Định tuyến động
(Dynamic routing protocols)

- **Phần I**

  - Distance Vector routing
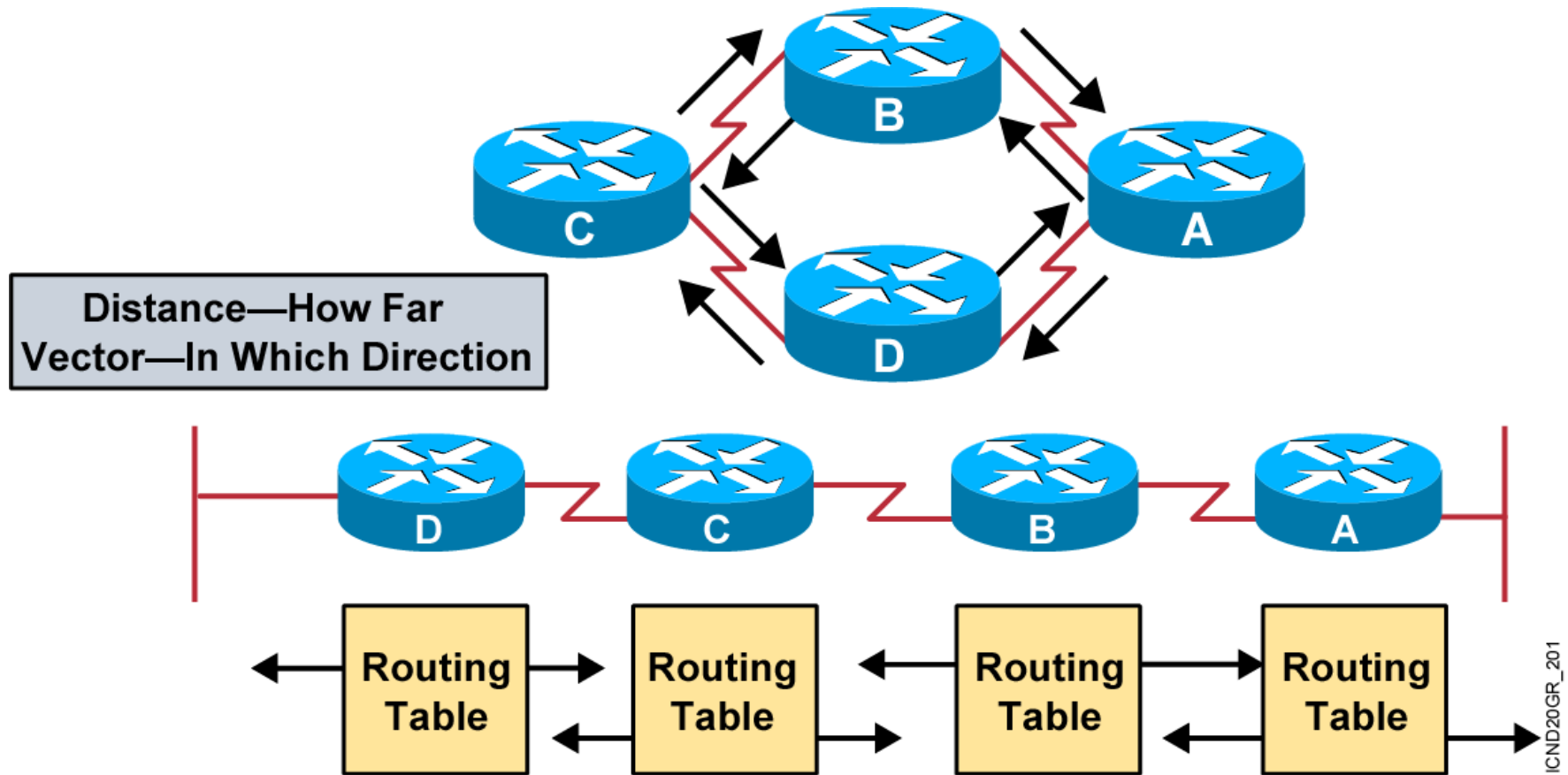 - Link State routing

