Video by
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# Distance Vector Routing Protocols

## Routing Protocols and Concepts – Chapter 4

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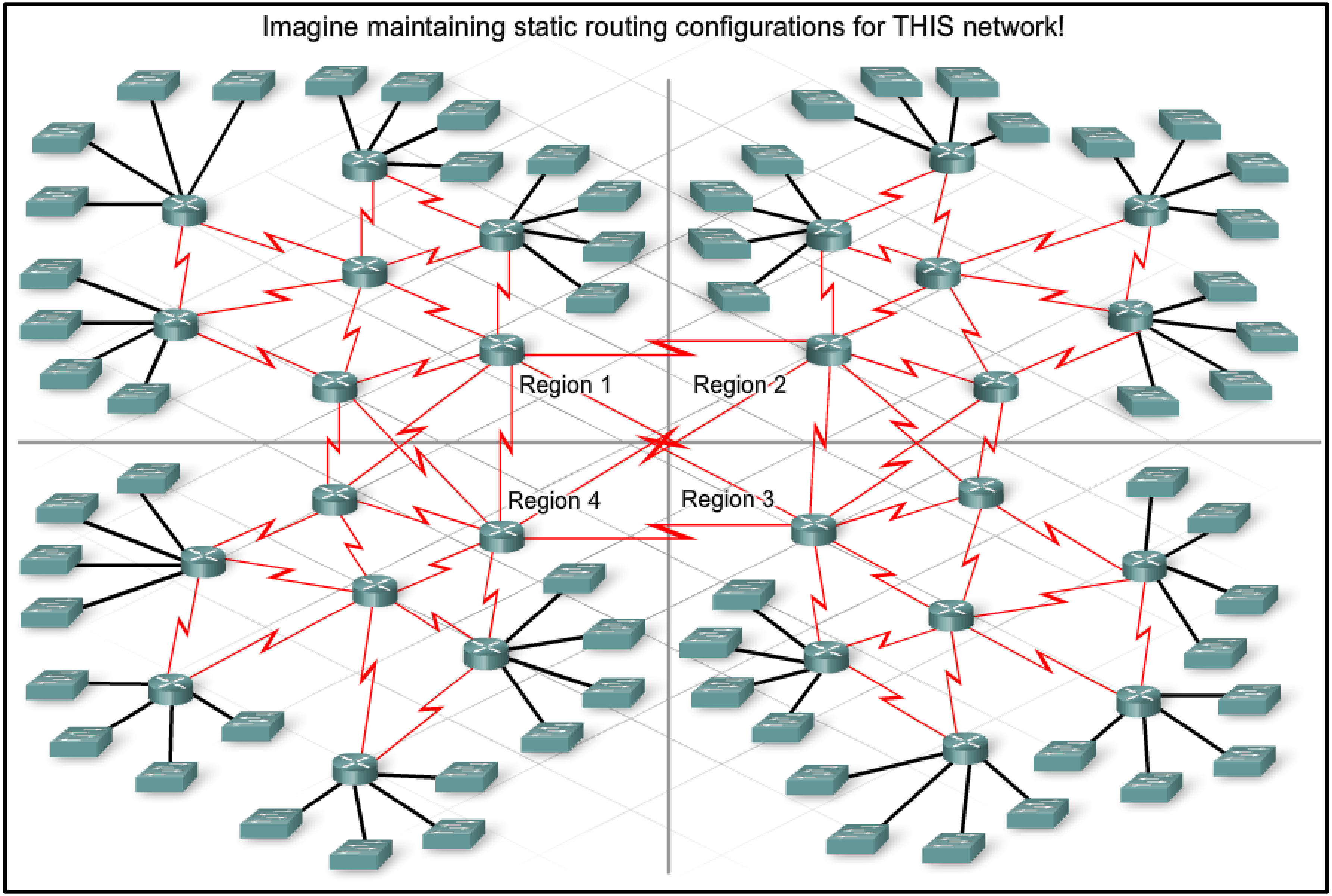
# 4.0.1 Introduction *

| | Interior Gateway Protocols | | | | Exterior Gateway Protocols |
|---|---|---|---|---|---|
| | Distance Vector Routing Protocols | | Link State Routing Protocols | | Path Vector |
| Classful | **RIP** | **IGRP** | | | **EGP** |
| Classless | **RIPv2** | **EIGRP** | **OSPFv2** | **IS-IS** | **BGPv4** |
| IPv6 | **RIPng** | EIGRP for IPv6 | **OSPFv3** | IS-IS for IPv6 | BGPv4 for IPv6 |

In this chapter, you will learn to:

- Identify the characteristics of distance vector routing protocols.
- Describe the network discovery process of distance vector routing protocols using Routing Information Protocol (RIP).
- Describe the processes for maintaining accurate routing tables that are used by distance vector routing protocols.
- Identify the conditions leading to a routing loop and explain the implications for router performance.
- Identify the types of distance vector routing protocols in use today.

# 4.1.1 Distance Vector Routing Protocols *



## Distance vector routing protocols include RIP, IGRP, and EIGRP.

### RIP

Routing Information Protocol (RIP) was originally specified in RFC 1058. It has the following key characteristics:

- Hop count is used as the metric for path selection.
- If the hop count for a network is greater than 15, RIP cannot supply a route to that network.
- Routing updates are broadcast or multicast every 30 seconds, by default.

# 4.1.1 Distance Vector Routing Protocols

## IGRP

Interior Gateway Routing Protocol (IGRP) is a proprietary protocol developed by Cisco. IGRP has the following key design characteristics:

- Bandwidth, delay, load and reliability are used to create a composite metric.
- Routing updates are broadcast every 90 seconds, by default.
- IGRP is the predecessor of EIGRP and is now obsolete.

## EIGRP

Enhanced IGRP (EIGRP) is a Cisco proprietary distance vector routing protocol. EIGRP has these key characteristics:

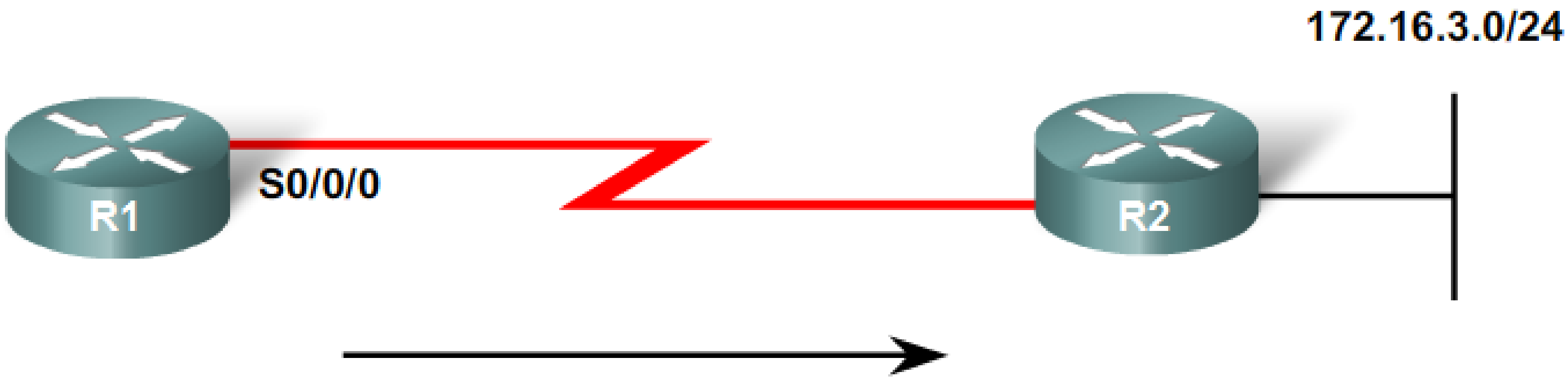
- It can perform unequal cost load balancing.
- It uses Diffusing Update Algorithm (DUAL) to calculate the shortest path.
- There are no periodic updates as with RIP and IGRP. Routing updates are sent only when there is a change in the topology.

