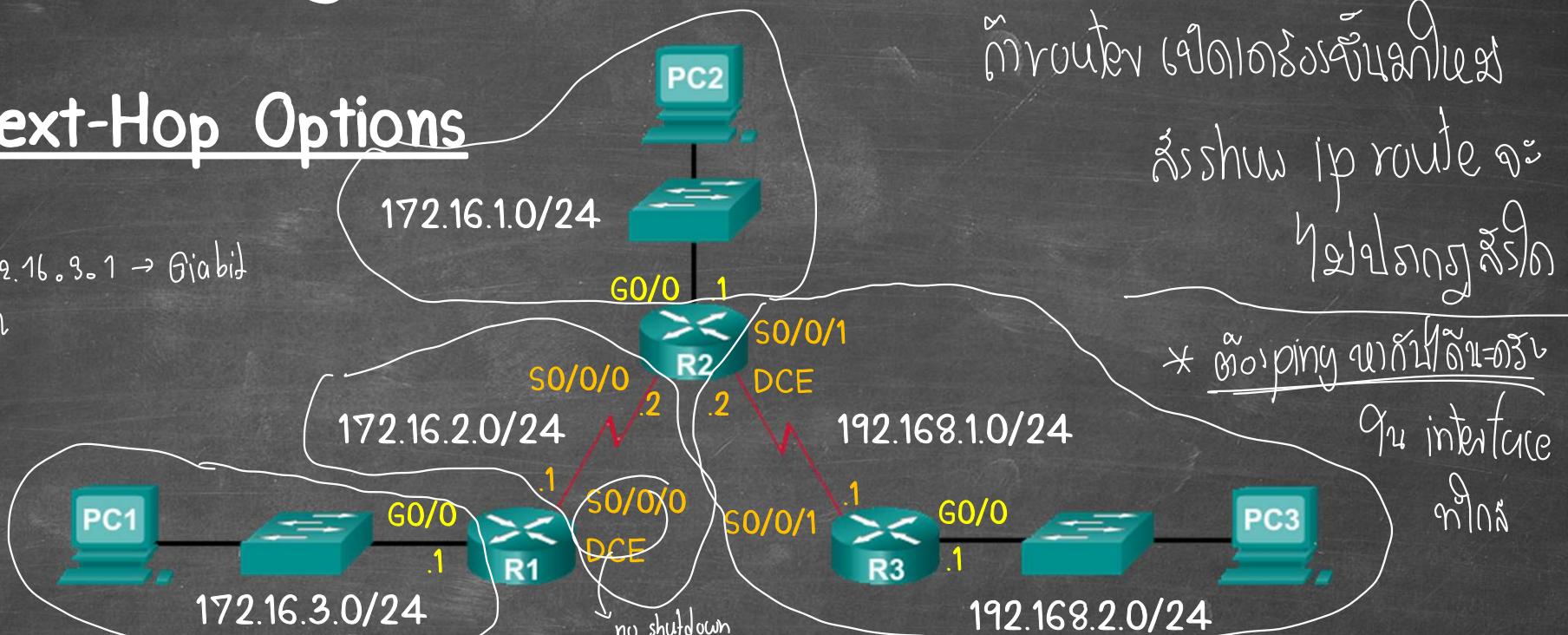
- Next-Hop Options : The next hop can be identified by an IP address, exit interface, or both. How the destination is specified creates one of the three following route types:
 - Next-hop route - Only the next-hop IP address is specified.
 - Directly connected static route - Only the router exit interface is specified.
 - Fully specified static route - The next-hop IP address and exit interface are specified.

Configure IPv4 Static Routes

• Next-Hop Options

ໃຫຍ່

ip address 172.16.3.1 → 0/abit
no shutdown



R1#show ip route | begin Gateway

Gateway of last resort is not set

```
172.16.0.0/16 is variably subnet, 4 subnets, 2 masks
C 172.16.2.0/24 is directly connected, Serial0/0/0
L 172.16.2.1/32 is directly connected, Serial0/0/0
D C 172.16.3.0/24 is directly connected, GigabitEthernet0/0
L 172.16.3.1/32 is directly connected, GigabitEthernet0/0
```

R2#show ip route | begin Gateway

Gateway of last resort is not set

```
172.16.0.0/16 is variably subnet, 4 subnets, 2 masks
C 172.16.1.0/24 is directly connected, GigabitEthernet0/0
L 172.16.1.1/32 is directly connected, GigabitEthernet0/0
C 172.16.2.0/24 is directly connected, Serial0/0/0
L 172.16.2.2/32 is directly connected, Serial0/0/0
192.168.1.0/24 is variably subnet, 2 subnets, 2 masks
C 192.168.1.0/24 is directly connected, Serial0/0/1
L 192.168.1.2/32 is directly connected, Serial0/0/1
```

R3#show ip route | begin Gateway

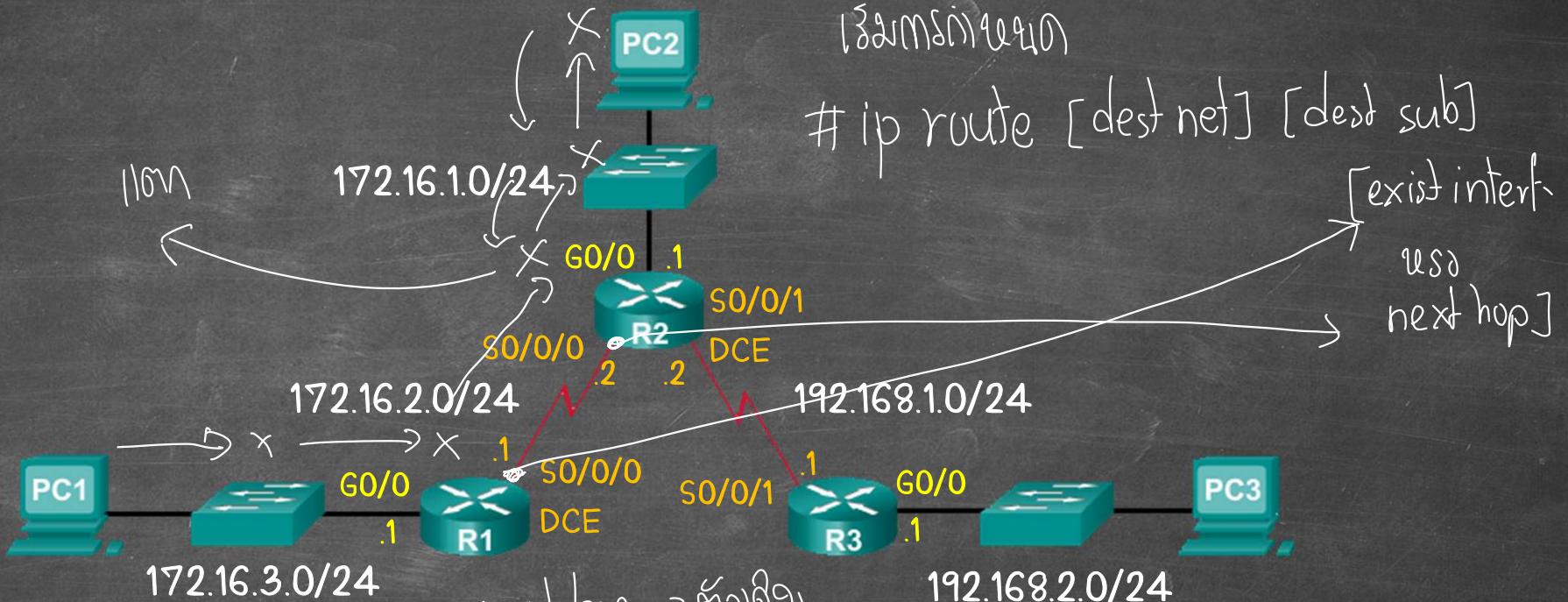
Gateway of last resort is not set

```
192.168.1.0/24 is variably subnet, 4 subnets, 2 masks
C 192.168.1.0/24 is directly connected, Serial0/0/1
L 192.168.1.1/32 is directly connected, Serial0/0/1
192.168.2.0/24 is variably subnet, 4 subnets, 2 masks
C 192.168.2.0/24 is directly connected, GigabitEthernet0/0
L 192.168.2.1/32 is directly connected, GigabitEthernet0/0
```

R3#show ip route | include C

Code:L - local, C - connected, S - static, R - RIP, . . .
C 192.168.1.0/24 is directly connected, Serial0/0/1
C 192.168.2.0/24 is directly connected, GigabitEthernet0/0