- **Phần II**

  - RIP
    - Các tính năng
    - Cấu hình RIP trên router
  - IGRP
    - Các tính năng
    - Cấu hình IGRP trên router
  - EIGRP
    - Các tính năng
    - Cấu hình EIGRP trên router
  - OSPF
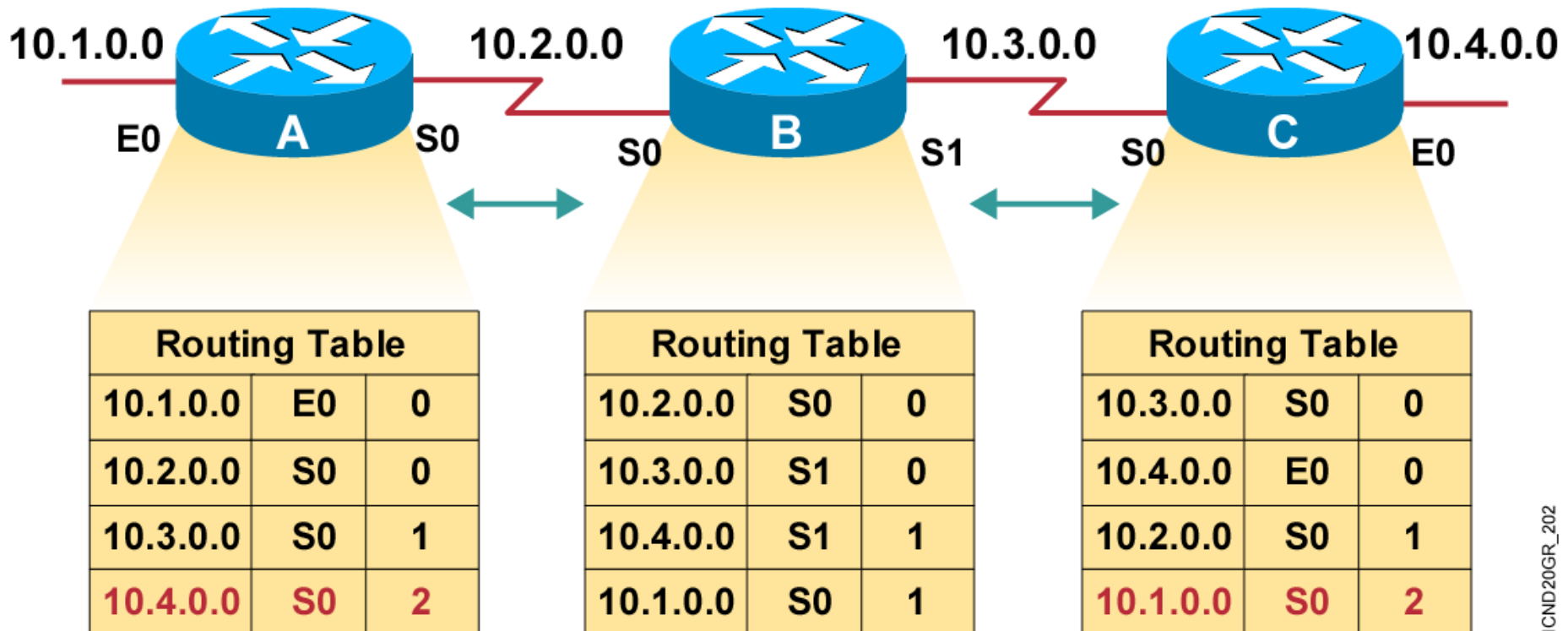   - Các tính năng
    - Cấu hình OSPF trên router

