Advanced Computer Network

LECTURE 4

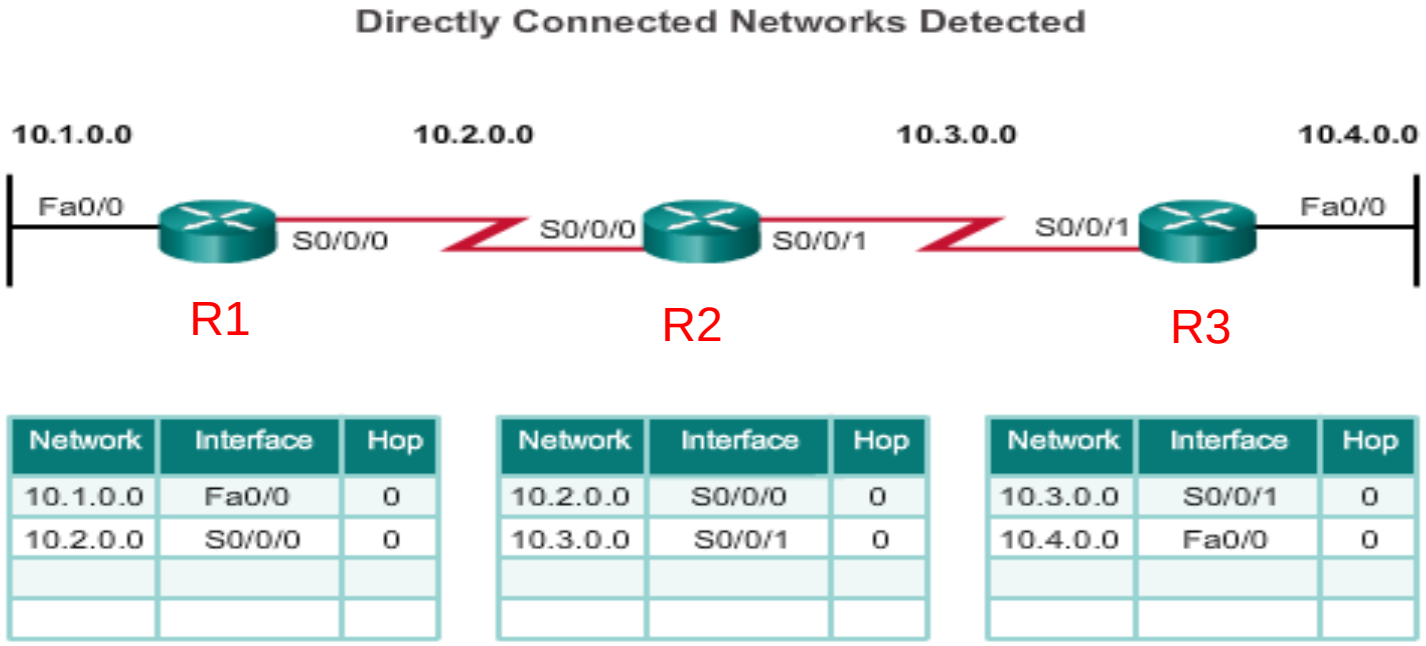
RIP (Router Information Protocol)

What is RIP?

RIP is

- A dynamic routing protocol used in small to medium-sized networks.
- It is a Distance-vector protocol.
- One of the oldest and simplest routing protocols that was introduced in 1988.
- RIPv2 appears in 1993 which supports classless routing.
- RIPng supports IPv6.