Configure IPv4 Static Routes



Configure a Next-Hop Static Route

```
R1(config)#ip route 172.16.1.0 255.255.255.0 172.16.2.2
R1(config)#ip route 192.168.1.0 255.255.255.0 172.16.2.2
R1(config)#ip route 192.168.2.0 255.255.255.0 172.16.2.2
```

Configure a Directly Connected Static Route

```
R1(config)#ip route 172.16.1.0 255.255.255.0 s0/0/0
R1(config)#ip route 192.168.1.0 255.255.255.0 s0/0/0
R1(config)#ip route 192.168.2.0 255.255.255.0 s0/0/0
```

Configure a Fully Specified Static Route

```
R1(config)#ip route 172.16.1.0 255.255.255.0 172.16.2.2 Ge0/1
R1(config)#ip route 192.168.1.0 255.255.255.0 172.16.2.2 Ge0/1
R1(config)#ip route 192.168.2.0 255.255.255.0 172.16.2.2 Ge0/1
```

```
R1#show ip route | begin Gateway
Gateway of last resort is not set
  172.16.0.0/16 is variably subnetted, 5 subnets, 2 masks
    S  172.16.1.0/24 [1/0] via 172.16.2.2
    C  172.16.2.0/24 is directly connected, Serial0/0/0
    L  172.16.2.1/32 is directly connected, Serial0/0/0
    C  172.16.3.0/24 is directly connected, GigabitEthernet0/0
    L  172.16.3.1/32 is directly connected, GigabitEthernet0/0
    S  192.16.1.0/24 [1/0] via 172.16.2.2
    S  192.16.2.0/24 [1/0] via 172.16.2.2
```

Configure IPv4 Static Routes

រាជរដ្ឋបាល

router r2 ស្តីពី

នៅក្នុង

បង្កើតឡើង

- Verify a Static Route

 - Along with ping and traceroute, useful commands to verify static routes include:

show ip route

show ip route static

show ip route network

Show running-config

fromconfig

```
R1# show ip route static | begin Gateway
```

Gateway of last resort is not set

172.16.0.0/16 is variably subnetted, 5 subnets, 2 masks

S 172.16.1.0/24 [1/0] via 172.16.2.2

S 192.168.1.0/24 [1/0] via 172.16.2.2

S 192.168.2.0/24 [1/0] via 172.16.2.2

R1#

```
R1# show running-config | section ip route
```

ip route 172.16.1.0 255.255.255.0 172.16.2.2

ip route 192.168.1.0 255.255.255.0 172.16.2.2

ip route 192.168.2.0 255.255.255.0 172.16.2.2

```
R1# show ip route 192.168.2.1
```

Routing entry for 192.168.2.0/24

Known via "static", distance 1, metric 0

Routing Descriptor Blocks:

* 172.16.2.2

Route metric is 0, traffic share count is 1

R1#

Configure IPv4 Static Routes

Default Static Route Syntax

ស្រួលបង្កែវ

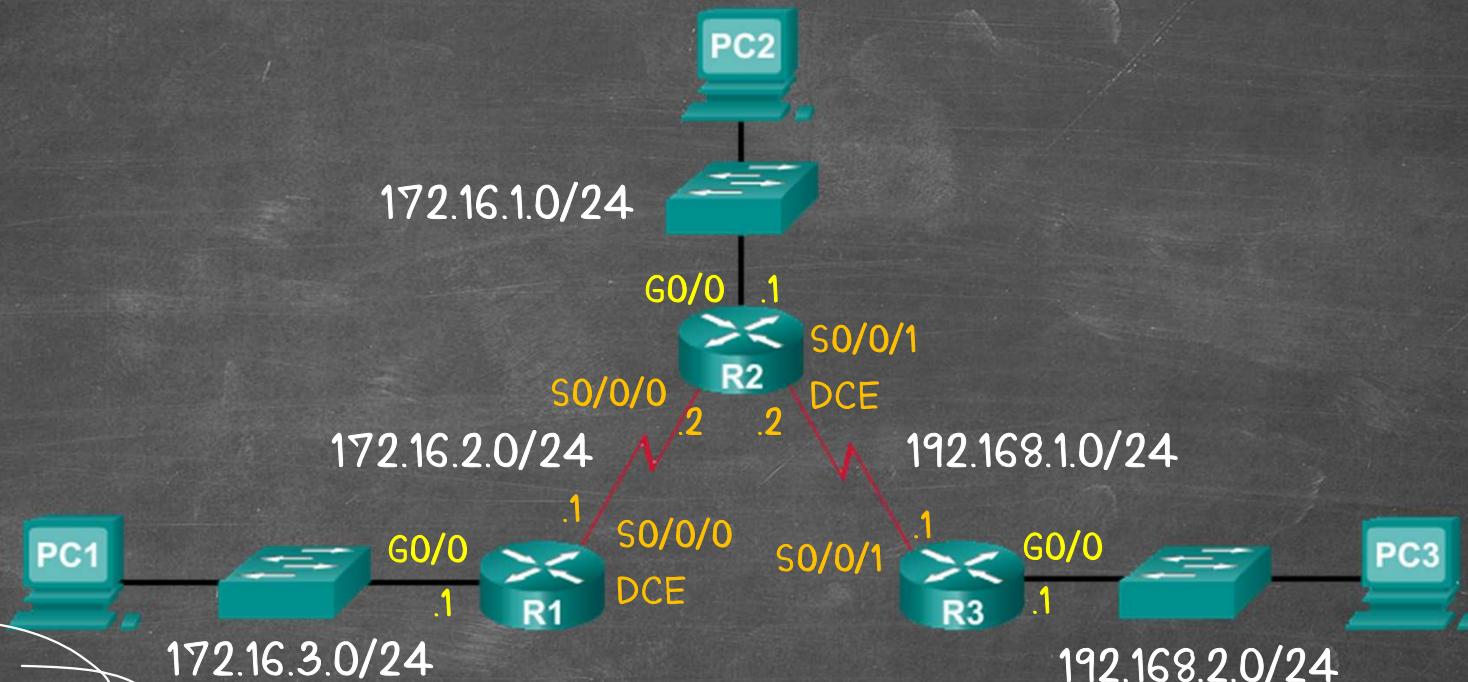
ការផ្តល់ព័ត៌មាន

network និង រាយការណ៍

```
Router(config)#ip route 0.0.0.0 0.0.0.0 {ip-address | exit-intf}
```

Parameter	Description
0.0.0.0	Matches any network address.
0.0.0.0	Matches any subnet mask.
ip-address	<ul style="list-style-type: none">Commonly referred to as the next-hop router's IP address.Typically used when connecting to a broadcast media (i.e., Ethernet).Commonly creates a recursive lookup.
exit-intf	<ul style="list-style-type: none">Use the outgoing interface to forward packets to the destination network.Also referred to as a directly attached static route.Typically used when connecting in a point-to-point configuration.

Configure IPv4 Static Routes



Default Static Route

```
R3(config)#ip route 0.0.0.0 0.0.0.0 172.16.2.2
```

ఈ రూట్ లో డేఫుల్ట్ రూట్ లేదా
కొన్వెంట్ రూట్ లేదా
కొన్వెంట్ రూట్ లేదా

default
route

```
R1#show ip route | begin Gateway
Gateway of last resort is not set
S* 0.0.0.0/0 [1/0] via 172.16.2.2
    172.16.0.0/16 is variably subnetted, 5 subnets, 2 masks
    C    172.16.2.0/24 is directly connected, Serial0/0/0
    L    172.16.2.1/32 is directly connected, Serial0/0/0
    C    172.16.3.0/24 is directly connected, GigabitEthernet0/0/0
    L    172.16.3.1/32 is directly connected, GigabitEthernet0/0/0
```

```
R1#show ip route static
Gateway of last resort is 172.16.2.2 to network 0.0.0.0
S* 0.0.0.0/0 [1/0] via 172.16.2.2
```

