BRAC UNIVERSITY

Inspiring Excellence

Network Layer

Routing Algorithm

Distance Vector Routing

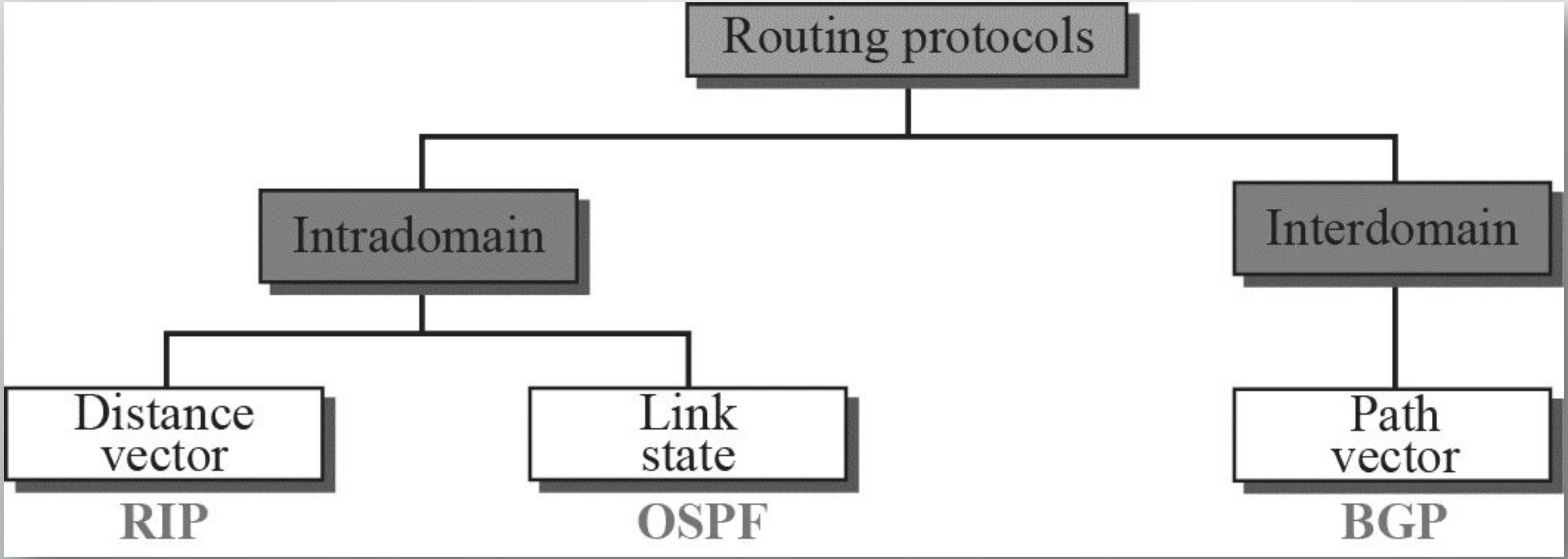
Lecture 11 | CSE421 – Computer Networks

Department of Computer Science and Engineering
School of Data & Science

Objectives

- understand principles behind network layer services:
  - routing algorithms
    - **distance vector**
    - **link state**