# 4.1.2 Distance Vector Technology

A router using distance vector routing protocols knows 2 things:

1. Distance to final destination
2. Vector, or direction, traffic should be directed

Distance = How Far




Vector = Direction

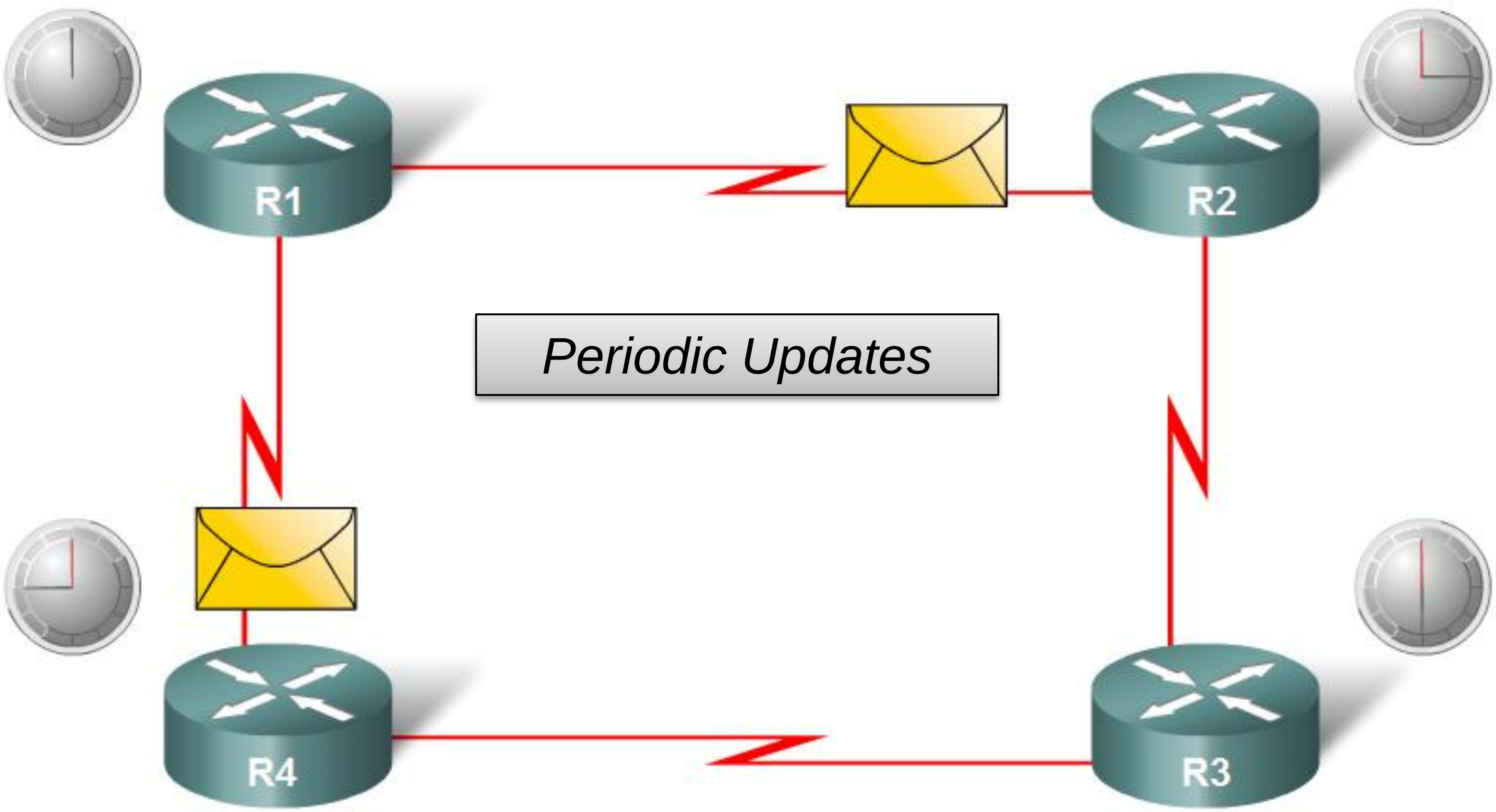
For R1, 172.16.3.0/24 is one hop away (distance).

It can be reached through R2 (vector).

# 4.1.2 Distance Vector Technology *

Characteristics of Distance Vector routing protocols:

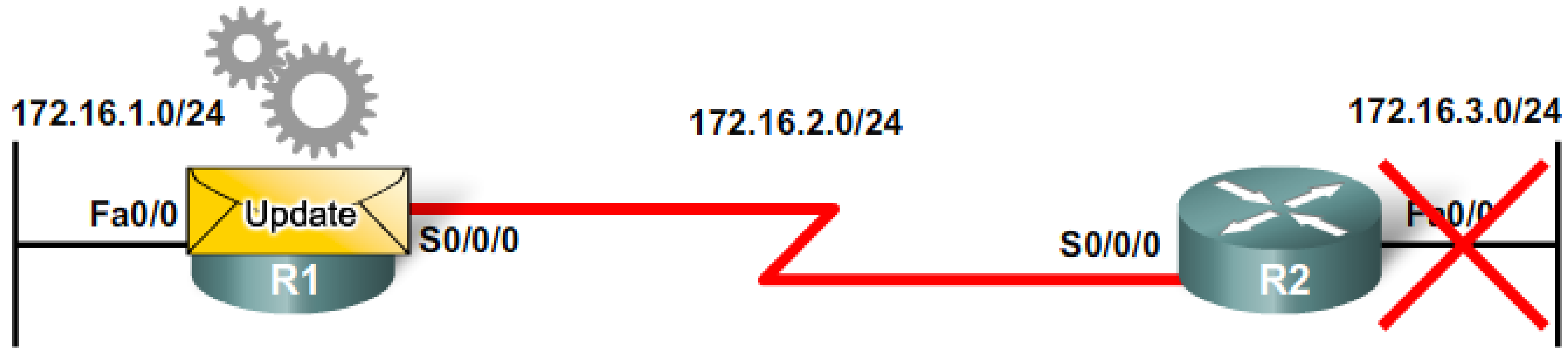
- Periodic updates
- Neighbors (unaware of the topology – only knows neighbors)
- Broadcast updates on periodic schedule
- Entire routing table is included with routing update



# 4.1.3 Routing Protocol Algorithms *

**Routing Protocol Algorithm:**

-Defined as a procedure for accomplishing a certain task




| Network | Interface | Hop |
|---|---|---|
| 172.16.1.0/24 | Fa0/0 | 0 |
| 172.16.2.0/24 | S0/0/0 | 0 |
| ~~172.16.3.0/24~~ | ~~S0/0/0~~ | ~~1~~ |

| Network | Interface | Hop |
|---|---|---|
| 172.16.2.0/24 | S0/0/0 | 0 |
| ~~172.16.3.0/24~~ | ~~Fa0/0~~ | ~~0~~ |
| 172.16.1.0/24 | S0/0/0 | 1 |

## Purpose of Routing Algorithms

- Send and receive updates
- Calculate best bath and install routes
- Detect and react to topology changes

## Routing Protocols Characteristics

**Time to Convergence** - Time to convergence defines how quickly the routers in the network topology share routing information and reach a state of consistent knowledge. The faster the convergence, the more preferable the protocol. **Routing loops** can occur when inconsistent routing tables are not updated due to **slow convergence** in a changing network.

**Scalability** - Scalability defines how large a network can become based on the routing protocol that is deployed. The larger the network is, the more scalable the routing protocol needs to be.

**Classless (Use of VLSM) or Classful** - Classless routing protocols do not include the subnet mask in the updates. Classful routing protocols do include the subnet mask and cannot support VLSM.

***Continued…..***

# 4.1.4 Routing Protocol Characteristics

**Routing Protocols Characteristics**

**Resource Usage** - Resource usage includes the requirements of a routing protocol such as memory space, CPU utilization, and link bandwidth utilization. Higher resource requirements necessitate more powerful hardware to support the routing protocol operation in addition to the packet forwarding processes.

**Implementation and Maintenance** - Implementation and maintenance describes the level of knowledge that is required for a network administrator to implement and maintain the network based on the routing protocol deployed.

# 4.1.4 Routing Protocol Characteristics

Advantages & Disadvantages of Distance Vector Routing Protocols

| Advantages: | Disadvantages: |
| --- | --- |
| **Simple implementation and maintenance.** The level of knowledge required to deploy and later maintain a network with distance vector protocol is not high. | **Slow convergence.** The use of periodic updates can cause slower convergence. Even if some advanced techniques are used, like triggered updates which are discussed later, the overall convergence is still slower compared to link state routing protocols. |
| **Low resource requirements.** Distance vector protocols typically do not need large amounts of memory to store the information. Nor do they require a powerful CPU. Depending of the network size and the IP addressing implemented they also typically do not require a high level of link bandwidth to send routing updates. However, this can become an issue if you deploy a distance vector protocol in a large network. | **Limited scalability.** Slow convergence may limit the size of the network because larger networks require more time to propagate routing information. |
| | **Routing loops.** Routing loops can occur when inconsistent routing tables are not updated due to slow convergence in a changing network. |

# 4.1.4 Routing Protocol Characteristics

| | Distance Vector | | | | Link State | |
|---|---|---|---|---|---|---|
| | RIPv1 | RIPv2 | IGRP | EIGRP | OSPF | IS-IS |
| Speed of Convergence | Slow | Slow | Slow | Fast | Fast | Fast |
| Scalability - Size of Network | Small | Small | Small | Large | Large | Large |
| Use of VLSM | No | Yes | No | Yes | Yes | Yes |
| Resource Usage | Low | Low | Low | Medium | High | High |
| Implementation and Maintenance | Simple | Simple | Simple | Complex | Complex | Complex |