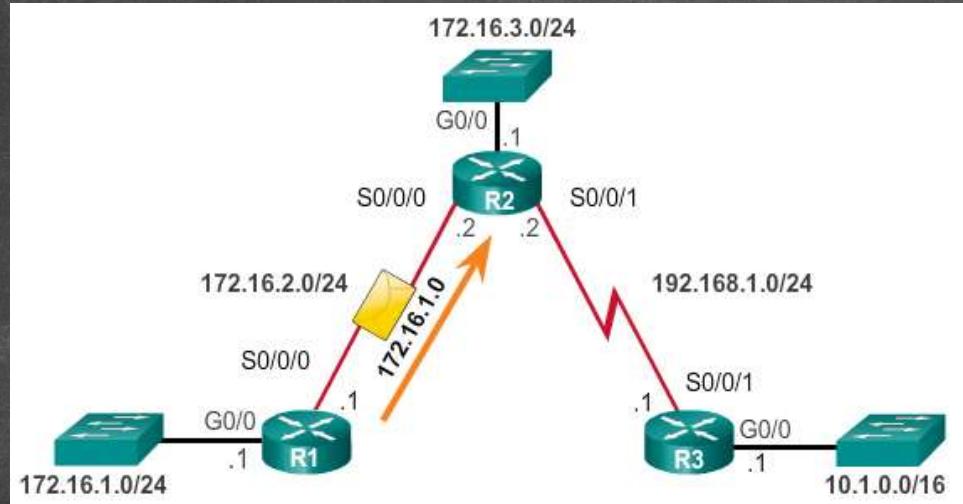
Classful Addressing

- Classful Network Addressing → กำหนด class

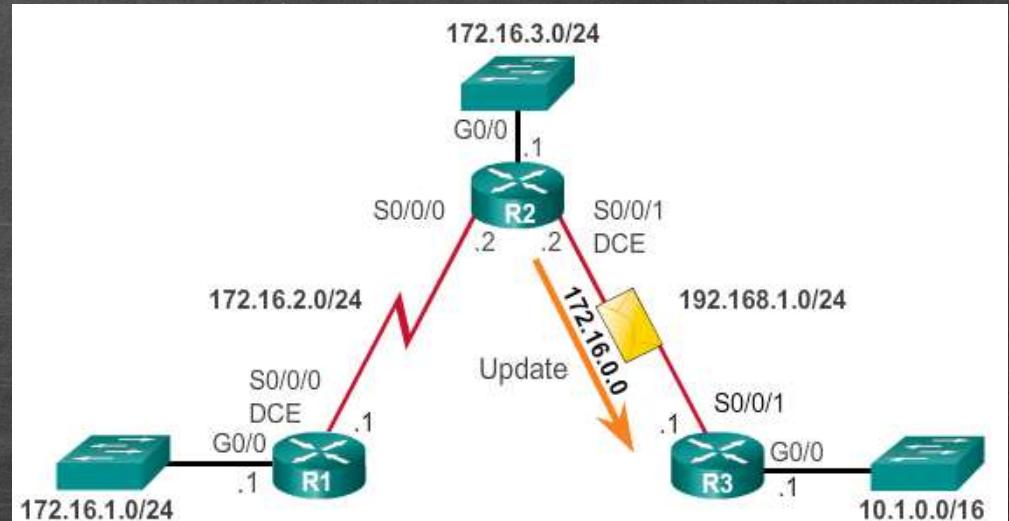
Class	High Order Bits	Start	End
Class A	0xxxxxxx	0.0.0.0	127.255.255.255
Class B	10xxxxxx	128.0.0.0	191.255.255.255
Class C	110xxxxx	192.0.0.0	223.255.255.255
Multicast	1110xxxx	224.0.0.0	239.255.255.255
Reserved	1111xxxx	240.0.0.0	255.255.255.255

Classful Addressing

- Classful Routing Protocol Example

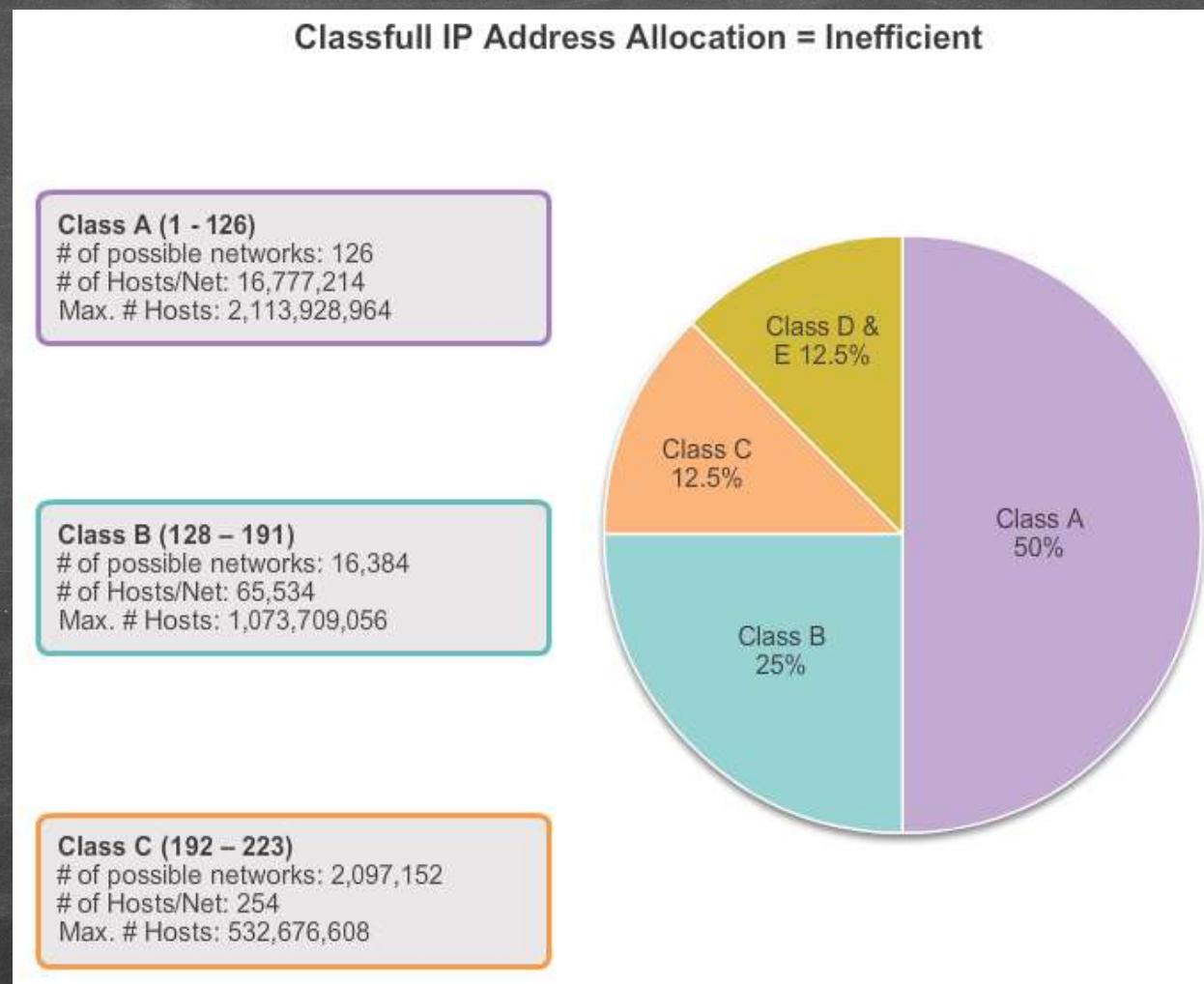


ims update (dynamic) dynamic route
 ↓
 update network
 not update subnet
 classless → update subnet ပေး