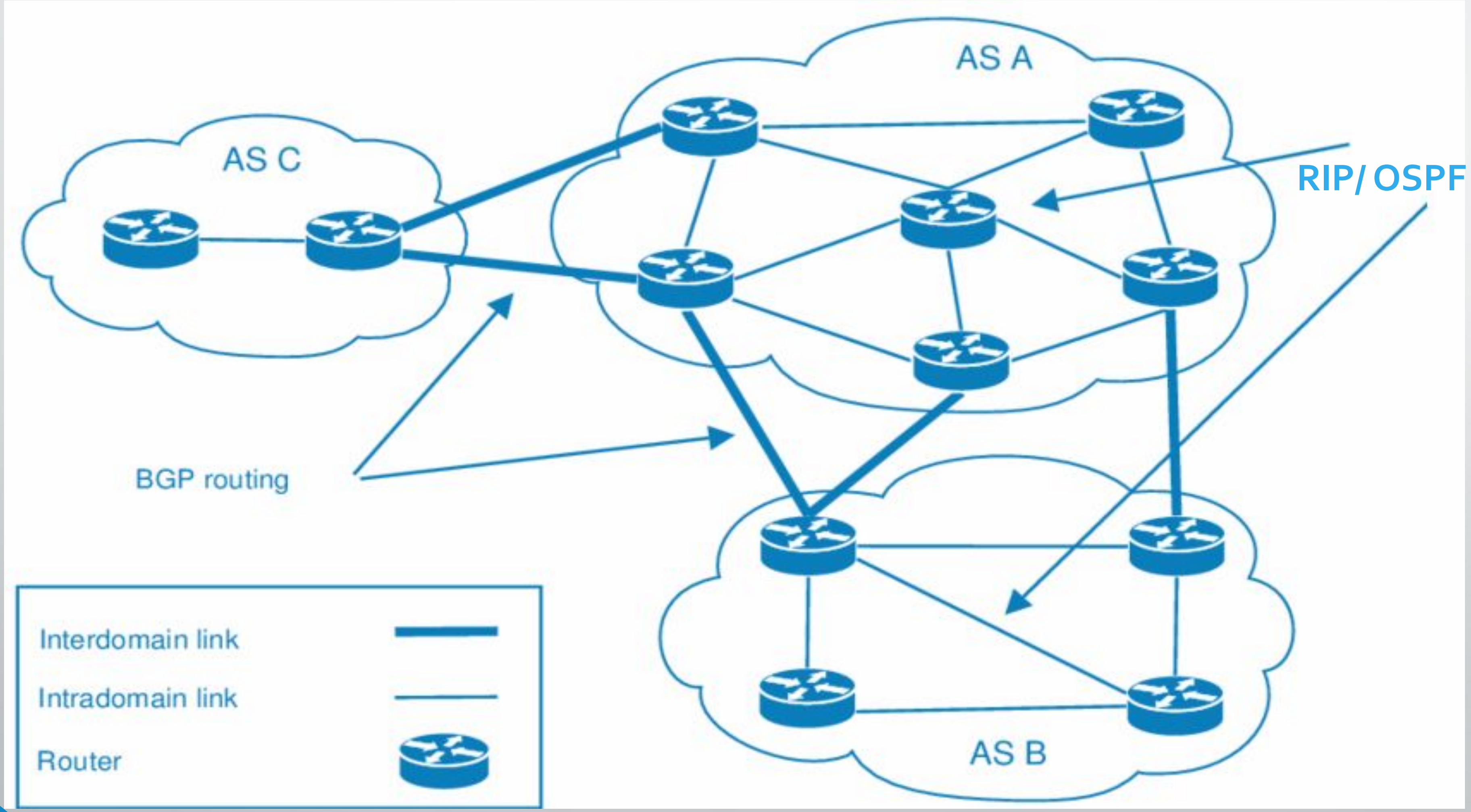
Popular Routing Protocols



Autonomous Systems

- Internet is divided into autonomous systems.
- An autonomous system (AS) is a group of networks and routers under the authority of a single administration.
- Routing ***inside*** an autonomous system is called **intra-domain routing**. Routing ***between*** autonomous systems is called **inter-domain routing.**

Autonomous Systems



Routing Algorithms

- Given a set of routers and links connecting the routers.
- Routing algorithm finds a “good” path from the source to destination router.
- Good path = Least cost path

Routing Algorithm classification

Global and Decentralized

Global:

- all routers have complete topology and link cost info
- "link state" algorithms

Decentralized:

- router knows physically-connected neighbors, link costs to neighbors
- iterative process of computation, exchange of info with neighbors
- "distance vector" algorithms

Distance Vector Algorithm

Distance Vector Algorithm

Based on **Bellman-Ford Algorithm**

- computes shortest paths from a single source node to all of the other nodes in a weighted topology.
- Shortest paths are based on the cost calculated from source node to destination node.
- Cost for now is arbitrary. It can be calculated using hop counts, link delay, link bandwidth etc.
- Distributed route computation using only neighbor's info

Distance vector algorithm

Basic idea:

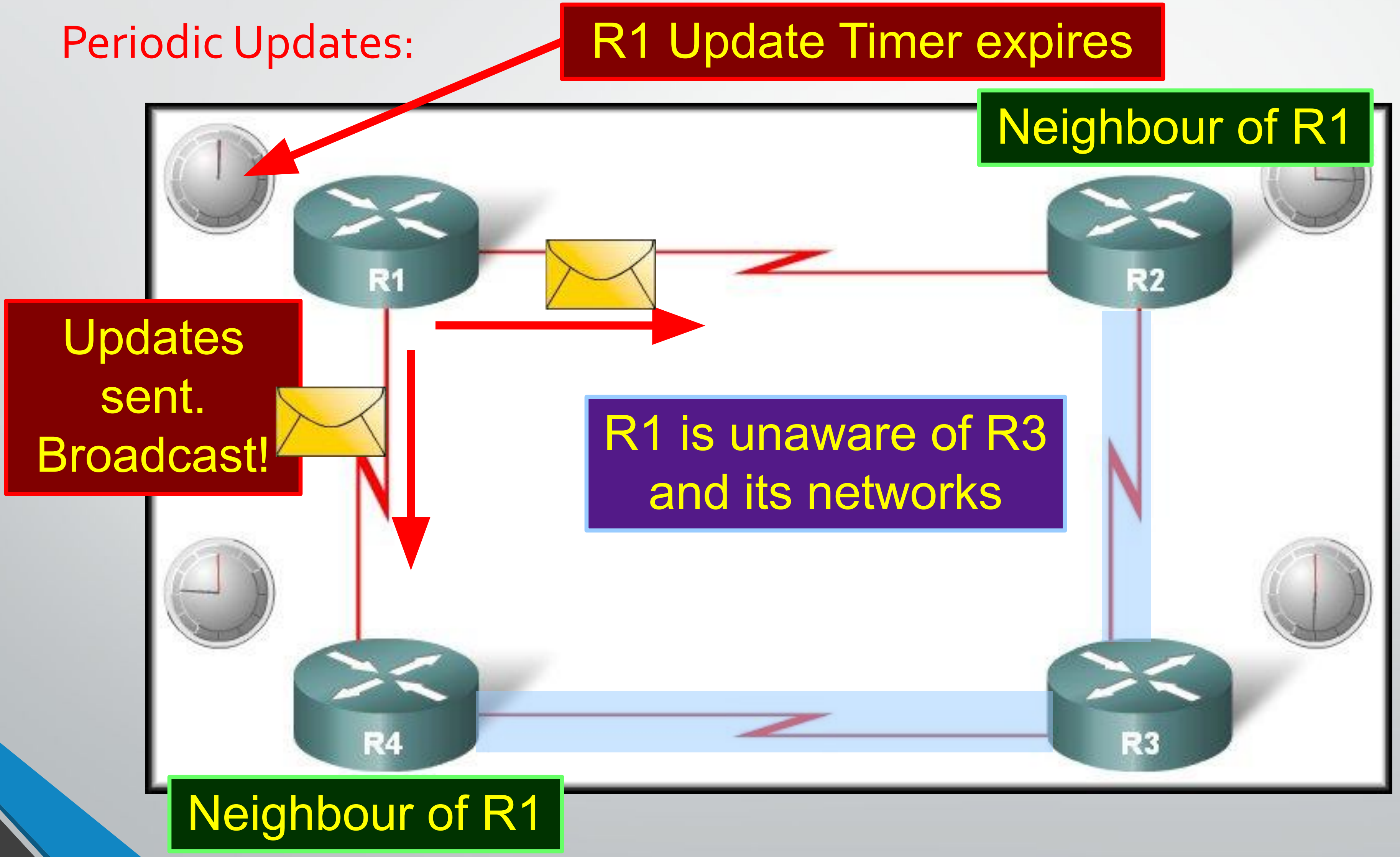
- Each node periodically sends its own distance vector estimate to neighbors
- When a node x receives new DV estimate from neighbor;
- It updates its own DV using B-F equation

Operation of Distance Vector

- Periodic Updates:
  - Periodically broadcast the entire routing table to each of its neighbors (RIP – every 30 seconds).
    - Inefficient
  - Router is only aware of the:
    - Network addresses of its own interfaces.
    - Network addresses the neighbors running the same routing protocol.