An Example of how RIP works



Network	Interface	Hop
10.1.0.0	Fa0/0	0
10.2.0.0	S0/0/0	0

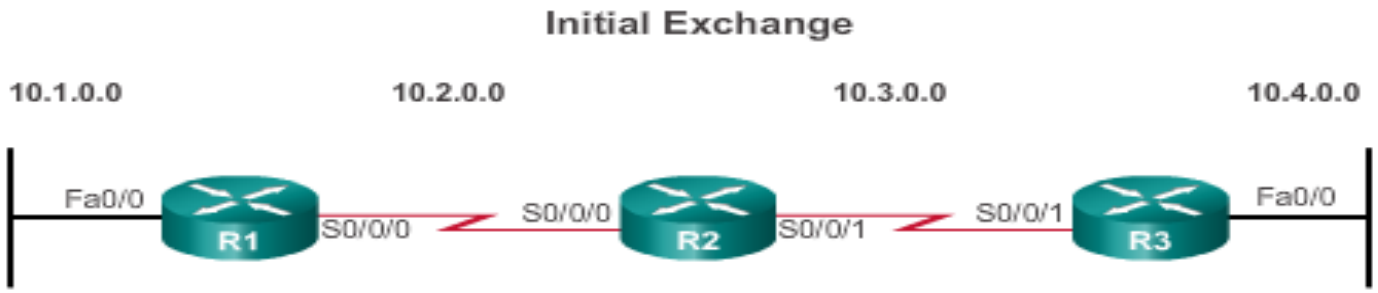
Network	Interface	Hop
10.2.0.0	S0/0/0	0
10.3.0.0	S0/0/1	0

Network	Interface	Hop
10.3.0.0	S0/0/1	0
10.4.0.0	Fa0/0	0

Routers running RIPv2

- **R1** adds the **10.1.0.0** network available through interface **FastEthernet 0/0** and 10.2.0.0 is available through interface Serial 0/0/0.
- **R2** adds the 10.2.0.0 network available through interface Serial 0/0/0 and 10.3.0.0 is available through interface Serial 0/0/1.
- **R3** adds the 10.3.0.0 network available through interface Serial 0/0/1 and **10.4.0.0** is available through interface **FastEthernet 0/0.**

An Example of how RIP works



Network	Interface	Hop
10.1.0.0	Fa0/0	0
10.2.0.0	S0/0/0	0
10.3.0.0	S0/0/0	1

Network	Interface	Hop
10.2.0.0	S0/0/0	0
10.3.0.0	S0/0/1	0
10.1.0.0	S0/0/0	1
10.4.0.0	S0/0/1	1

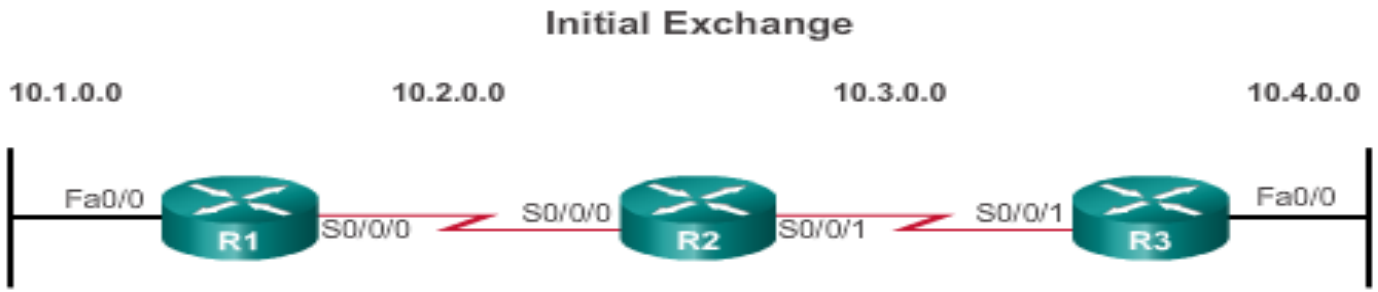
Network	Interface	Hop
10.3.0.0	S0/0/0	0
10.4.0.0	Fa0/0	0
10.2.0.0	S0/0/1	1

Routers running RIPv2

R1: metric 1

- **Sends** an update about network **10.1.0.0** out the Serial0/0/0 interface
- **Sends** an update about network 10.2.0.0 out the **FastEthernet0/0** interface
- **Receives** update from **R2** about network 10.3.0.0 with a metric of 1
- **Stores** network 10.3.0.0 in the routing table with a metric of 1

An Example of how RIP works



Network	Interface	Hop
10.1.0.0	Fa0/0	0
10.2.0.0	S0/0/0	0
10.3.0.0	S0/0/0	1

Network	Interface	Hop
10.2.0.0	S0/0/0	0
10.3.0.0	S0/0/1	0
10.1.0.0	S0/0/0	1
10.4.0.0	S0/0/1	1