Classful Addressing

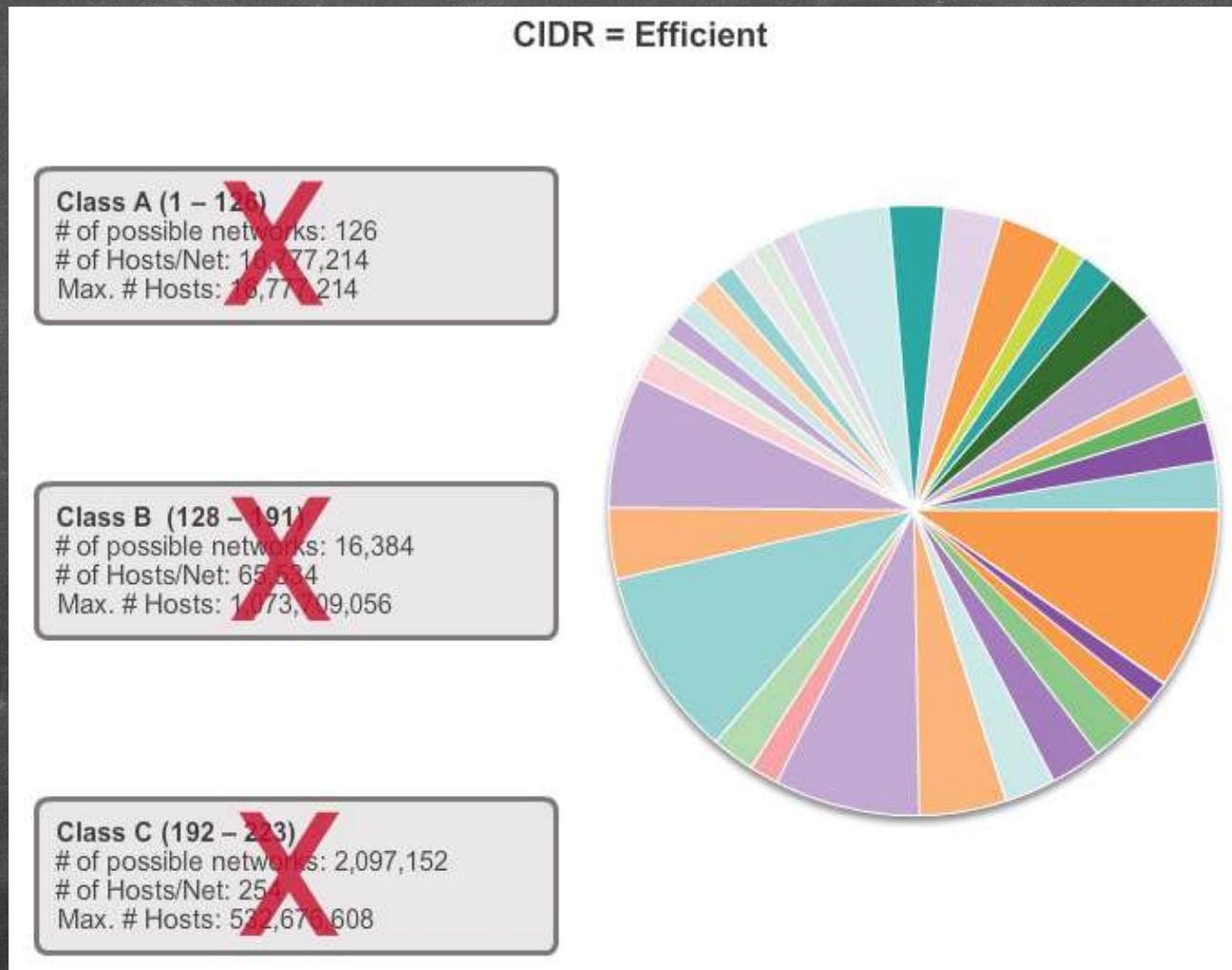
- Classful Addressing Waste



CIDR

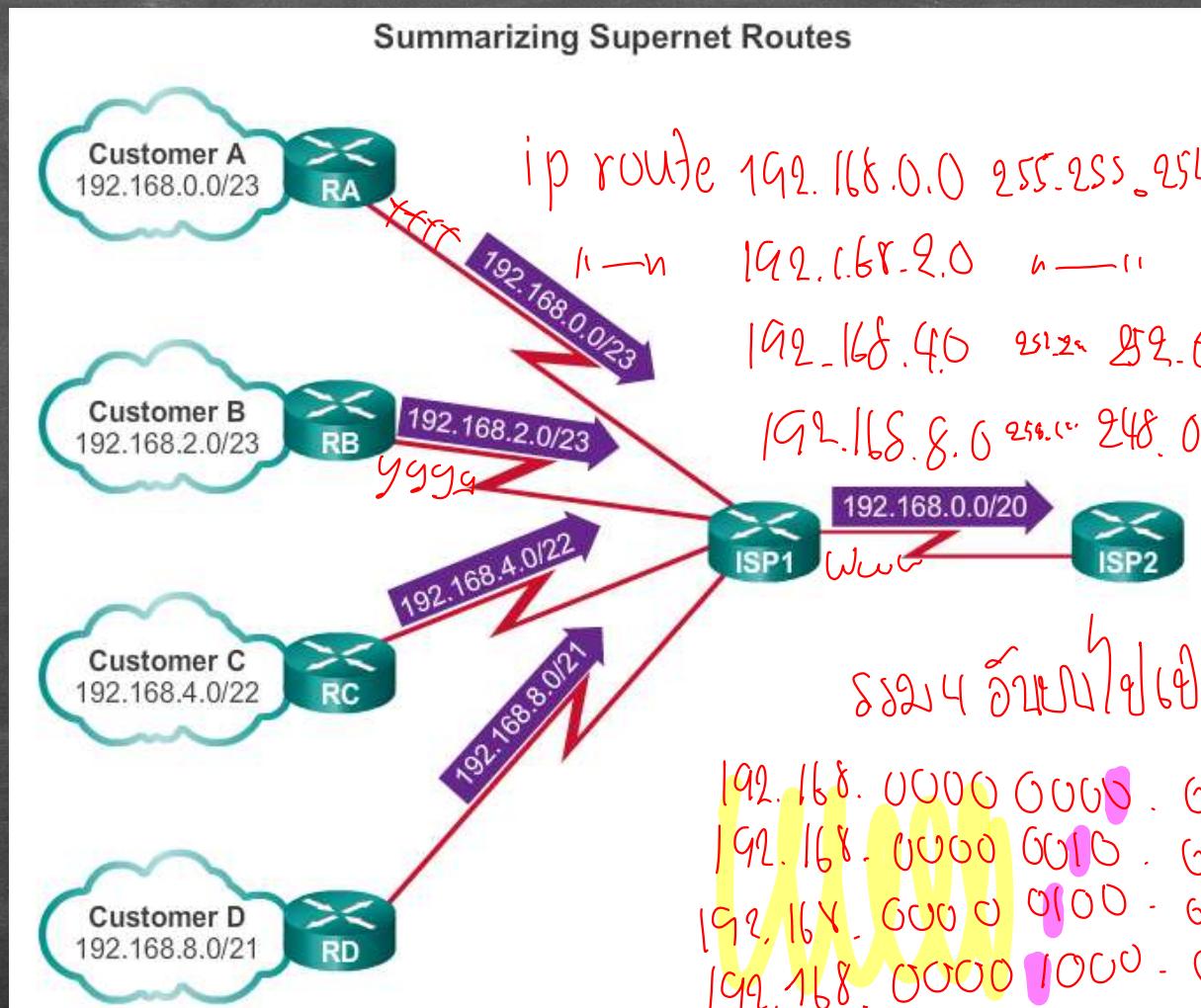
ကြေးပြန်လည်စုတေသန

• Classless Inter-Domain Routing



CIDR