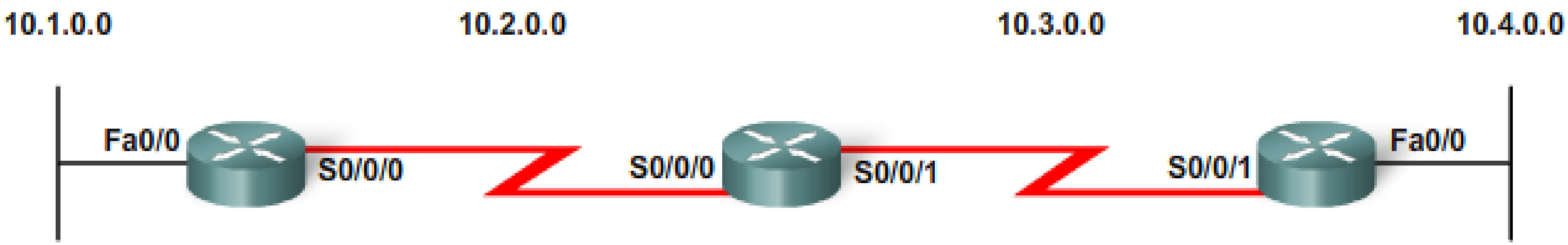
Complete the drag and drop exercise in your curriculum for practice in understanding the characteristics of Distance Vector and Link State protocols

Although the IS-IS routing protocol is covered in the CCNP courses, it is shown here because it is a commonly used interior gateway protocol.

# 4.2.1 Cold Start *

Initially Router only knows startup config stored in nvram

Network Discovery - Cold Start




| 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 |
| | | |
| | | |

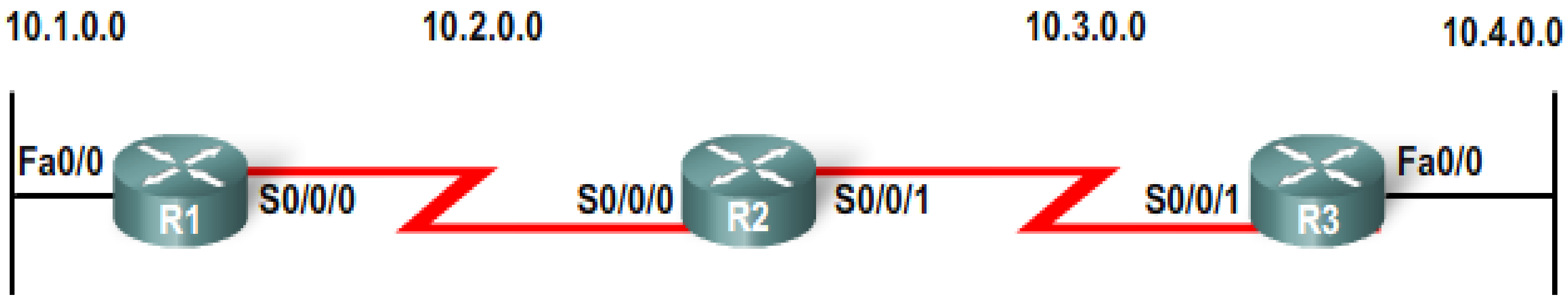
| Network | Interface | Hop |
|---|---|---|
| 10.3.0.0 | S0/0/1 | 0 |
| 10.4.0.0 | Fa0/0 | 0 |
| | | |
| | | |

**Router initial start up** (Cold Starts)

-**Initial network discovery**

Directly connected networks are initially placed in routing table

# 4.2.2 Initial Exchange of Routing Updates



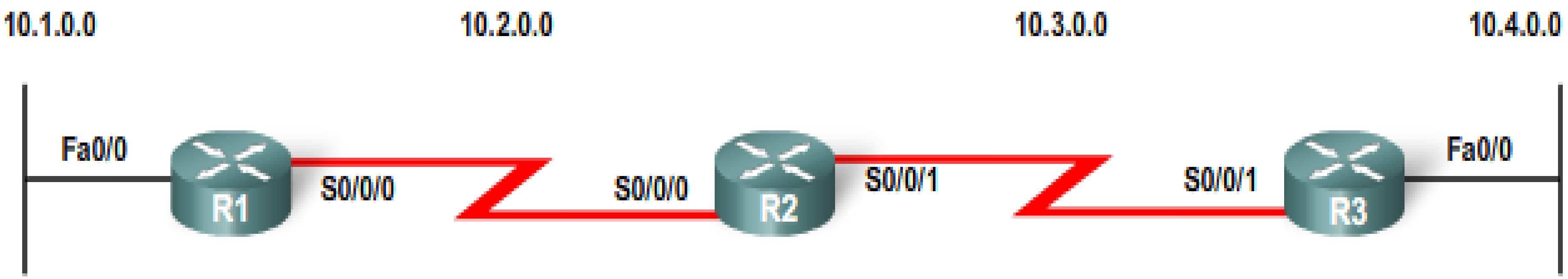

| Network | Interface | Hop |
|---|---|---|
| 10.1.0.0 | Fa0/0 | 0 |
| 10.2.0.0 | S0/0/0 | 0 |
| 10.3.0.0 | S0/0/0 | 1 |
| | | |

| 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 |
| | | |

- **Initial Exchange** of Routing Information
  - If a routing protocol is configured then Routers will exchange routing information
- **Routing updates** received from other routers
  - Router checks update for new information
  - If there is new information:
    - Metric is updated
    - New information is stored in routing table

# 4.2.3 Exchange Routing Information




| 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 |

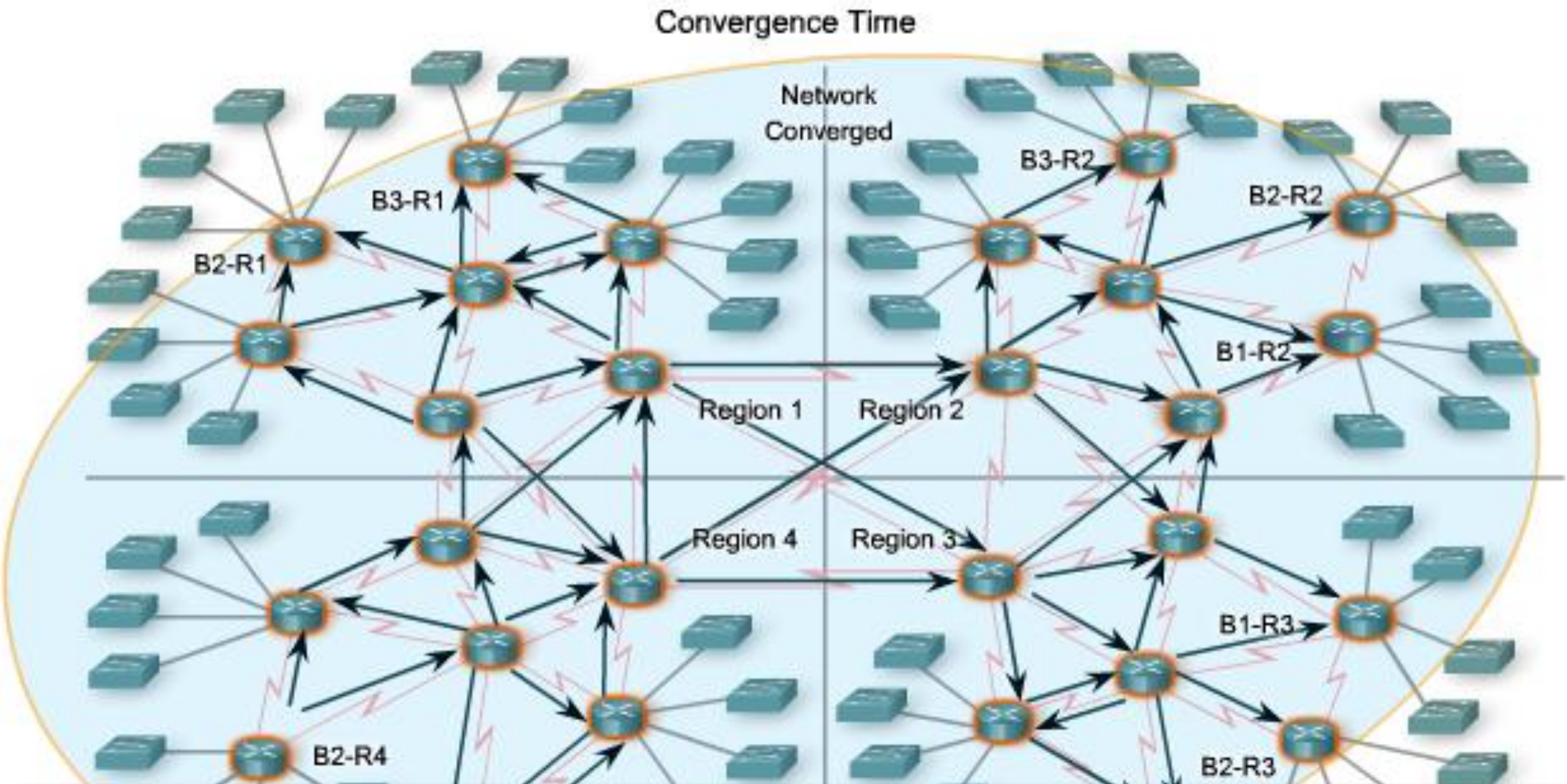
| Network | Interface | Hop |
|---|---|---|
| 10.3.0.0 | S0/0/1 | 0 |
| 10.4.0.0 | Fa0/0 | 0 |
| 10.2.0.0 | S0/0/1 | 1 |
| 10.1.0.0 | S0/0/1 | 2 |