Operation of Distance Vector

Periodic Updates:



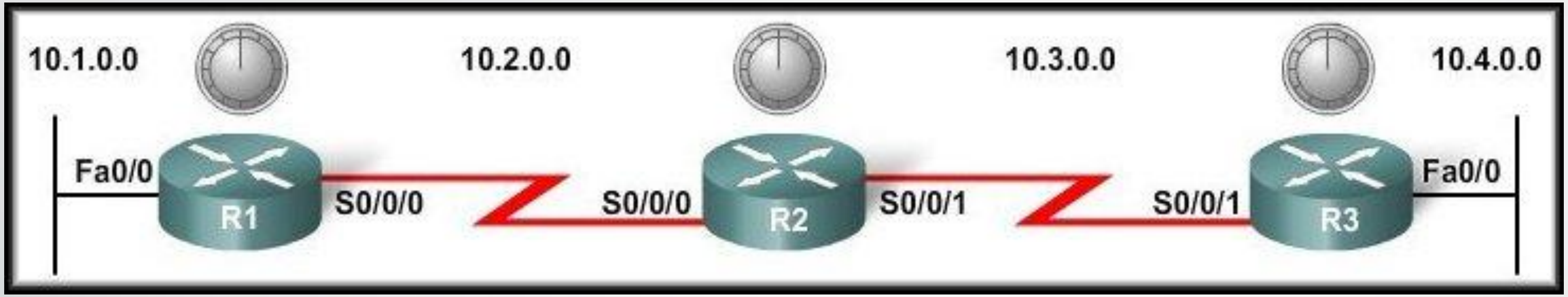
Distance Vector Routing Protocols

Network Discovery

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



- Network Discovery:
  - Is part of the process of the routing protocol algorithm that enables routers to learn about remote networks for the first time.

Cold Start

Network	Interface	Hop

Network	Interface	Hop

Network	Interface	Hop

- When a router powers up:
  - Knows nothing about the network topology.
  - Knows only the information saved in NVRAM.
  - Sends updates about its known networks out all ports.

Initial Exchange of Routing Information

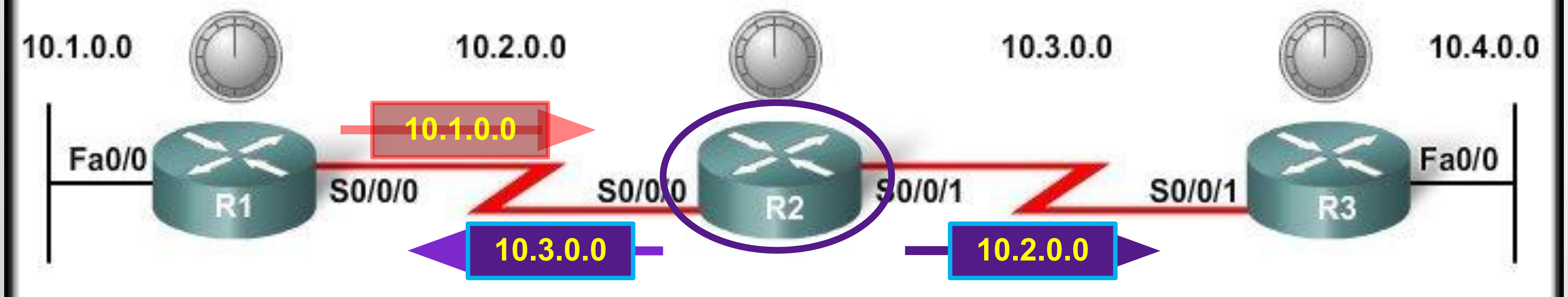
Network	Interface	Hop
10.1.0.0	Fa0/0	0
10.2.0.0	S0/0/0	0

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

- Sends an update about network 10.1.0.0 out the Serial 0/0/0 interface with a metric of 1.
- Sends an update about network 10.2.0.0 out the Fa0/0 interface with a metric of 1.