- CIDR and Route Summarization → (long) summary route



ନେ ଓରାଗ୍ରୀ

CIDR

ip route 199.168.0.0 255.255.940.0

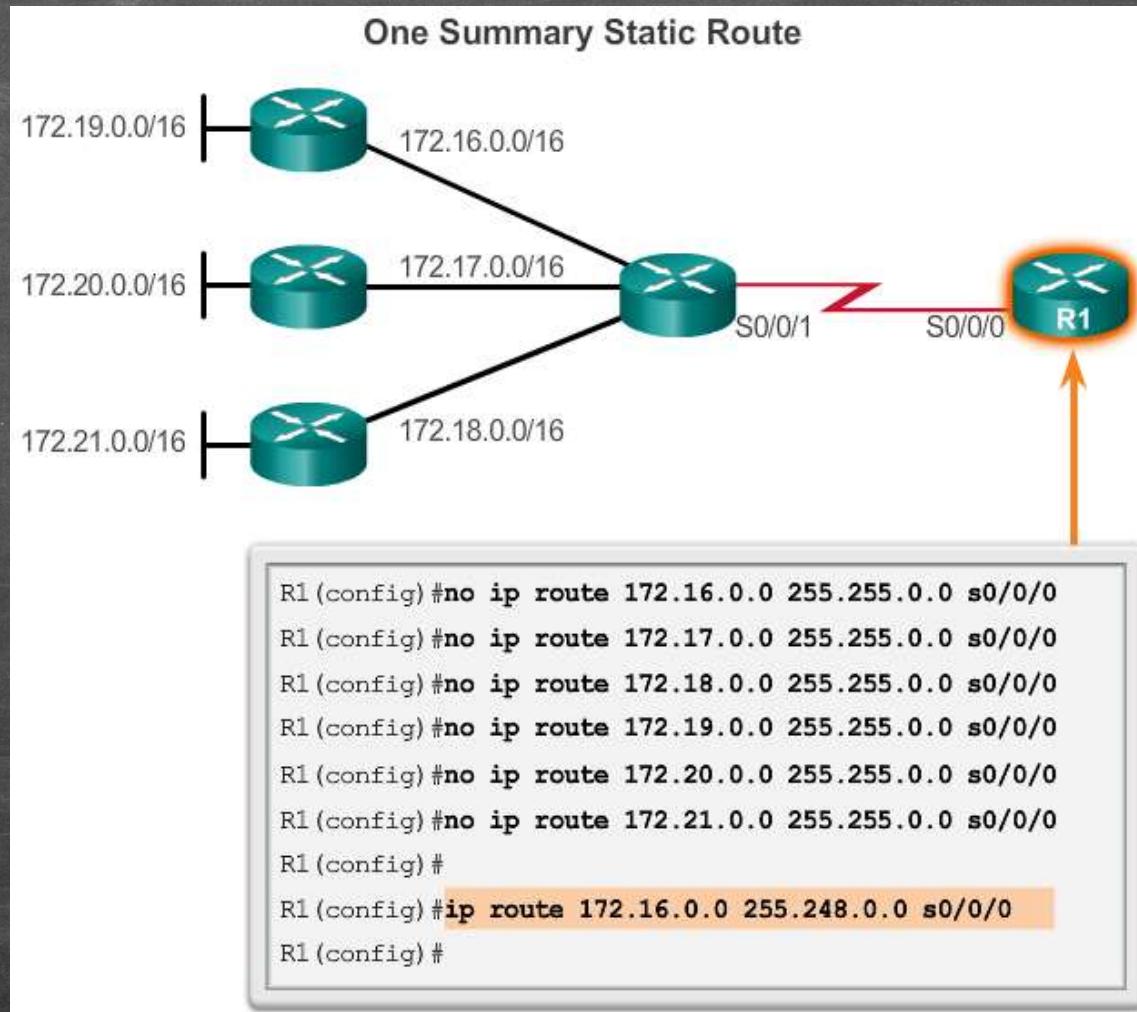
- Static Routing CIDR Example

ବୀଜୁପଣାମାର୍କୁର୍ଯ୍ୟୋଗୀ

ପାଇଁତାହିଁଲେଖିବାକୁର୍ଯ୍ୟୋଗୀ