**Router convergence** is reached when

- All routing tables in the network contain the same network information
- Routers continue to exchange routing information

    If no new information is found then Convergence is reached

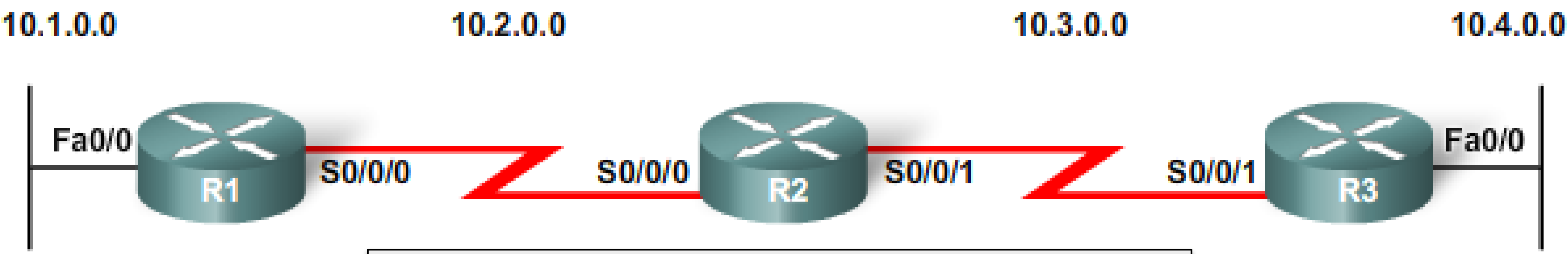
# 4.2.4 Convergence *




The speed of achieving convergence consists of:

- How quickly the routers propagate a change in the topology in a routing update to its neighbors.
- The speed of calculating best path routes using the new routing information collected.

# 4.3.1 Periodic Updates Ripv1 and IGRP




*For RIP, these updates are sent every 30 seconds as a broadcast whether or not there has been a topology change*

| 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 |

**Periodic Updates**: RIPv1 & IGRP

These are time intervals in which a router sends out its entire routing table.

**Changes may occur in the routing table because of :**

Failure of a link * Introduction of a new link * Failure of a router * Change of link parameters

# 4.3.1 Periodic Updates RIPv1 and IGRP

## RIP Timers (4)

**Update timer** clocks the interval between periodic routing updates. Generally, it is set to 30 seconds

**Invalid Timer**. If an update has not been received to refresh an existing route after 180 seconds (the default), the route is marked as invalid by setting the metric to 16. The route is retained in the routing table until the flush timer expires.

**Flush Timer**. By default, the flush timer is set for 240 seconds, which is 60 seconds longer than the invalid timer. When the flush timer expires, the route is removed from the routing table.

**Holddown Timer**. This timer stabilizes routing information and helps prevent routing loops during periods when the topology is converging on new information. Once a route is marked as unreachable, it must stay in holddown long enough for all routers in the topology to learn about the unreachable network.

# 4.3.1 Periodic Updates RIPv1 and IGRP

```
R1#show ip route


Gateway of last resort is not set

     10.0.0.0/16 is subnetted, 4 subnets
C       10.2.0.0 is directly connected, Serial0/0/0
R       10.3.0.0 [120/1] via 10.2.0.2, 00:00:04, Serial0/0/0
C       10.1.0.0 is directly connected, FastEthernet0/0
R       10.4.0.0 [120/2] via 10.2.0.2, 00:00:04, Serial0/0/0
```

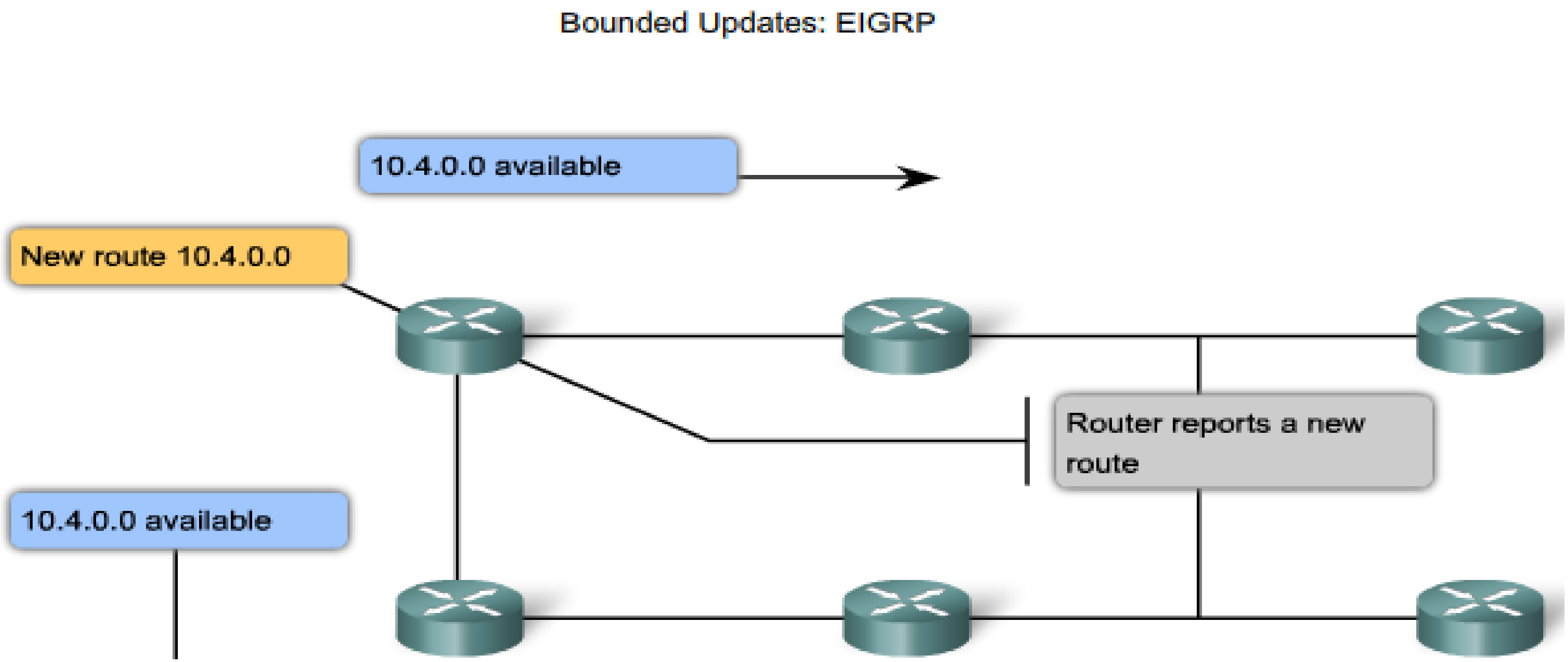
RIP - Elapsed time since the last update, expressed in seconds

```
R1#show ip protocols
Routing Protocol is "rip"
  Sending updates every 30 seconds, next due in 13 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240

  Routing for Networks:
    10.0.0.0
  Routing Information Sources:
    Gateway         Distance      Last Update
    10.3.0.1             120      00:00:27
  Distance: (default is 120)
```