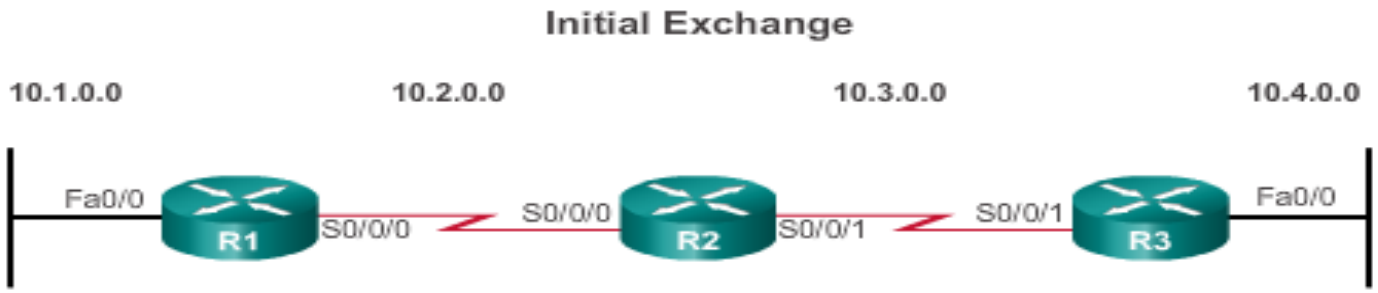
Network	Interface	Hop
10.3.0.0	S0/0/0	0
10.4.0.0	Fa0/0	0
10.2.0.0	S0/0/1	1

Routers running RIPv2

R2: metric 1

- **Sends** an update about network 10.3.0.0 out the Serial 0/0/0 interface
- **Sends** an update about network 10.2.0.0 out the Serial 0/0/1 interface
- **Receives** an update from **R1** about network 10.1.0.0 with a metric of 1
- **Stores** network 10.1.0.0 in the routing table with a metric of 1
- **Receives** an update from **R3** about network 10.4.0.0 with a metric of 1
- **Stores** network 10.4.0.0 in the routing table with a metric of 1

An Example of how RIP works



Network	Interface	Hop
10.1.0.0	Fa0/0	0
10.2.0.0	S0/0/0	0
10.3.0.0	S0/0/0	1

Network	Interface	Hop
10.2.0.0	S0/0/0	0
10.3.0.0	S0/0/1	0
10.1.0.0	S0/0/0	1
10.4.0.0	S0/0/1	1

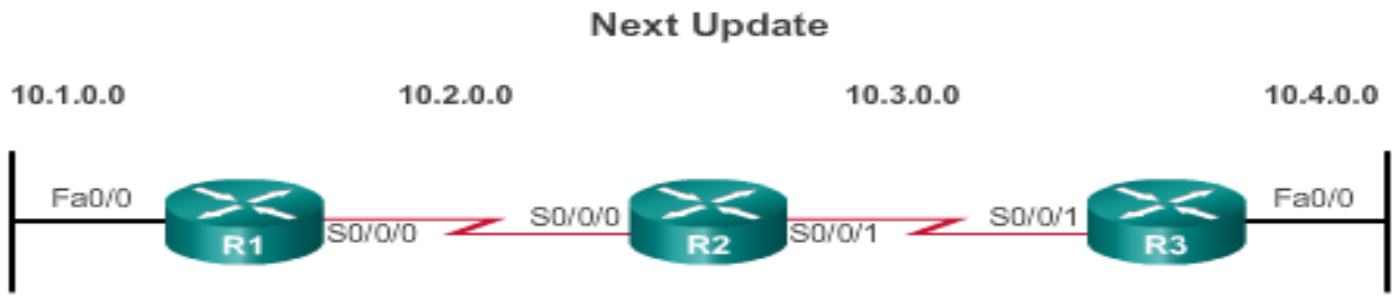
Network	Interface	Hop
10.3.0.0	S0/0/0	0
10.4.0.0	Fa0/0	0
10.2.0.0	S0/0/1	1

Routers running RIPv2

R3: **metric 1**

- **Sends** an update about network 10.4.0.0 out the Serial 0/0/1 interface
- **Sends** an update about network 10.3.0.0 out the FastEthernet0/0
- **Receives** an update from **R2** about network 10.2.0.0 with a metric of 1
- **Stores** network 10.2.0.0 in the routing table with a metric of 1

An Example of how RIP works



Network	Interface	Hop
10.1.0.0	Fa0/0	0
10.2.0.0	S0/0/0	0
10.3.0.0	S0/0/0	1
10.4.0.0	S0/0/0	2