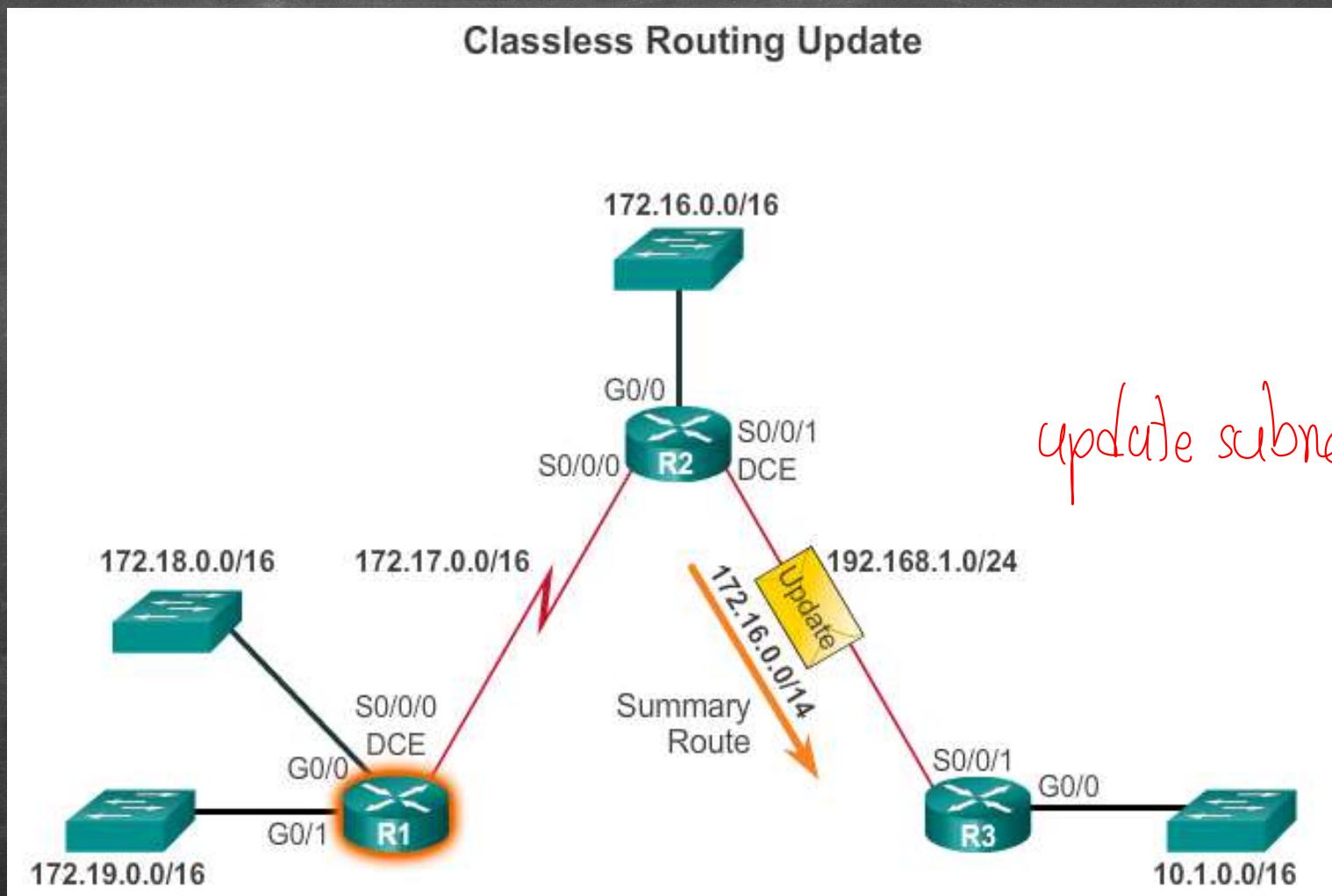
କିମ୍ବା

ସମ୍ପଦ → /୨୦



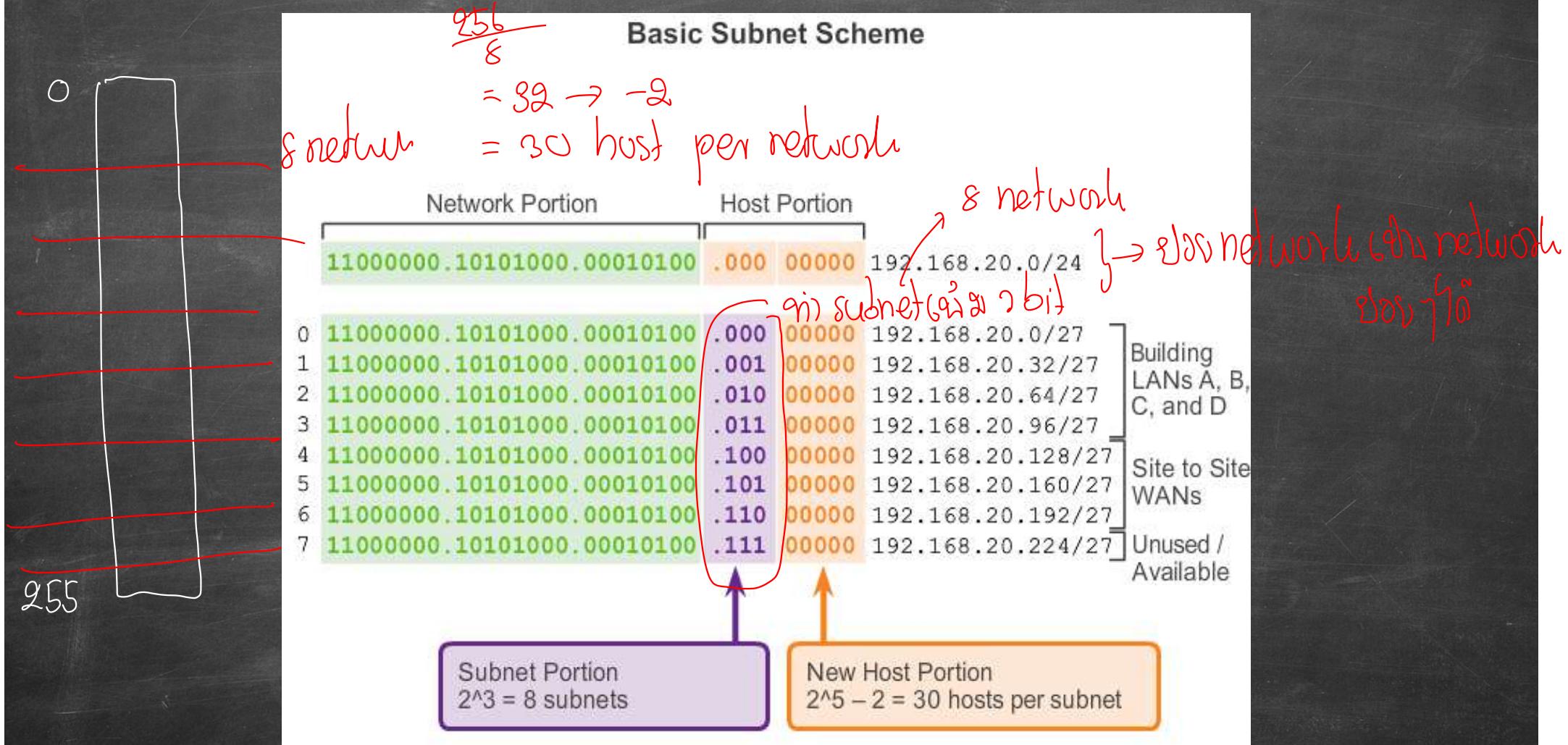
CIDR

- Classless Routing Protocol Example



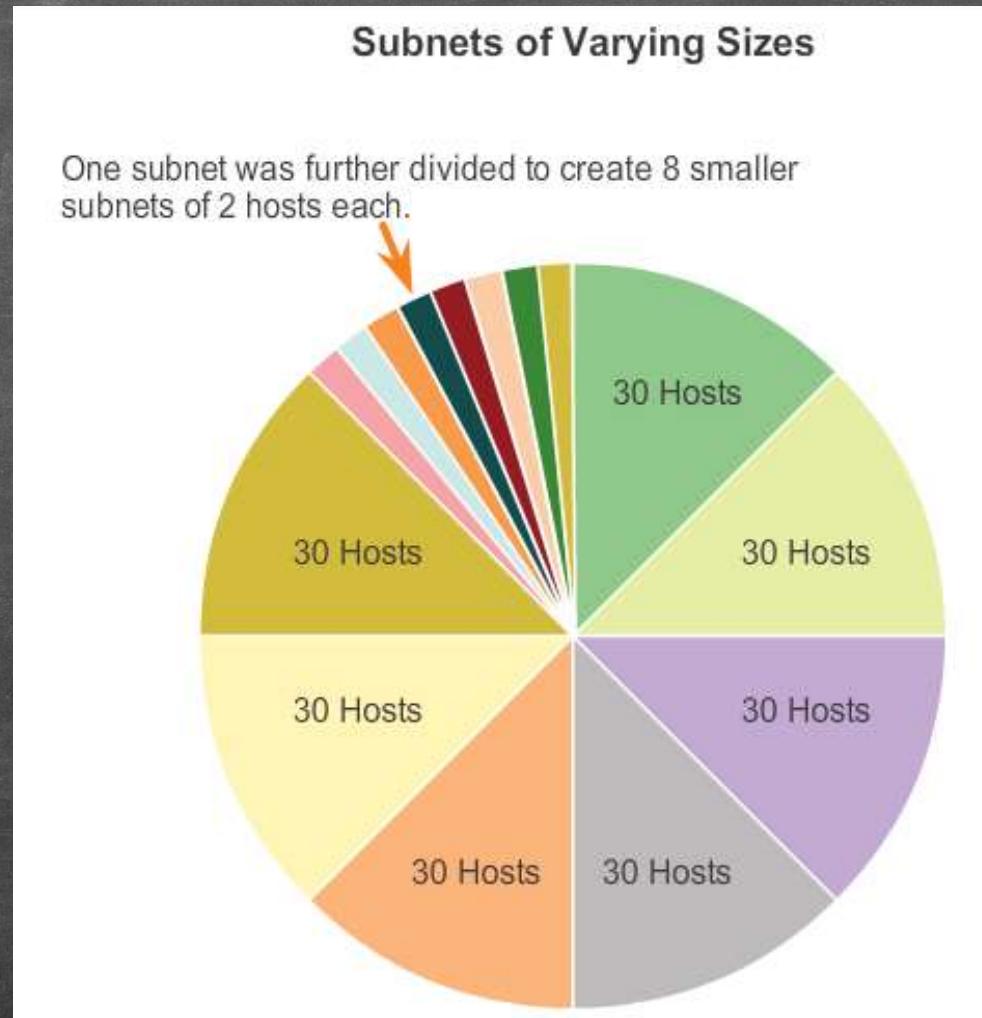
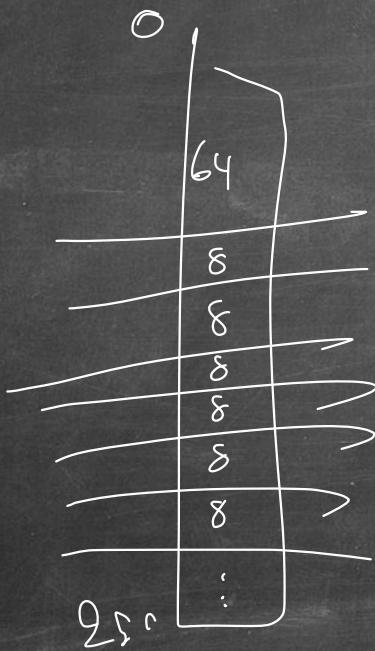
VLSM