You can use this information to tell when next update is due to be sent out

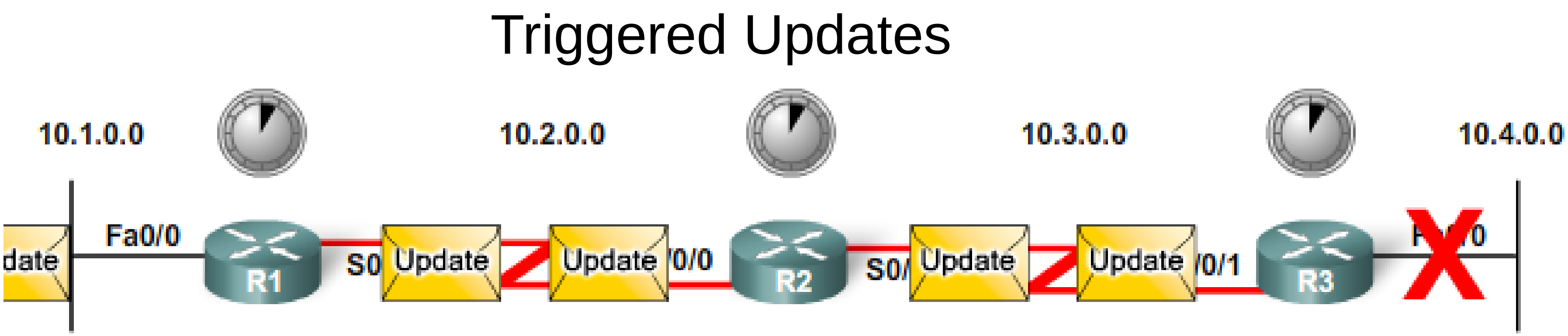
# 4.3.2 EIGRP Bounded Updates




**EIGRP uses updates that are:**

- Non-periodic because they are not sent out on a regular basis.
- Partial updates sent only when there is a change in topology that influences routing information.
- **Bounded**, meaning the propagation of partial updates are automatically bounded so that only those routers that need the information are updated.

# 4.3.3 Triggered Updates *



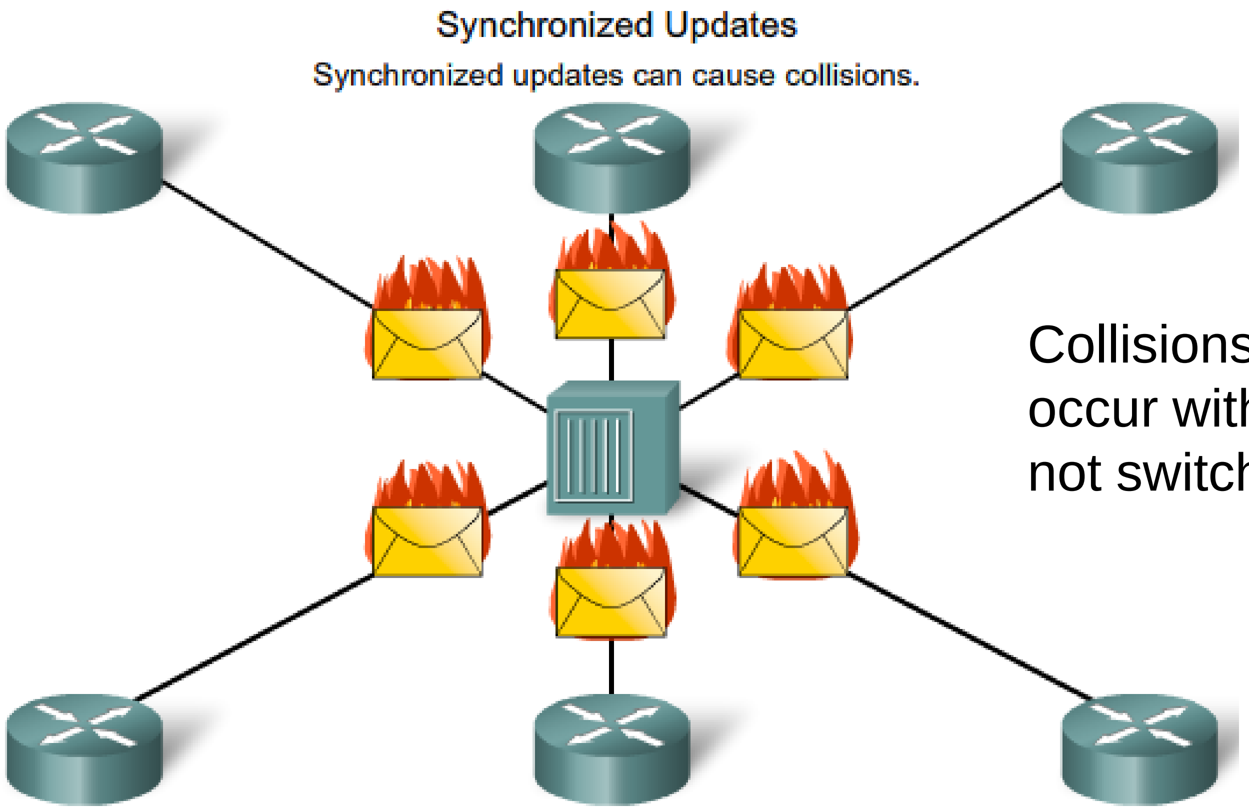

**RIP uses triggered updates that do not wait for timers to expire**

**Triggered updates** are sent when one of the following occurs:

- An interface changes state (up or down)
- A route has entered (or exited) the "unreachable" state
- A route is installed in the routing table

Networks have built-in **latency**. It takes time for data to travel through the wires from one router to another. Updates are not received on all routers at **exactly** the same time.

# 4.3.4 Random Jitter




Collisions only occur with hubs, not switches

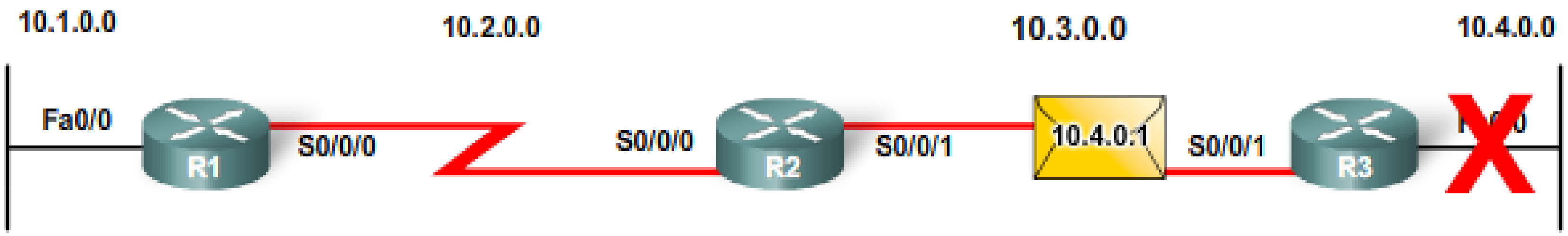
Sending updates at the same time is known as the synchronization of updates. Synchronization can become a problem with distance vector routing protocols due to their usage of periodic updates.

To prevent the synchronization of updates between routers, the Cisco IOS uses a random variable, called **RIP_JITTER**, which subtracts a variable amount of time to the update interval for each router in the network.

# 4.4.1 Routing Loop Definition and Implications

Routing Loop

The network now has a loop.



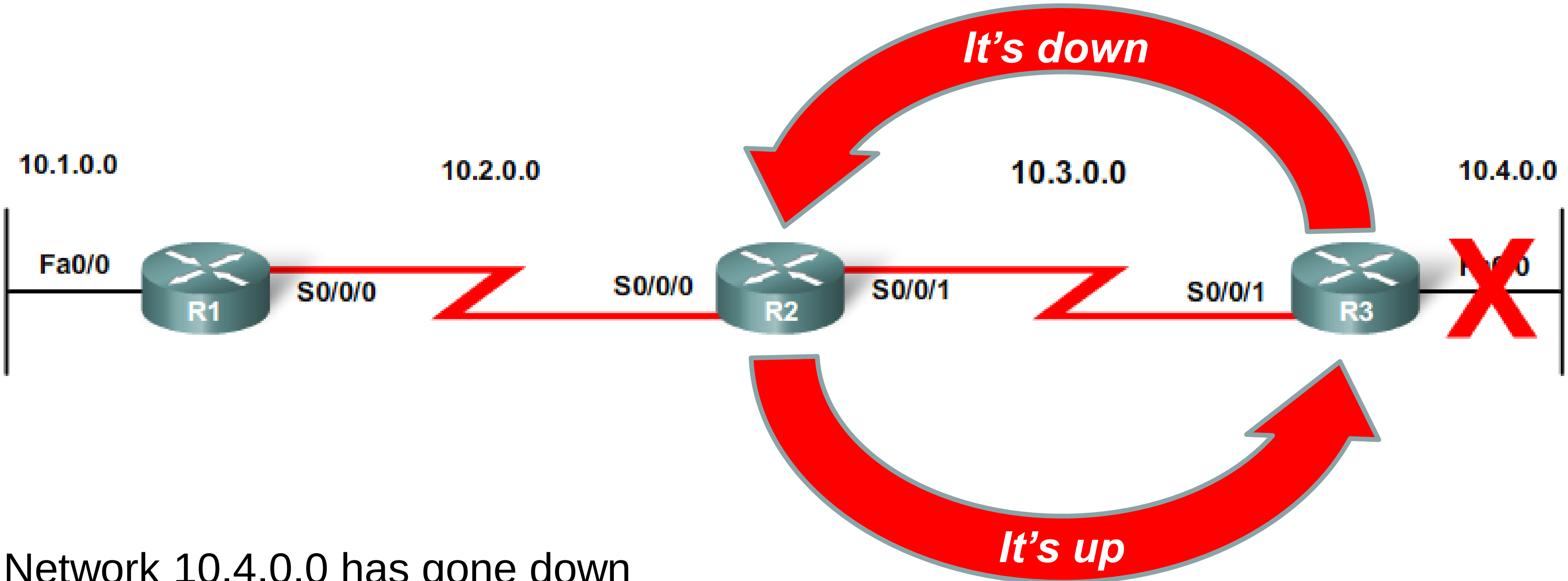

| Network | Interface | Hop |
|---|---|---|
| 10.1.0.0 | Fa0/0 | 0 |
| 10.2.0.0 | S0/0/0 | 0 |
| 10.3.0.0 | S0/0/0 | 1 |
| 10.4.0.0 | S0/0/0 | 2 |

| 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 | S0/0/1 | 0 |
| 10.2.0.0 | S0/0/1 | 1 |
| 10.1.0.0 | S0/0/1 | 2 |