Network	Interface	Hop
10.2.0.0	S0/0/0	0
10.3.0.0	S0/0/1	0
10.1.0.0	S0/0/0	1
10.4.0.0	S0/0/1	1

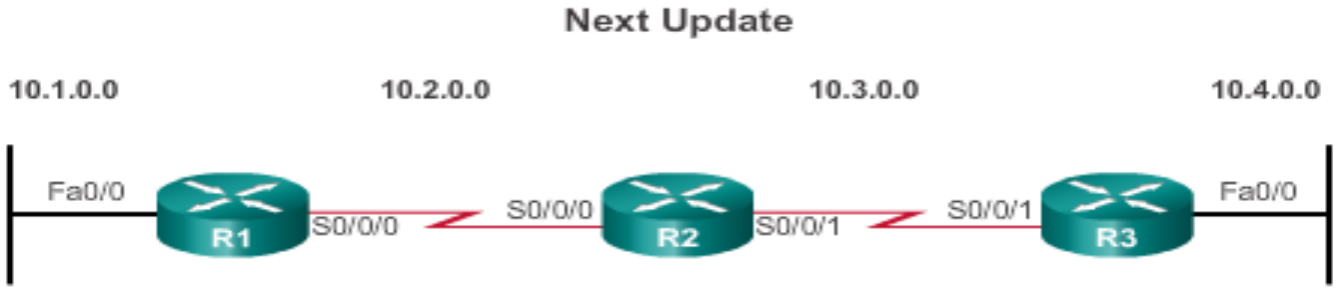
Network	Interface	Hop
10.3.0.0	S0/0/1	0
10.4.0.0	Fa0/0	0
10.2.0.0	S0/0/1	1
10.1.0.0	S0/0/1	2

Routers running RIPv2

R1: metric 2

- **Sends** an update about network 10. 1. 0. 0 out the Serial 0/0/0 interface
- **Sends** an update about networks 10. 2. 0. 0 and 10. 3. 0. 0 out the FastEthernet0/0 interface
- **Receives** an update from R2 about network 10. 4. 0. 0 with a metric of 2
- **Stores** network 10. 4. 0. 0 in the routing table with a metric of 2
- **Same update** from R2 contains information about network 10. 3. 0. 0 with a metric of 1. There is no change; therefore, the routing information remains the same

An Example of how RIP works



Network	Interface	Hop
10.1.0.0	Fa0/0	0
10.2.0.0	S0/0/0	0
10.3.0.0	S0/0/0	1
10.4.0.0	S0/0/0	2

Network	Interface	Hop
10.2.0.0	S0/0/0	0
10.3.0.0	S0/0/1	0
10.1.0.0	S0/0/0	1
10.4.0.0	S0/0/1	1

Network	Interface	Hop
10.3.0.0	S0/0/1	0
10.4.0.0	Fa0/0	0
10.2.0.0	S0/0/1	1
10.1.0.0	S0/0/1	2

Routers running RIPv2

R2: metric 2

- **Sends** an update about networks 10. 3. 0. 0 and 10. 4. 0. 0 out of Serial 0/0/0 interface
- **Sends** an update about networks 10. 1. 0. 0 and 10. 2. 0. 0 out of Serial 0/0/1 interface
- **Receives** an update from **R1** about network 10. 1. 0. 0. There is no change; therefore, the routing information remains the same.
- **Receives** an update from **R3** about network 10. 4. 0. 0. There is no change; therefore, the routing information remains the same.

An Example of how RIP works

Network	Interface	Hop
10.1.0.0	Fa0/0	0
10.2.0.0	S0/0/0	0
10.3.0.0	S0/0/0	1
10.4.0.0	S0/0/0	2

Network	Interface	Hop
10.2.0.0	S0/0/0	0
10.3.0.0	S0/0/1	0
10.1.0.0	S0/0/0	1
10.4.0.0	S0/0/1	1

Network	Interface	Hop
10.3.0.0	S0/0/1	0
10.4.0.0	Fa0/0	0
10.2.0.0	S0/0/1	1
10.1.0.0	S0/0/1	2

Routers running RIPv2

R3: metric 2

- **Sends** an update about network 10. 4. 0. 0 out the Serial 0/0/1 interface
- **Sends** an update about networks 10. 2. 0. 0 and 10. 3. 0. 0 out the FastEthernet0/0 interface
- **Receives** an update from **R2** about network 10. 1. 0. 0 with a metric of 2
- **Stores** network 10. 1. 0. 0 in the routing table with a metric of 2
- **Same update** from **R2** contains information about network 10. 2. 0. 0 with a metric of 1. There is no change; therefore, the routing information remains the same.