- Fixed Length Subnet Masking → ก่อสร้าง subnet บนเครือข่าย



VLSM

- Variable Length Subnet Masking → Subnet 181.111.12.191/28

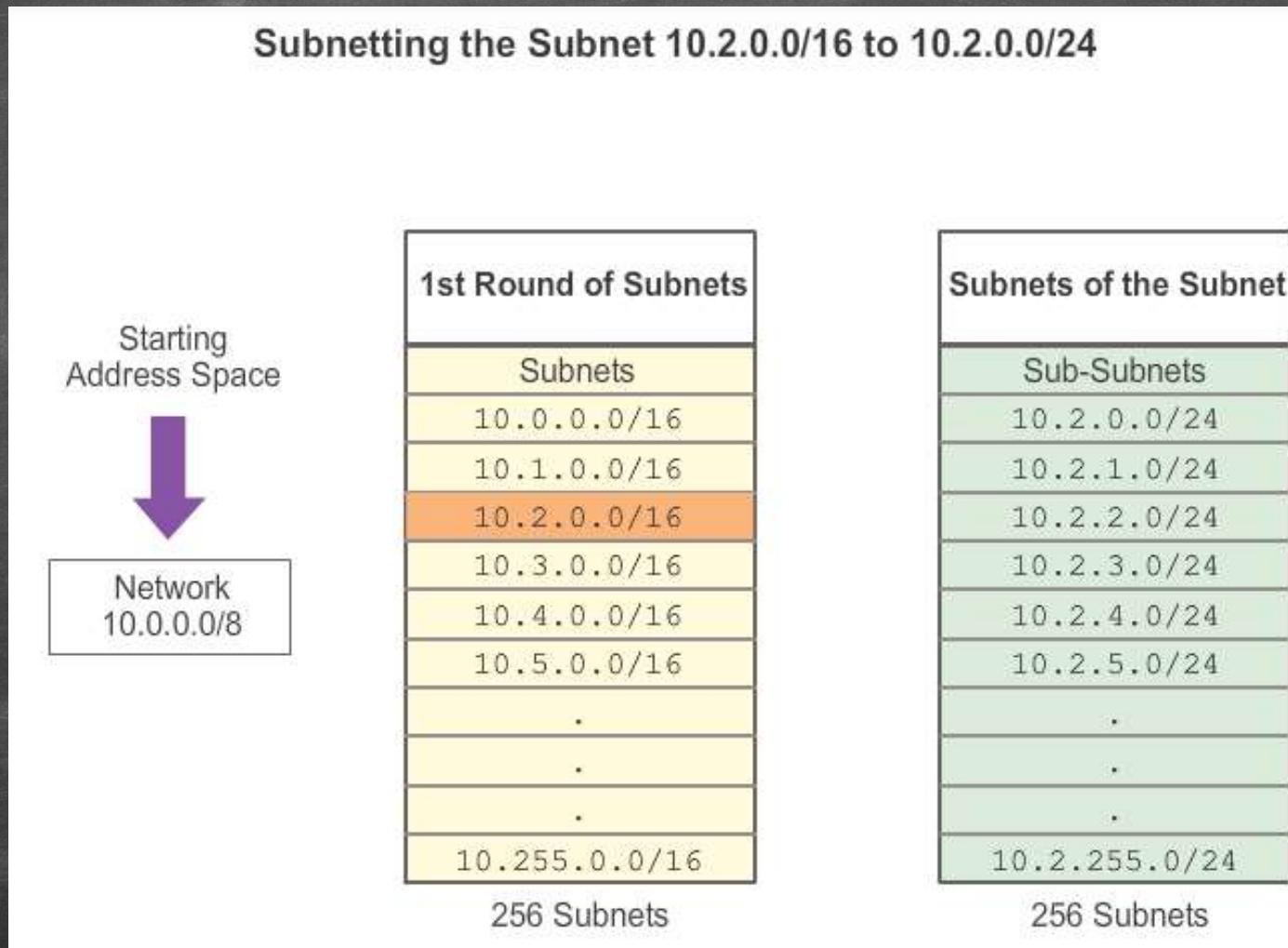


VLSM

- VLSM in Action
 - VLSM allows the use of different masks for each subnet.
 - After a network address is subnetted, those subnets can be further subnetted.
 - VLSM is simply subnetting a subnet. VLSM can be thought of as sub-subnetting.
 - Individual host addresses are assigned from the addresses of "sub-subnets".

VLSM

- Subnetting Subnets

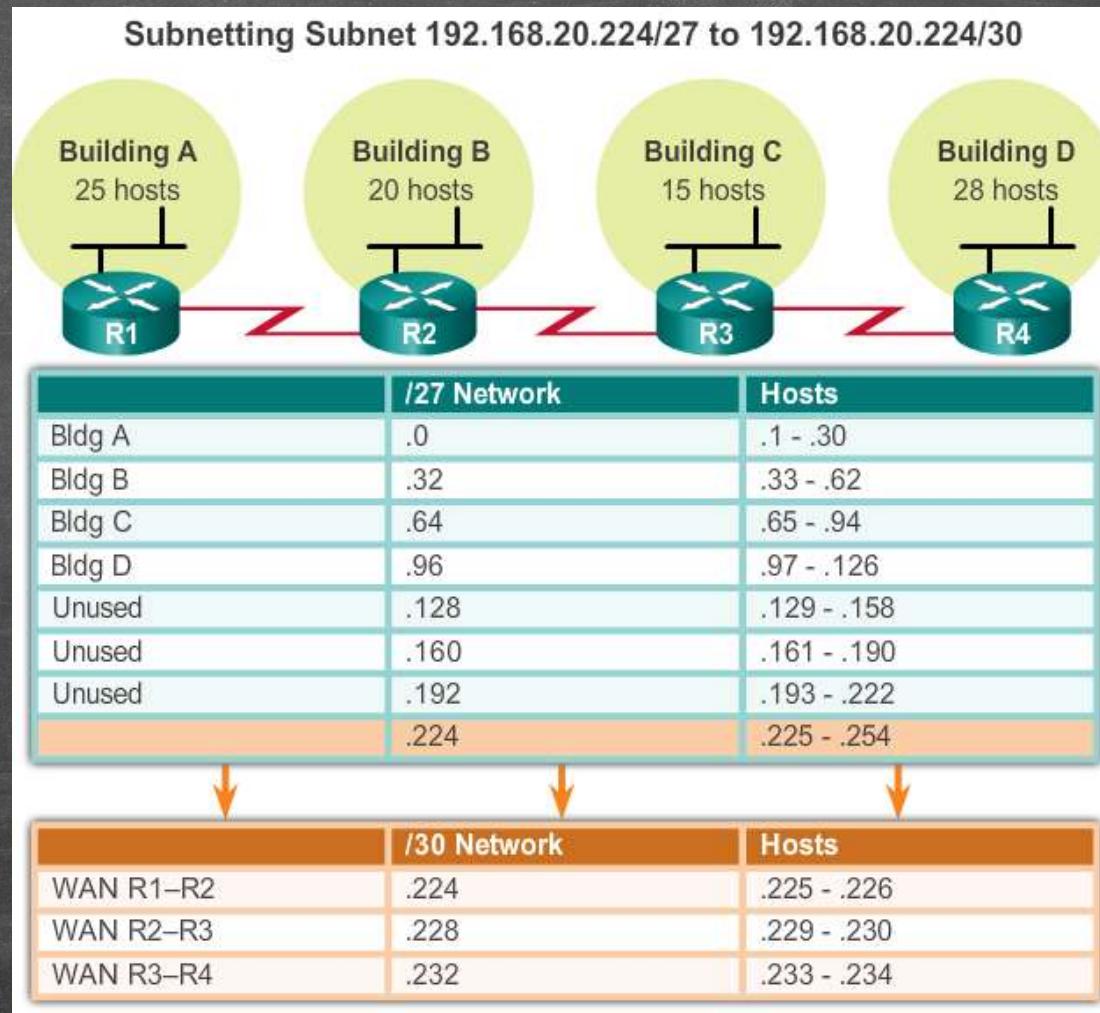


8/15

VLSM

VL2

- VLSM Example



Configure IPv4 Summary Routes

အုပါပေါ်

- Route summarization, also known as route aggregation, is the process of advertising a contiguous set of addresses as a single address with a less-specific, shorter subnet mask.
- CIDR is a form of route summarization and is synonymous with the term supernetting.
- CIDR ignores the limitation of classful boundaries, and allows summarization with masks that are smaller than that of the default classful mask.
- This type of summarization helps reduce the number of entries in routing updates and lowers the number of entries in local routing tables.

Configure IPv4 Summary Routes

- Calculate a Summary Route

Calculating a Route Summary

Step 1: List networks in binary format.

172.20.0.0	10101100 . 00010100 . 00000000 . 00000000
172.21.0.0	10101100 . 00010101 . 00000000 . 00000000
172.22.0.0	10101100 . 00010110 . 00000000 . 00000000
172.23.0.0	10101100 . 00010111 . 00000000 . 00000000

Step 2: Count the number of far-left matching bits to determine the mask.

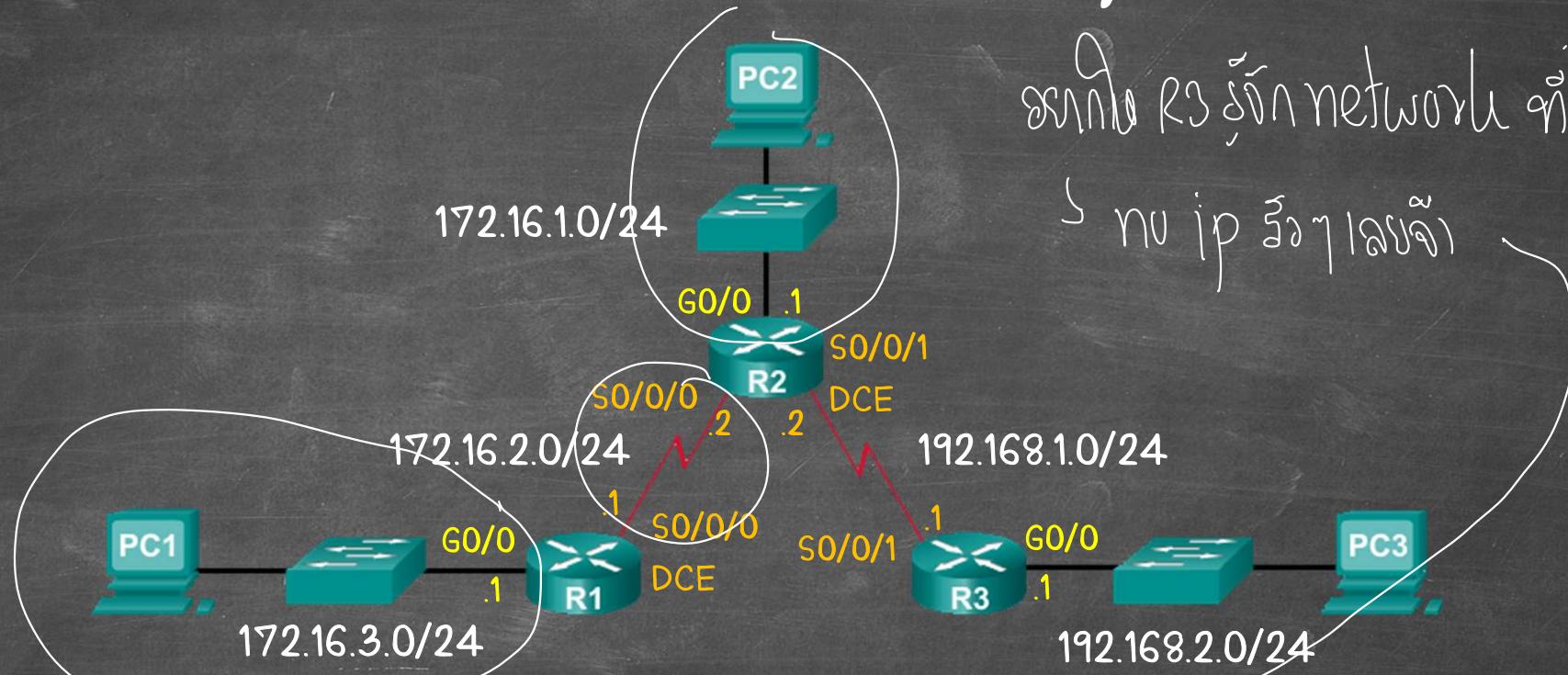
Answer: 14 matching bits = /14 or 255.252.0.0