A **routing loop** can occur when two or more routers have routing information that incorrectly indicates that a valid path to an unreachable destination exists.

# 4.4.1 Routing Loop Definition and Implications




Network 10.4.0.0 has gone down

R3 has sent an update to R2 with information about network 10.4.0.0

R1 and R2 have not yet received the update from R3 and think there is still a route to 10.4.0.0

What happens if R2 sends a periodic update to R3 saying it has a route to 10.4.0.0?

R3 will then contain the R2 table which says 10.4.0.0 is reachable

It will tell R2 that 10.4.0.0 **is** reachable

Even though R3 will continue to send updates that say 10.4.0.0 is unreachable, it will continue to receive updates from R2 that says it **IS** reachable.

We now have a routing loop.

# 4.4.1 Routing Loop Definition and Implications

**Routing Loop causes and implications**

**Routing loops may be caused by:**

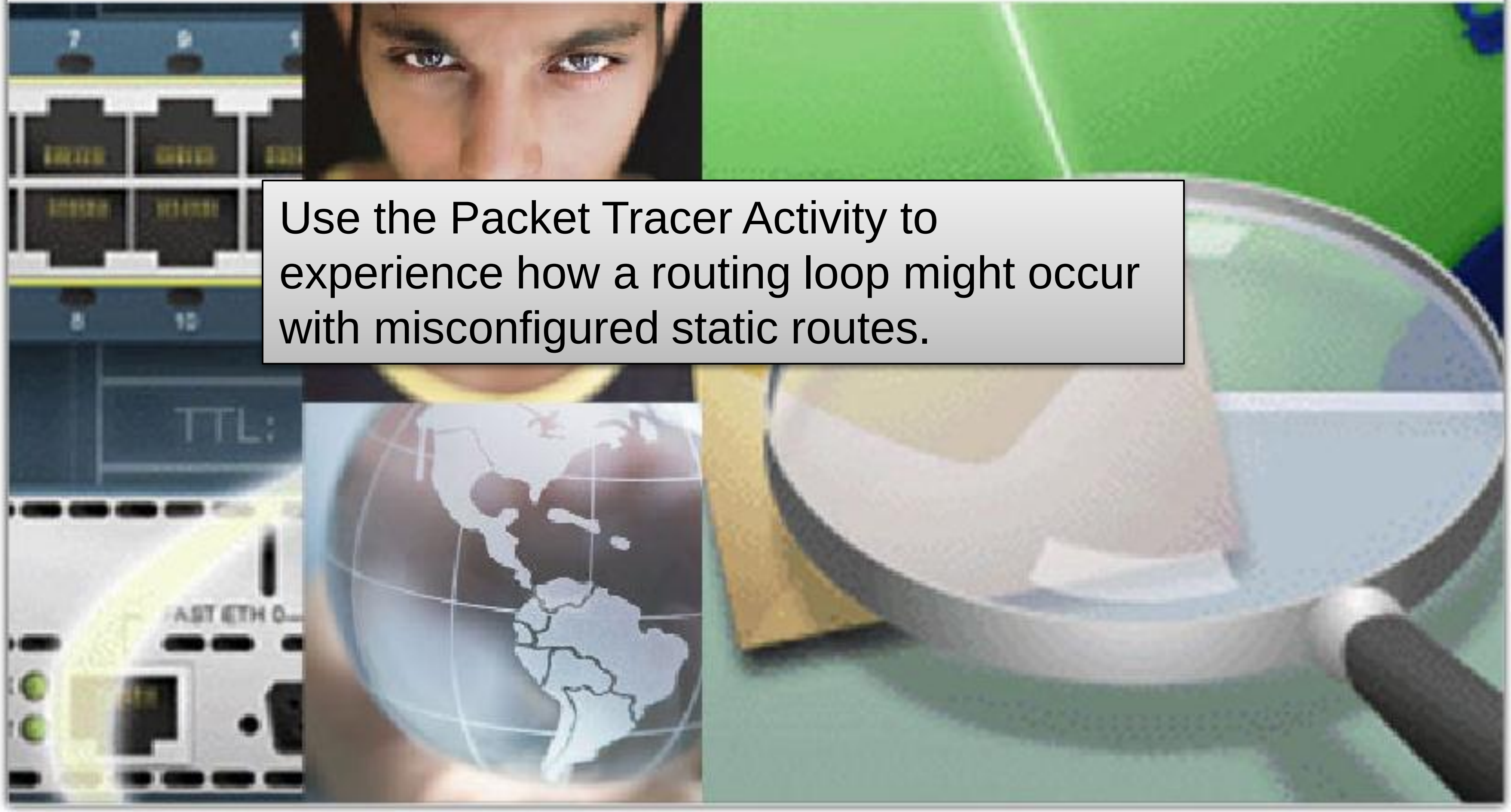
- -Incorrectly configured static routes
- -Incorrectly configured route redistribution
- -Slow convergence
- -Incorrectly configured discard routes

**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

# 4.4.1 Routing Loop Definition and Implications

**Packet Tracer Exploration:**
Routing Loops

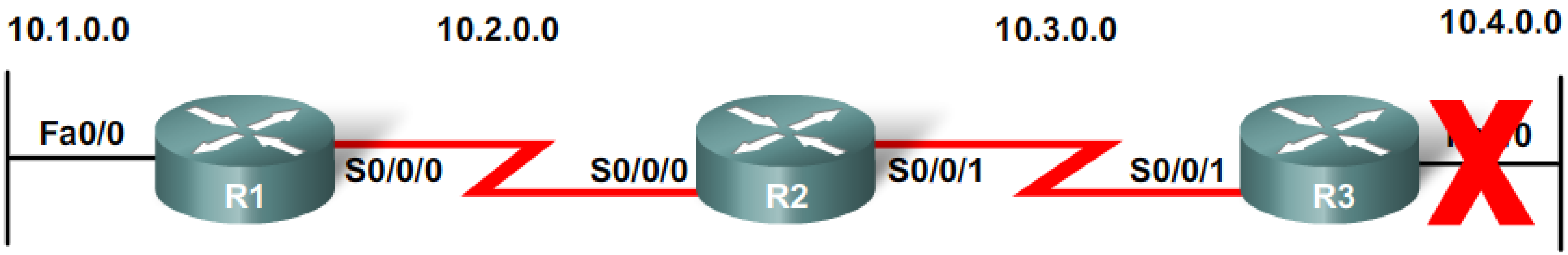



Use the Packet Tracer Activity to experience how a routing loop might occur with misconfigured static routes.

# 4.4.2 Problem, Count to Infinity

**Count to infinity** is a condition that exists when inaccurate routing updates increase the metric value to "infinity" for a network that is no longer reachable.