Initial Exchange of Routing Information

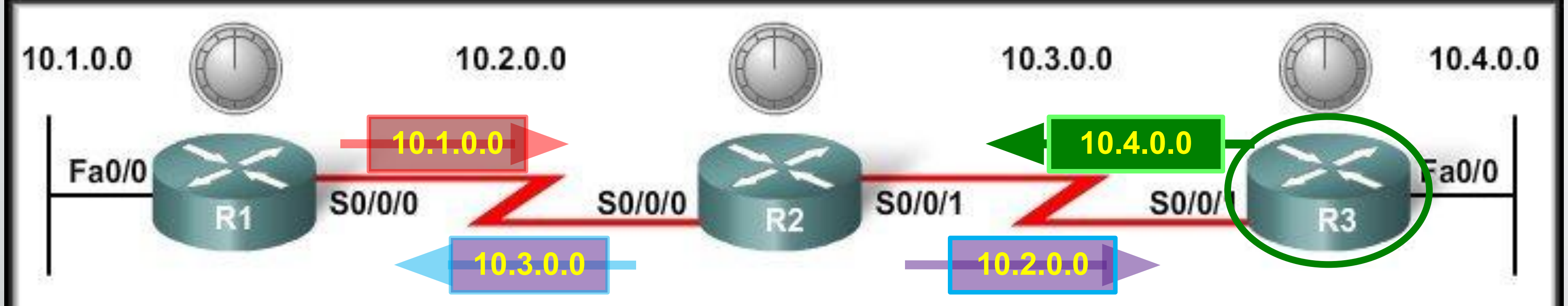


Network	Interface	Hop
10.1.0.0	Fa0/0	0
10.2.0.0	S0/0/0	0

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

Initial Exchange of Routing Information

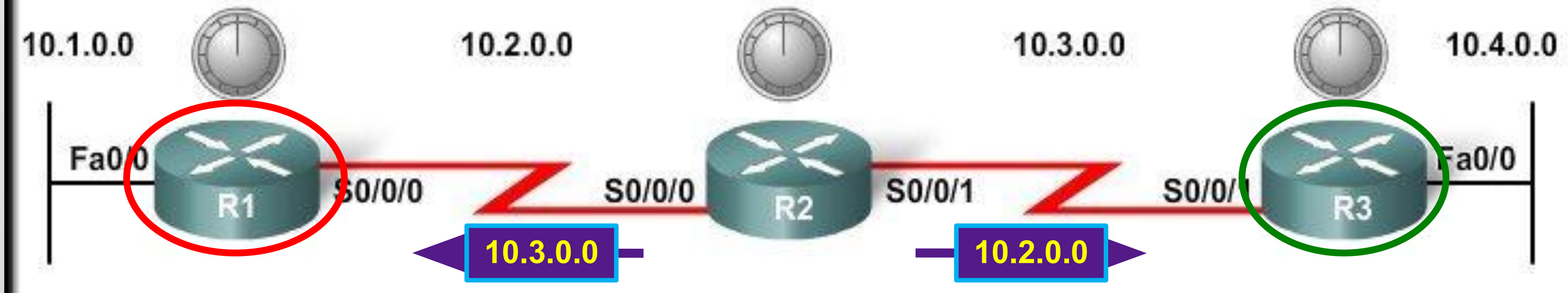


Network	Interface	Hop
10.1.0.0	Fa0/0	0
10.2.0.0	S0/0/0	0

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

Initial Exchange of Routing Information



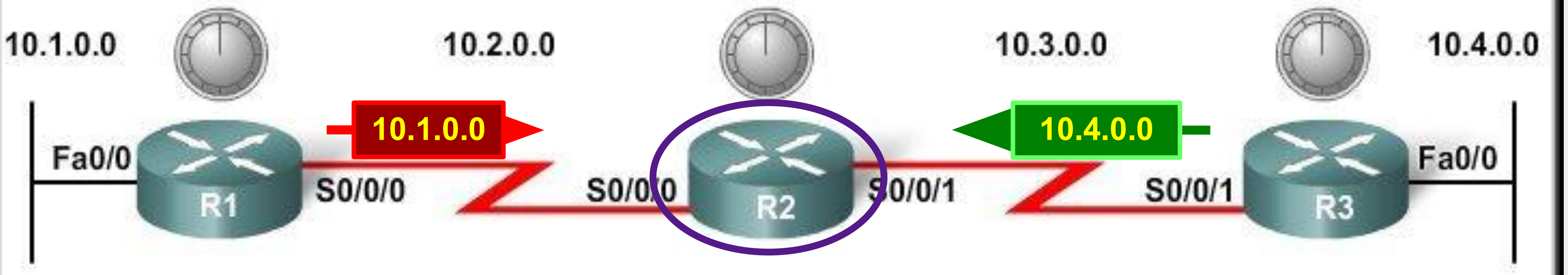
Network	Interface	Hop
10.1.0.0	Fa0/0	0
10.2.0.0	S0/0/0	0

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

- R1 Receives the update from R2 about network 10.3.0.0 and adds it to its routing table.
- R3 Receives the update from R2 about network 10.2.0.0 and adds it to its routing table.