Routing Loops

- Routing loops may be caused by:
  - -Incorrectly configured static routes
  - -Incorrectly configured route redistribution
  - -Slow convergence
  - -Incorrectly configured discard routes
- Routing loops can create the following issues
  - -Excess use of bandwidth
  - -CPU resources may be strained
  - -Network convergence is degraded
  - -Routing updates may be lost or not processed in a timely manner

Routing Loops

- The Split Horizon Rule is used to prevent routing loops
- Split Horizon rule:

  A router should not advertise a network through the interface from which the update came.

Network Convergence

The network is converged when all routers have complete and accurate information about the entire network:

- Convergence time is the time it takes routers to share information, calculate best paths, and update their routing tables.
- A network is not completely operable until the network has converged.
- Convergence properties include the speed of propagation of routing information and the calculation of optimal paths. The speed of propagation refers to the amount of time it takes for routers within the network to forward routing information.

Classful Routing Protocols

Classful routing protocols do not send subnet mask information in their routing updates:

- Only RIPv1 and IGRP are classful.
- Created when network addresses were allocated based on classes (class A, B, or C).
- Cannot provide variable length subnet masks (VLSMs) and classless interdomain routing (CIDR).
- Create problems in discontiguous networks.

Classless Routing Protocols

Classless routing protocols include subnet mask information in the routing updates:

- RIPv2, EIGRP, OSPF, and IS_IS
- Support VLSM and CIDR
- IPv6 routing protocols

RIPV1 and RIPV2 Comparison

Routing updates broadcasted every 30 seconds

RIPv1 versus RIPv2

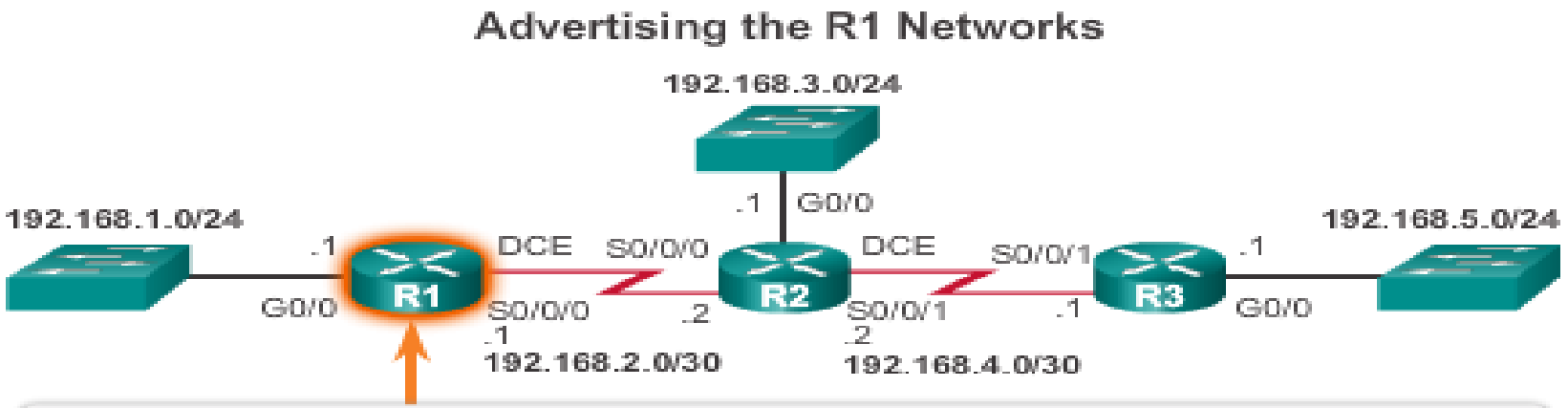
Characteristics and Features	RIPv1	RIPv2
Metric	Both use hop count as a simple metric. The maximum number of hops is 15.	
Updates Forwarded to Address	255.255.255.255	224.0.0.9
Supports VLSM	✗	✓
Supports CIDR	✗	✓
Supports Summarization	✗	✓
Supports Authentication	✗	✓