To eventually stop the incrementing of the metric, "infinity" is defined by setting a maximum metric value. For example, RIP defines infinity as 16 hops - an "unreachable" metric. Once the routers "count to infinity," they mark the route as unreachable.




| 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 | 16 |

| 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 | 16 |

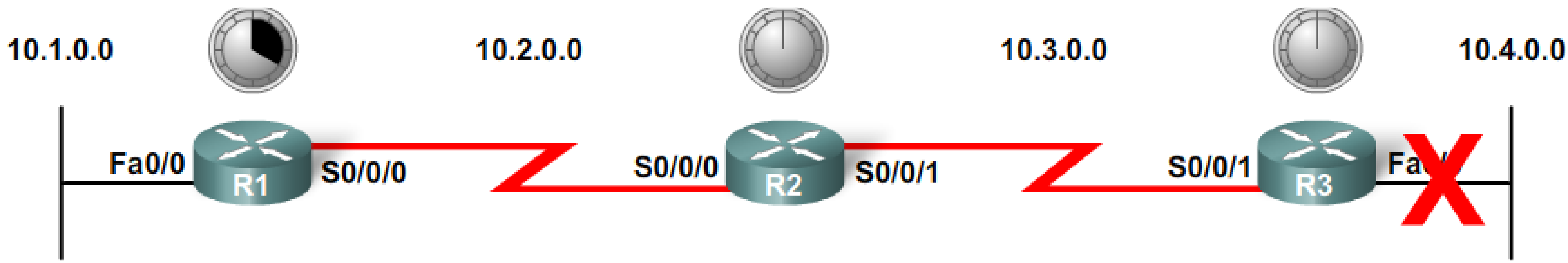
| Network | Interface | Hop |
|---|---|---|
| 10.3.0.0 | S0/0/1 | 0 |
| 10.4.0.0 | S0/0/1 | 16 |
| 10.2.0.0 | S0/0/1 | 1 |
| 10.1.0.0 | S0/0/1 | 2 |

# 4.4.4 Preventing Routing Loops with Holddown Timers

**Preventing loops with holddown timers**

- -Holddown timers allow a router to not accept any changes to a route for a specified period of time.
- -Holddown timers allow routing updates to propagate through network with the most current information.

Holddown timers allow routers enough time to discard inaccurate routing updates




| 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 | S0/0/1 | 0 |
| 10.2.0.0 | S0/0/1 | 1 |
| 10.1.0.0 | S0/0/1 | 2 |

*Watch the animation in your curriculum for a good illustration of Holddown Timers*

# 4.4.5 Split Horizon Rule

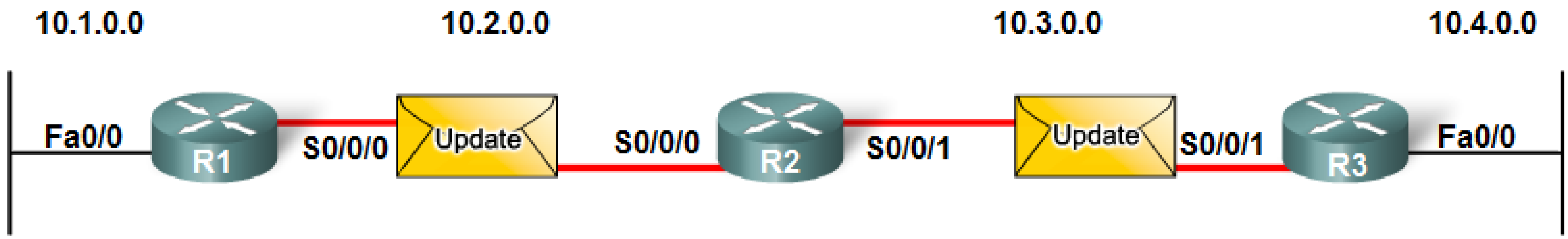
The Split Horizon Rule is used to prevent routing loops

**Split Horizon rule:**

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

R2 only advertises 10.3.0.0 and 10.4.0.0 to R1.

R2 only advertises 10.2.0.0 and 10.1.0.0 to R3.



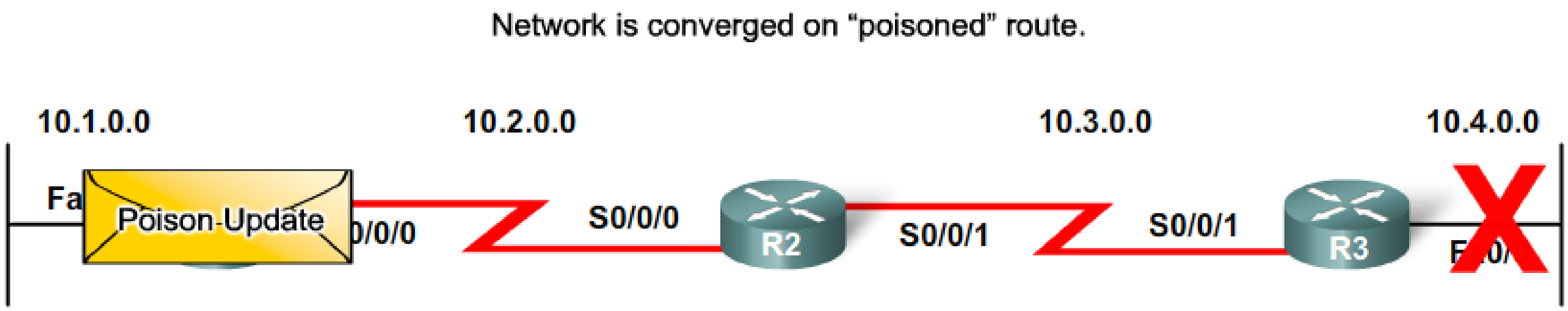

| Network | Interface | Hop |
|---|---|---|
| 10.1.0.0 | Fa0/0 | 0 |
| 10.2.0.0 | S0/0/0 | 0 |
| 10.3.0.0 | S0/0/0 | 1 |
| 10.4.0.0 | S0/0/0 | 2 |

| 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 |

R2 advertises the 10.4.0.0 network to R1 out S0/0/0.
R2 does not advertise 10.4.0.0 to R3 out S0/0/1, because the route originated from that interface

# 4.4.6 Split Horizon with Poison reverse or Route Poisoning




| 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 | 16 |

| 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 | 16 |

| Network | Interface | Hop |
|---|---|---|
| 10.3.0.0 | S0/0/1 | 0 |
| 10.4.0.0 | Fa0/0 | 16 |
| 10.2.0.0 | S0/0/1 | 1 |
| 10.1.0.0 | S0/0/1 | 2 |

**Split horizon with poison reverse**

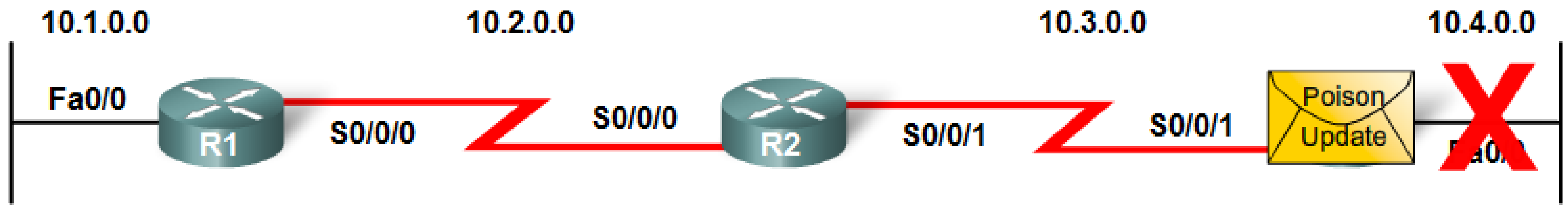
The rule states that once a router learns of an unreachable route through an interface, advertise it as unreachable back through the same interface

# 4.4.6 Split Horion with Poison Reverse or Route Poisoning

1. Network 10.4.0.0 becomes unavailable due to a link failure.

2. R3 poisons the metric with a value of 16 and then sends out a triggered update stating that 10.4.0.0 is unavailable.

3. R2 processes that update, invalidates the routing entry in its routing table, and immediately sends a poison reverse back to R3.




| 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 | 16 |

| Network | Interface | Hop |
|---|---|---|
| 10.3.0.0 | S0/0/1 | 0 |
| 10.4.0.0 | Fa0/0 | 16 |
| 10.2.0.0 | S0/0/1 | 1 |
| 10.1.0.0 | S0/0/1 | 2 |

# 4.4.7 IP and TTL

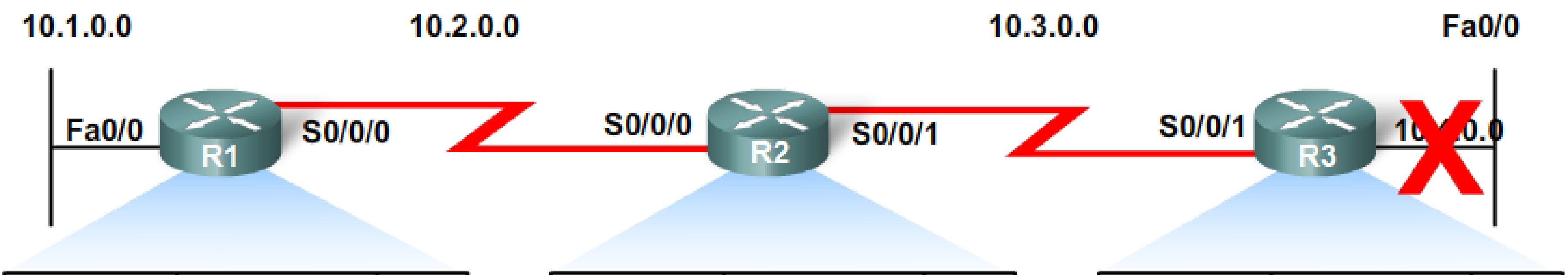
**IP & TTL**

**Purpose of the TTL field**

The TTL field is found in an IP header and is used to prevent packets from endlessly traveling on a network