Initial Exchange of Routing Information



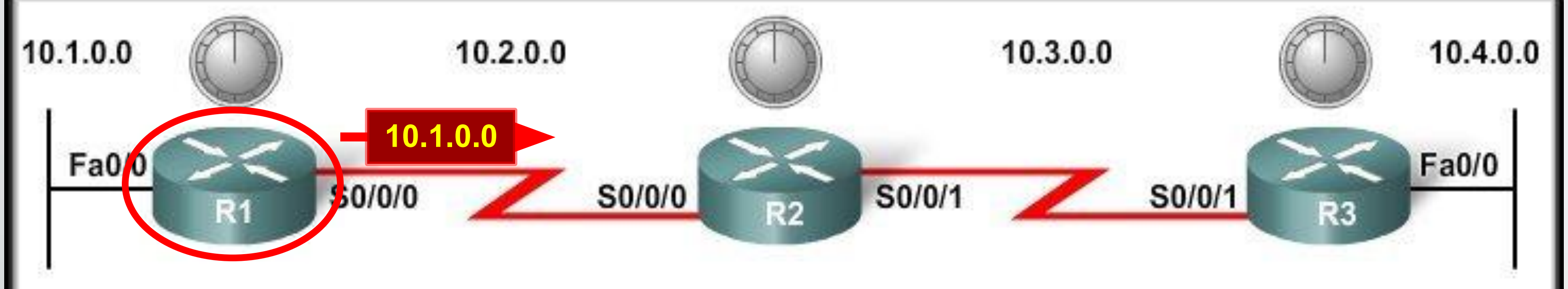
Network	Interface	Hop
10.1.0.0	Fa0/0	0
10.2.0.0	S0/0/0	0
10.3.0.0	S0/0/0	1

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
10.2.0.0	S0/0/1	1

- R2 Receives the update from R1 about network 10.1.0.0 and adds it to its routing table.
- R2 Receives the update from R3 about network 10.4.0.0 and adds it to its routing table.

Next Exchange of Routing Information



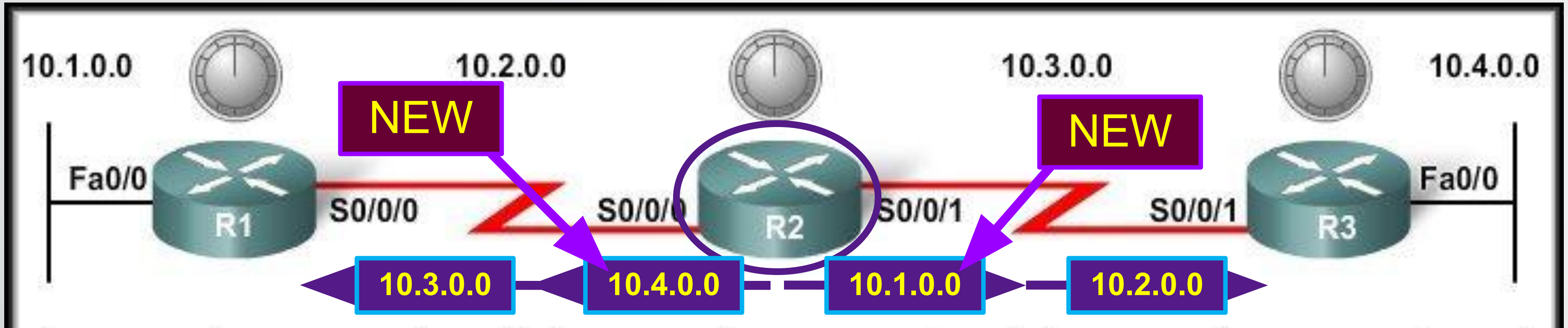
Network	Interface	Hop
10.1.0.0	Fa0/0	0
10.2.0.0	S0/0/0	0
10.3.0.0	S0/0/0	1

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

- Sends an update about network 10.1.0.0 out the S0/0/0 interface with a metric of 1 - AGAIN!
- When R2 receives the update, there is no change in information so the update is ignored.