Step 3: Copy the matching bits and add zero bits to determine the network address.

10101100 . 00010100 . 00000000 . 00000000
Copy Add zero bits

Answer: 172.20.0.0

Configure IPv4 Summary Routes



```
R3#show ip route static | begin Gateway
Gateway of last resort is not set
  172.16.0.0/24 is subnet, 3 subnets
S    172.16.1.0/24 [1/0] via 192.168.1.2
S    172.16.2.0/24 [1/0] via 192.168.1.2
S    172.16.3.0/24 [1/0] via 192.168.1.2
```

```
R3(config)#no ip route 172.16.1.0 255.255.255.0 192.168.1.2
R3(config)#no ip route 172.16.2.0 255.255.255.0 192.168.1.2
R3(config)#no ip route 172.16.3.0 255.255.255.0 192.168.1.2
R3(config)#ip route 172.16.0.0 255.255.252.0 192.168.1.2
```

```
R3#show ip route static | begin Gateway
Gateway of last resort is not set
  172.16.0.0/22 is subnet, 1 subnets
S    172.16.1.0 [1/0] via 192.168.1.2
```

Summary Boundary	
Routes that can be summarized	First 22 bits are the same
172.16.1.0 172.16.2.0 172.16.3.0	01011100.00010000.00000000 01.00000000 01011100.00010000.00000000 10.00000000 01011100.00010000.00000000 11.00000000
172.16.0.0 255.255.252.0	10101100.00010000.00000000 00.00000000 11111111.11111111.11111111 00.00000000
Summarized into one route	

network ip សាន្ត (លួចដាក់ពី
ប៊ូលុកណាបិប)

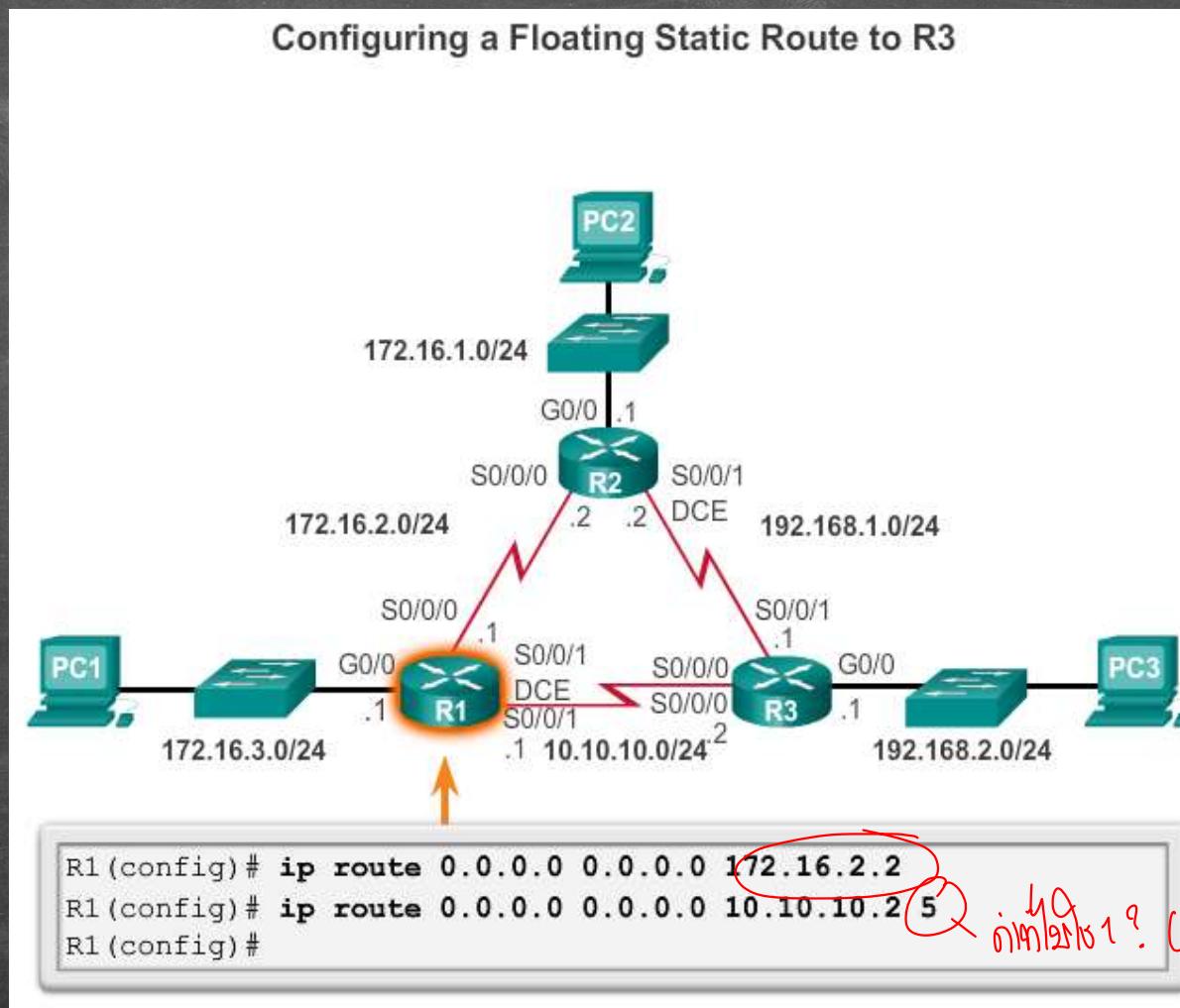
Configure Floating Static Routes

Administrative Distance

- Floating static routes are static routes that have an administrative distance greater than the administrative distance of another static route or dynamic routes.
- The administrative distance of a static route can be increased to make the route less desirable than that of another static route or a route learned through a dynamic routing protocol.
- In this way, the static route “floats” and is not used when the route with the better administrative distance is active.
- However, if the preferred route is lost, the floating static route can take over, and traffic can be sent through this alternate route.

Configure Floating Static Routes

- Configure a Floating Static Route



Configure Floating Static Routes

- Test the Floating Static Route
 - Use a show ip route command to verify that the routing table is using the default static route.
 - Use a traceroute command to follow the traffic flow out the primary route.
 - Disconnect the primary link or shutdown the primary exit interface.
 - Use a show ip route command to verify that the routing table is using the floating static route.
 - Use a traceroute command to follow the traffic flow out the backup route.

Troubleshoot IPv4 Static and Default Route Configuration

- ## • Troubleshoot a Missing Route

ping

traceroute

show ip route

show ip interface brief

show cdp neighbors detail

{ କୁଳାଶାଖାପଣ୍ଡିତ }

ଓঁ প্রিয়ার্থ পুষ্পপুরুষ

Questions and Answers