**How the TTL field works**

- -TTL field contains a numeric value
- The numeric value is decreased by one by every router on the route to the destination.
- If numeric value reaches 0 then Packet is discarded.




| 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 | 4 |

| Network | Interface | Hop |
|---|---|---|
| 10.2.0.0 | S0/0/0 | 0 |
| 10.3.0.0 | S0/0/1 | 0 |
| 10.4.0.0 | S0/0/0 | 1 |
| 10.1.0.0 | S0/0/1 | 3 |

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

# 4.5.1 RIP and EIGRP

Distance Vector Routing Protocols Compared

| | RIPv1 | RIPv2 | IGRP | EIGRP |
|---|---|---|---|---|
| Speed of Convergance | Slow | Slow | Slow | Fast |
| Scalability - size of network | Small | Small | Small | Large |
| Use of VLSM | No | Yes | No | Yes |
| Resource usage | Low | Low | Low | Medium |
| Implementation and maintenance | Simple | Simple | Simple | Complex |

***For distance vector routing protocols, there really are only two choices: RIP or EIGRP***.

**Factors used to determine whether to use RIP or EIGRP include**

- -Network size
- -Compatibility between models of routers
- -Administrative knowledge

Note: RIPv1 uses classfull addressing while RIPv2 uses classless

# 4.5.1 RIP and EIGRP

**Features of RIP:**

-Supports split horizon & split horizon with poison reverse

- -Capable of load balancing
- -Easy to configure
- -Works in a multi vendor router environment

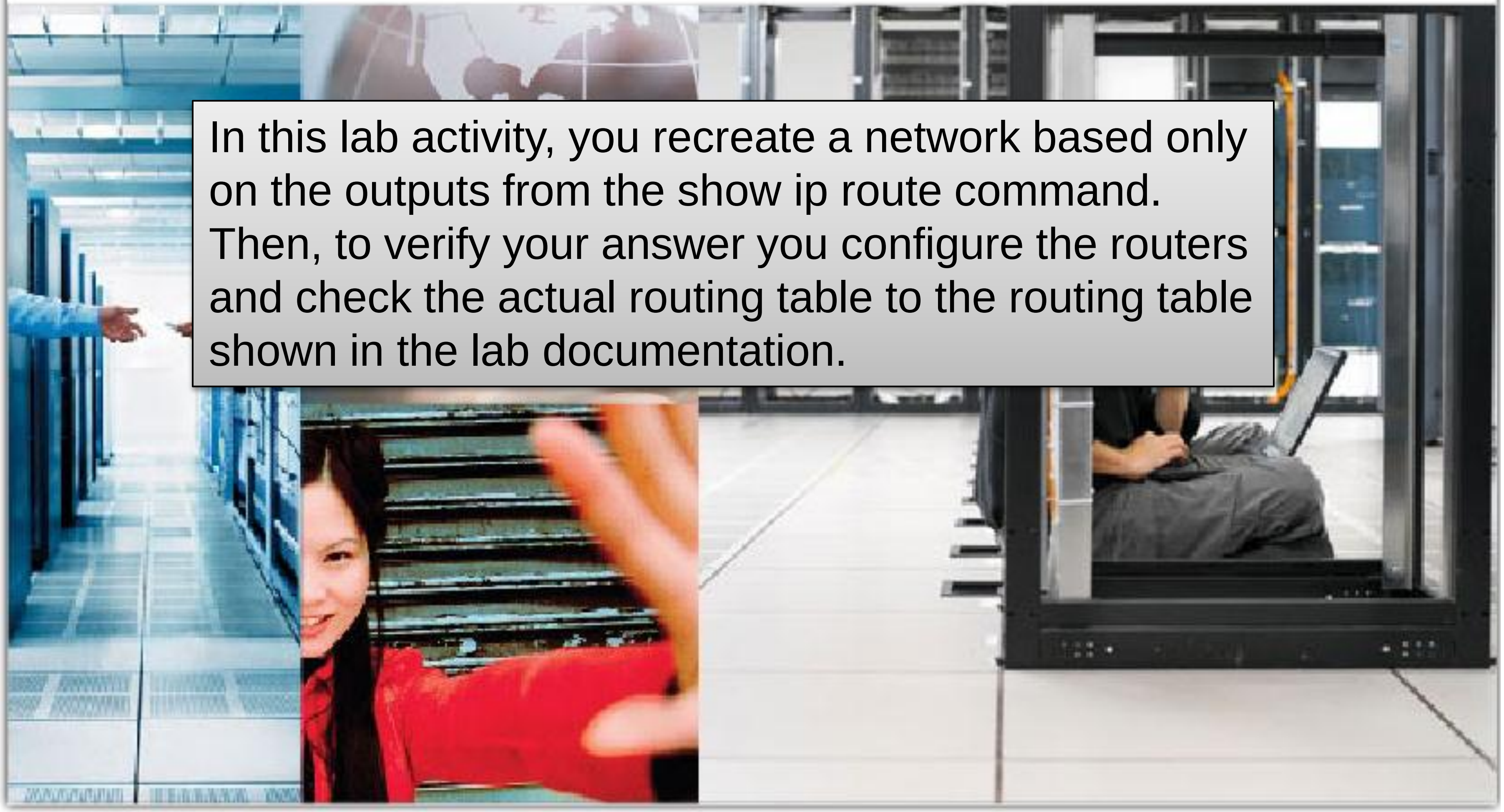
**Features of EIGRP:**

- -Triggered updates
- -EIGRP hello protocol used to establish neighbor adjacencies
- -Supports VLSM & route summarization
- -Use of topology table to maintain all routes
- -Classless distance vector routing protocol
- -Cisco proprietary protocol

# 4.6.1 Lab Activities

**Hands-on Lab:**

Routing Table Interpretation Lab



In this lab activity, you recreate a network based only on the outputs from the show ip route command. Then, to verify your answer you configure the routers and check the actual routing table to the routing table shown in the lab documentation.

# 4.7.1 Summary and Review

| | Interior Gateway Protocols | | Exterior Gateway Protocols |
|---|---|---|---|
| | Distance Vector Routing Protocols | Link State Routing Protocols | Path Vector |
| Classful | **RIP** **IGRP** | | **EGP** |
| Classless | **RIPv2** **EIGRP** | **OSPFv2** **IS-IS** | **BGPv4** |
| IPv6 | **RIPng** EIGRP for IPv6 | **OSPFv3** IS-IS for IPv6 | BGPv4 for IPv6 |

In this chapter, you have learned to:

- Identify the characteristics of distance vector routing protocols.
- Describe the network discovery process of distance vector routing protocols using Routing Information Protocol (RIP).
- Describe the processes for maintaining accurate routing tables that are used by distance vector routing protocols.
- Identify the conditions leading to a routing loop and explain the implications for router performance.
- Identify the types of distance vector routing protocols in use today.

# Summary

- **Characteristics of Distance Vector routing protocols**
  - Periodic updates
  - RIP routing updates include the entire routing table
  - Neighbors are defined as routers that share a link and are configured to use the same protocol
- **The network discovery process for distance vector routing protocol**
  - Directly connected routes are placed in routing table 1st
  - If a routing protocol is configured then
    - Routers will exchange routing information
  - Convergence is reached when all network routers have the same network information

# Summary

- **D.V. routing protocols maintains routing tables by**
  - –RIP sending out periodic updates
  - –RIP using 4 different timers to ensure information is accurate and convergence is achieved in a timely manner
  - –EIGRP sending out triggered updates
- **D.V. routing protocols may be prone to routing loops**
  - – routing loops are a condition in which packets continuously traverse a network
  - –Mechanisms used to minimize routing loops include defining maximum hop count, holddown timers, split horizon, route poisoning and triggered updates

# Summary

- **Conditions that can lead to routing loops include**
  - –Incorrectly configured static routes
  - –Incorrectly configured route redistribution
  - –Slow convergence
  - –Incorrectly configured discard routes
- **How routing loops can impact network performance includes:**
  - –Excess use of bandwidth
  - –CPU resources may be strained
  - –Network convergence is degraded
  - –Routing updates may be lost or not processed

# Summary

- **Routing Information Protocol (RIP)**

  A distance vector protocol that has 2 versions

  RIPv1 – a classful routing protocol

  RIPv2 - a classless routing protocol

- **Enhanced Interior Gateway Routing Protocol (EIGRP)**

  – A distance vector routing protocols that has some features of link state routing protocols

  – A Cisco proprietary routing protocol