Next Exchange of Routing Information



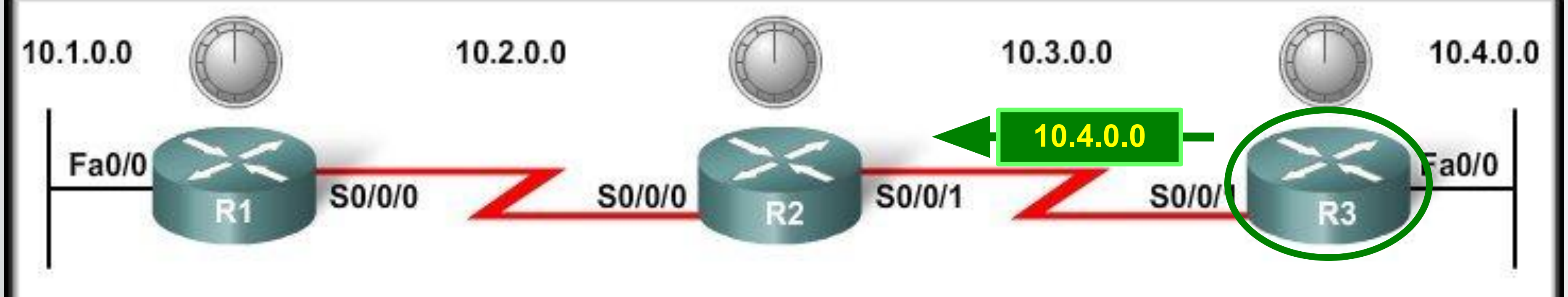
Network	Interface	Hop
10.1.0.0	Fa0/0	0
10.2.0.0	S0/0/0	0
10.3.0.0	S0/0/0	1

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

- Sends an update about networks 10.3.0.0 with a metric of 1 and 10.4.0.0 with a metric of 2 out the Serial 0/0/0 interface.
- Similarly sends updates about networks 10.1.0.0 with a metric of 2 and 10.2.0.0 with a metric of 1 out the Serial 0/0/1 interface.

Next Exchange of Routing Information



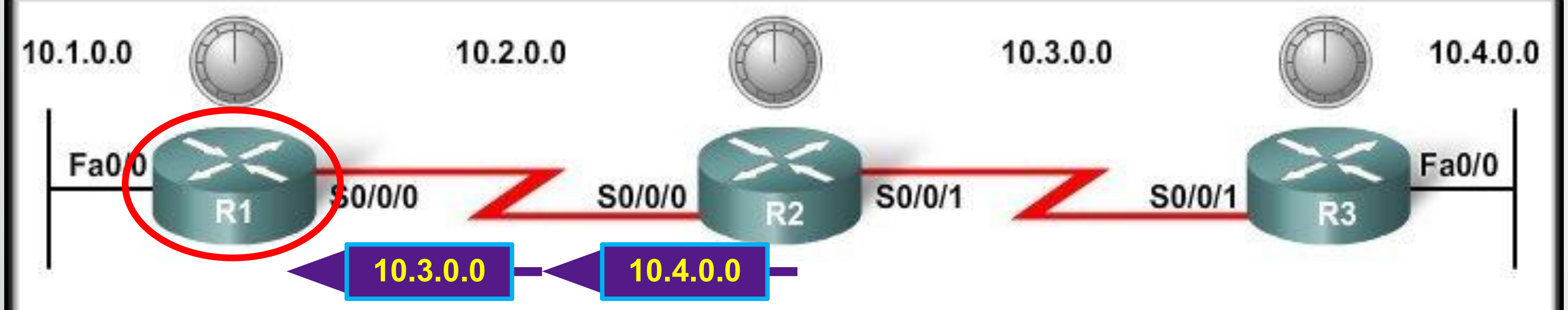
Network	Interface	Hop
10.1.0.0	Fa0/0	0
10.2.0.0	S0/0/0	0
10.3.0.0	S0/0/0	1

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

- Sends an update about network 10.4.0.0 out the S0/0/0 interface with a metric of 1 - AGAIN!
- When R2 receives the update, there is no change in information so the update is ignored.