Updates use UDP port 520

RIPng is based on RIPv2 with a 15 hop limitation and the administrative distance of 120

RIP Configuration Commands Example

```
R1# conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)# router rip
R1(config-router)#
```




```
R1(config)#router rip
R1(config-router)#network 192.168.1.0
R1(config-router)#network 192.168.2.0
R1(config-router)#
```

Protocol Status Verification Example

Verifying RIP Settings on R1

```
R1# show ip protocols
*** IP Routing is NSF aware ***

Routing Protocol is "rip"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Sending updates every 30 seconds, next due in 16 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Redistributing: rip

  Default version control: send version 1, receive any version
    Interface              Send  Recv  Triggered RIP  Key-chain
    GigabitEthernet0/0     1     1 2
    Serial0/0/0            1     1 2

  Automatic network summarization is in effect
  Maximum path: 4
  Routing for Networks:
    192.168.1.0
    192.168.2.0

  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.2.2           120     00:00:15
  Distance: (default is 120)

R1#
```

Routing Table Verification

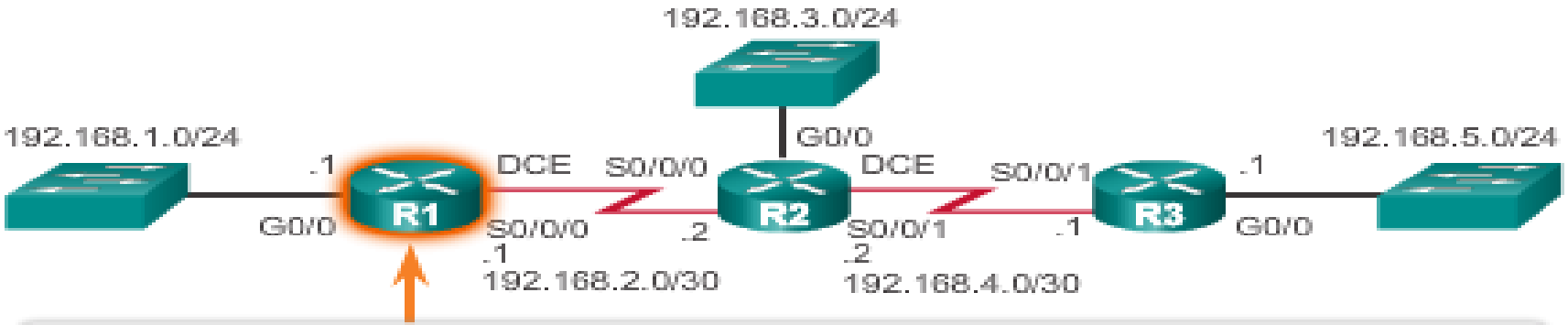
Verifying RIP Routes on R1

```
R1# show ip route | begin Gateway
Gateway of last resort is not set

      192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.1.0/24 is directly connected, GigabitEthernet0/0
L        192.168.1.1/32 is directly connected, GigabitEthernet0/0
      192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.2.0/24 is directly connected, Serial0/0/0
L        192.168.2.1/32 is directly connected, Serial0/0/0
R     192.168.3.0/24 [120/1] via 192.168.2.2, 00:00:24, Serial0/0/0
R     192.168.4.0/24 [120/1] via 192.168.2.2, 00:00:24, Serial0/0/0
R     192.168.5.0/24 [120/2] via 192.168.2.2, 00:00:24, Serial0/0/0
R1#
```

RIPV2 Configuration

Enable and Verify RIPv2 on R1




```
R1(config)# router rip
R1(config-router)# version 2
R1(config-router)# ^Z
R1#
R1# show ip protocols | section Default
  Default version control: send version 2, receive version 2
    Interface              Send  Recv  Triggered RIP  Key-chain
    GigabitEthernet0/0     2     2
    Serial0/0/0            2     2
R1#
```

Auto Summarization

- RIPv1 and RIPv2 automatically summarizes networks at major network boundaries by default.
- To modify the default RIPv2 behavior of automatic summarization, use the **`no auto-summary`** router configuration mode command.
- This command has no effect when using RIPv1.
- When automatic summarization has been disabled, RIPv2 no longer summarizes networks to their classful address at boundary routers. RIPv2 now includes all subnets and their appropriate masks in its routing updates.

Auto Summarization Example

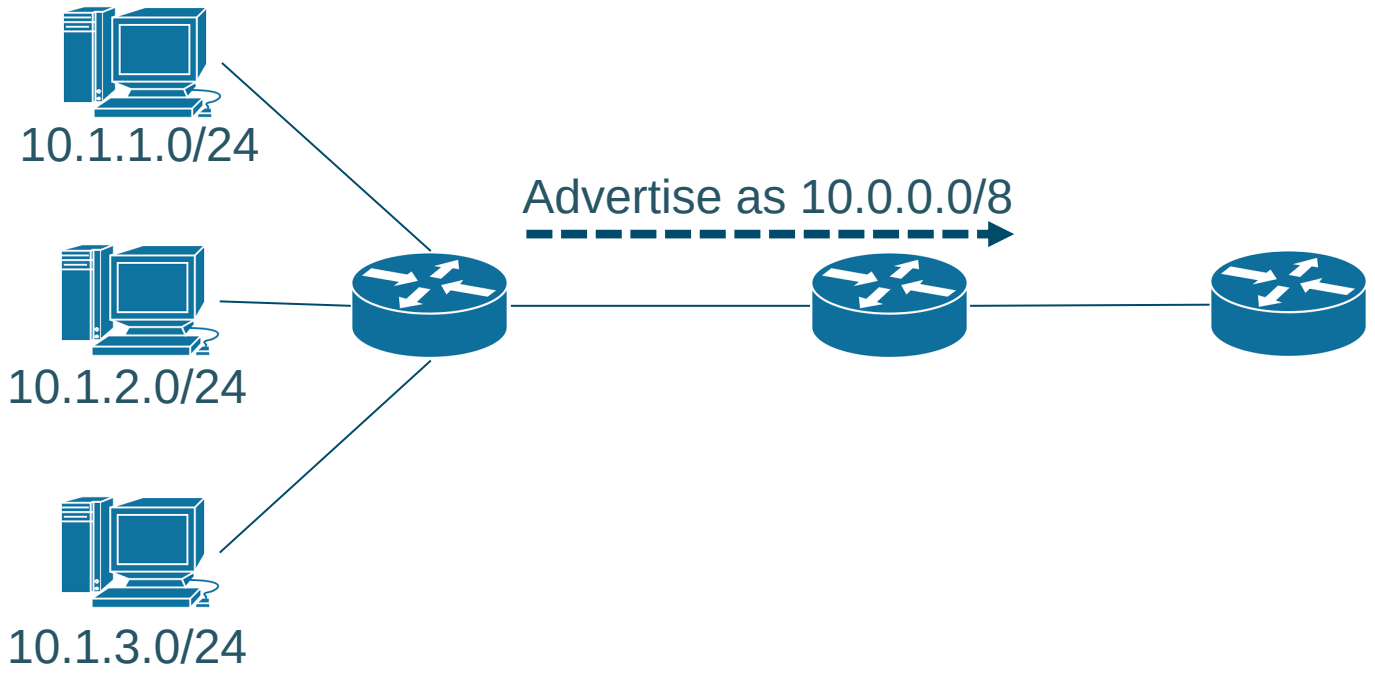
10.1.1.0/24

10.1.2.0/24

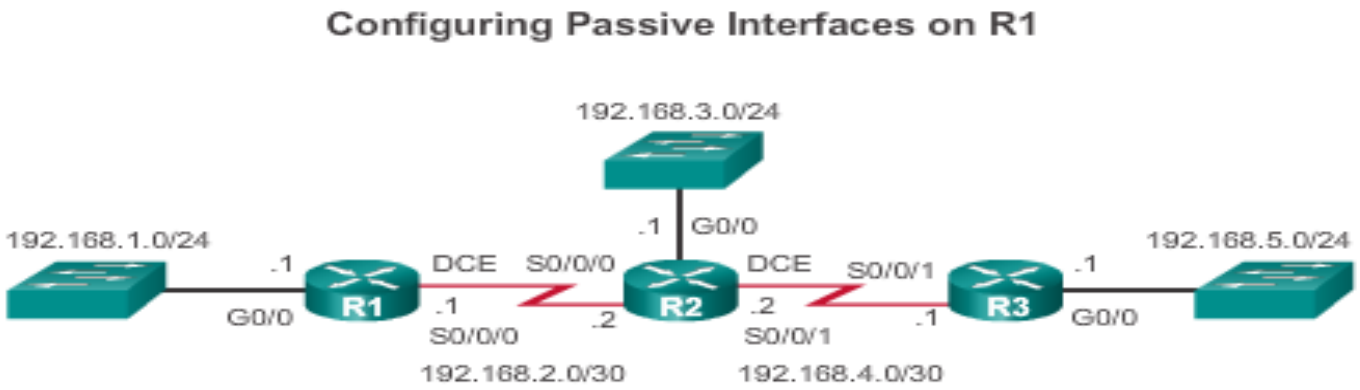
10.1.3.0/24

It will advertise only:

10.0.0.0/8



Passive Interfaces



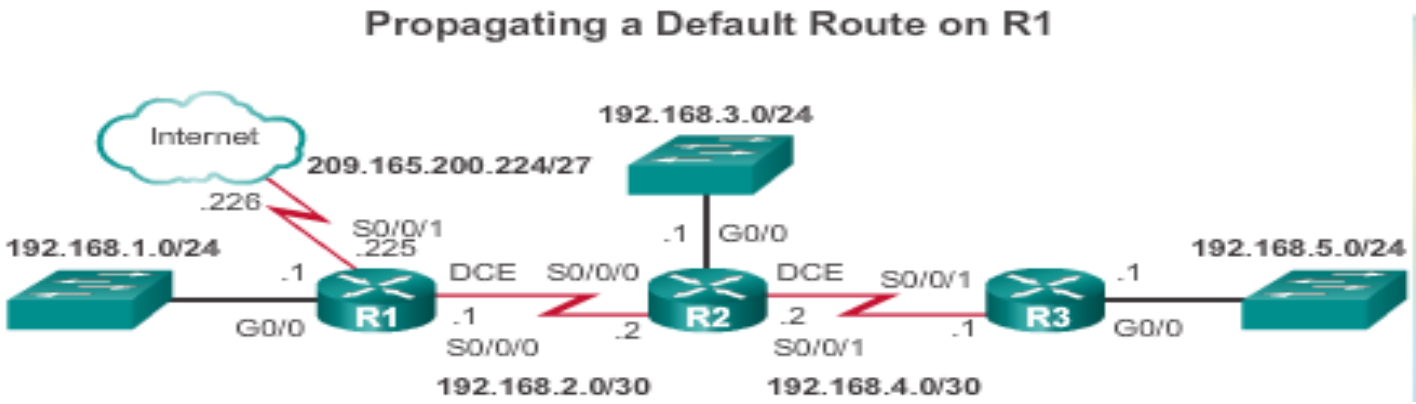
Sending out unneeded updates on a LAN impacts the network in three ways:

- Wasted Bandwidth
- Wasted Resources
- Security Risk

```
R1(config)# router rip
R1(config-router)# passive-interface g0/0
R1(config-router)# end
R1#
R1# show ip protocols | begin Default
  Default version control: send version 2, receive version 2
    Interface              Send  Recv  Triggered RIP  Key-chain
    Serial0/0/0            2     2
  Automatic network summarization is not in effect
  Maximum path: 4
  Routing for Networks:
    192.168.1.0
    192.168.2.0
  Passive Interface(s):
    GigabitEthernet0/0
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.2.2           120      00:00:06
  Distance: (default is 120)

R1#
```

Propagating a Default Route




```
R1(config)# ip route 0.0.0.0 0.0.0.0 S0/0/1 209.165.200.226
R1(config)# router rip
R1(config-router)# default-information originate
R1(config-router)# ^Z
R1#
*Mar 10 23:33:51.801: %SYS-5-CONFIG_I: Configured from
console by console
R1# show ip route | begin Gateway
Gateway of last resort is 209.165.200.226 to network
0.0.0.0

S*    0.0.0.0/0 [1/0] via 209.165.200.226, Serial0/0/1
      192.168.1.0/24 is variably subnetted, 2 subnets, 2
masks
C        192.168.1.0/24 is directly connected,
GigabitEthernet0/0
L        192.168.1.1/32 is directly connected,
GigabitEthernet0/0
      192.168.2.0/24 is variably subnetted, 2 subnets, 2
masks
C        192.168.2.0/24 is directly connected, Serial0/0/0
L        192.168.2.1/32 is directly connected, Serial0/0/0
R     192.168.3.0/24 [120/1] via 192.168.2.2, 00:00:08,
```

Thank you