Next Exchange of Routing Information



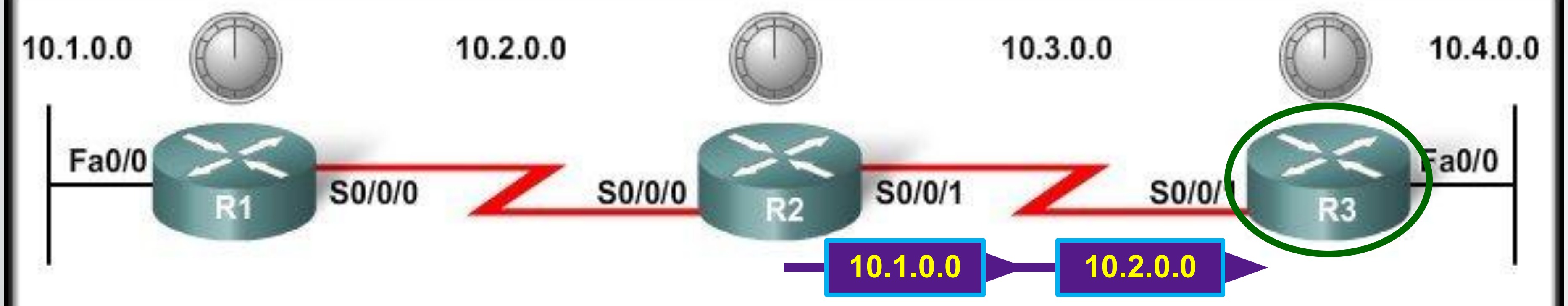
Network	Interface	Hop
10.1.0.0	Fa0/0	0
10.2.0.0	S0/0/0	0
10.3.0.0	S0/0/0	1

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

- R1 receives an update from R2 about network 10.3.0.0 and there is no change – update ignored.
- R1 receives an update from R2 about network 10.4.0.0 (new) and adds it to its routing table.

Next Exchange of 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

- R3 receives an update from R2 about network 10.2.0.0 and there is no change – update ignored.
- R3 receives an update from R2 about network 10.1.0.0 (new) and adds it to its routing table.

Next Exchange of 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

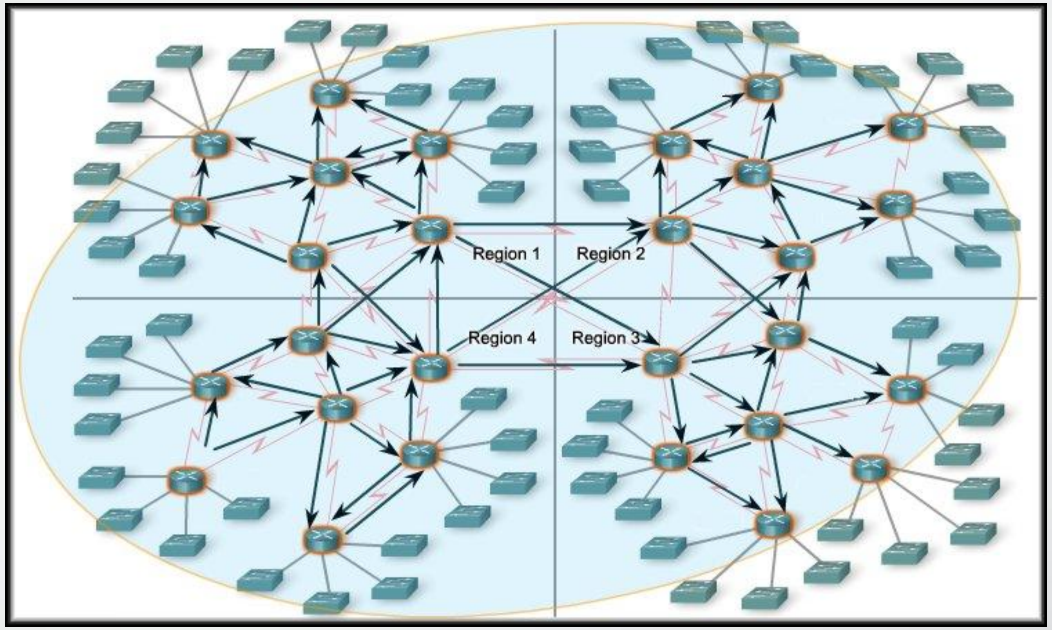
Network	Interface	Hop
10.2.0.0	S0/0/0	0
10.3.0.0	S0/0/1	0
10.1.0.0	S0/0/0	1
10.4.0.0	S0/0/1	1

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

- The network has CONVERGED!
  - All routers now know about all of the networks attached to all of their neighbouring routers.

Convergence

- The amount of time it takes for a network to converge is directly proportional to the size of that network.



- Routing protocols are compared based on how fast they can propagate this information - their speed to convergence.

- A network is not completely operable until it has converged.
  - Network administrators prefer routing protocols with shorter convergence times.

THE END