Phần I

Distance Vector & Link State Protocols

Distance Vector Routing Protocols
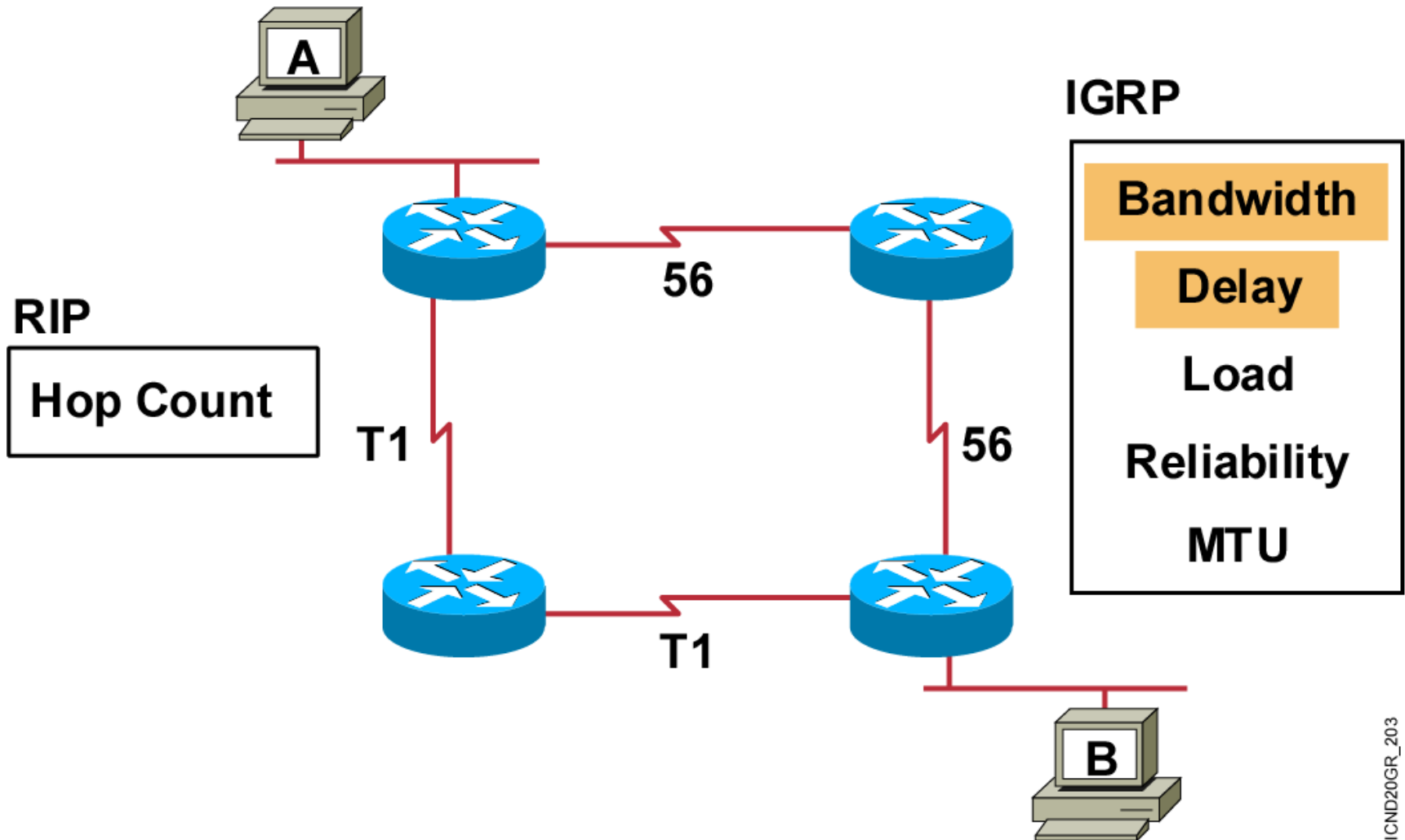

Distance—How Far
Vector—In Which Direction

- Router chuyển bảng routing cho tất cả các neighbor theo những khoảng thời gian nhất định và tính toán các vector khoảng cách.
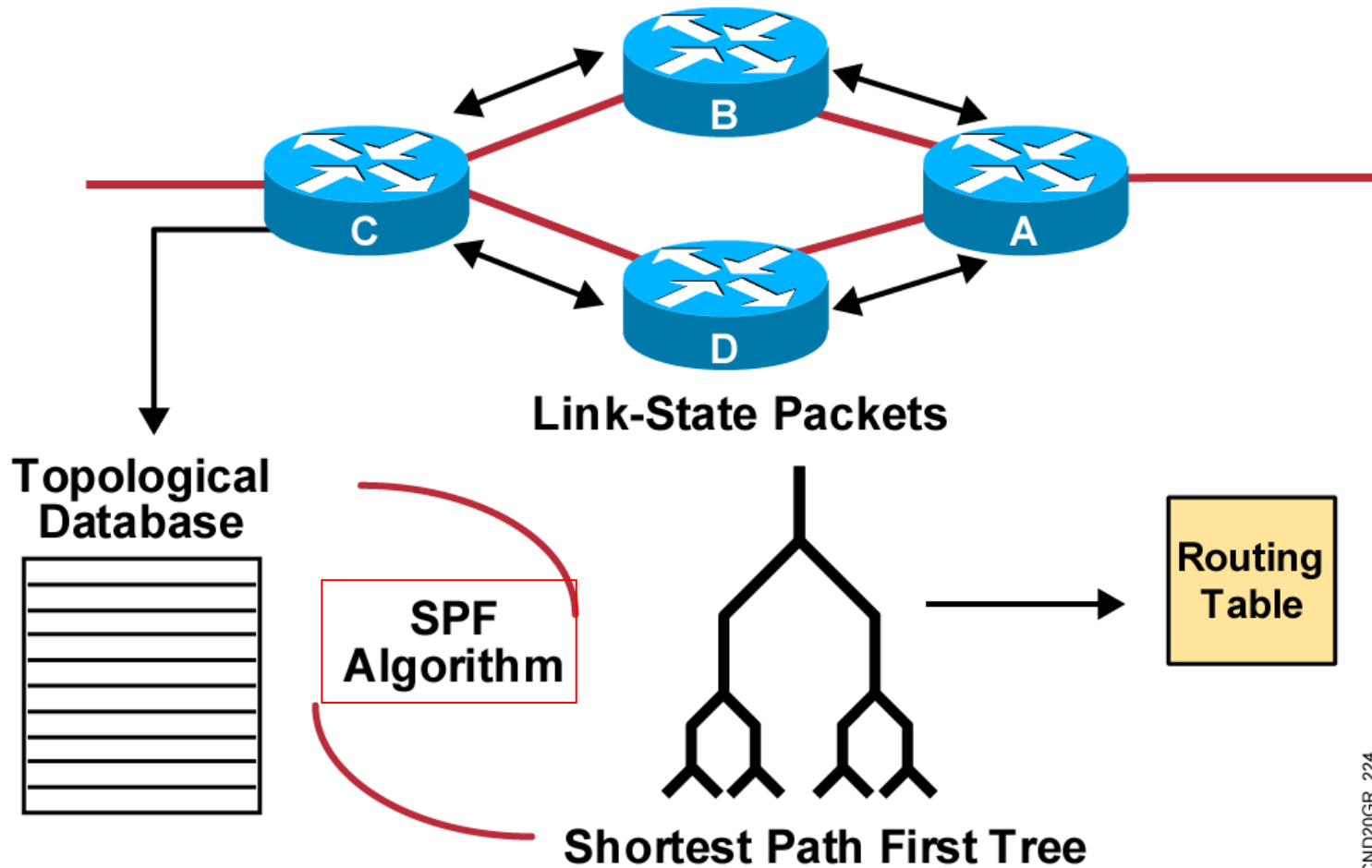
Sources of Information and Discovering Routes

Routing Table (Router A)

10.1.0.0	E0	0
10.2.0.0	S0	0
10.3.0.0	S0	1
10.4.0.0	S0	2

Routing Table (Router B)

10.2.0.0	S0	0
10.3.0.0	S1	0
10.4.0.0	S1	1
10.1.0.0	S0	1

Routing Table (Router C)

10.3.0.0	S0	0
10.4.0.0	E0	0
10.2.0.0	S0	1
10.1.0.0	S0	2

ICND20GR_202

- Routers tìm route tốt nhất từ bảng routing của neighbors.

Selecting the
Best Route with Metrics

A

IGRP

RIP

56

Bandwidth

Delay

Load

Hop Count

T1

56

Reliability

MTU

T1

B

ICND20GR_203

Link-State Routing Protocols

Link-State Packets

Topological Database
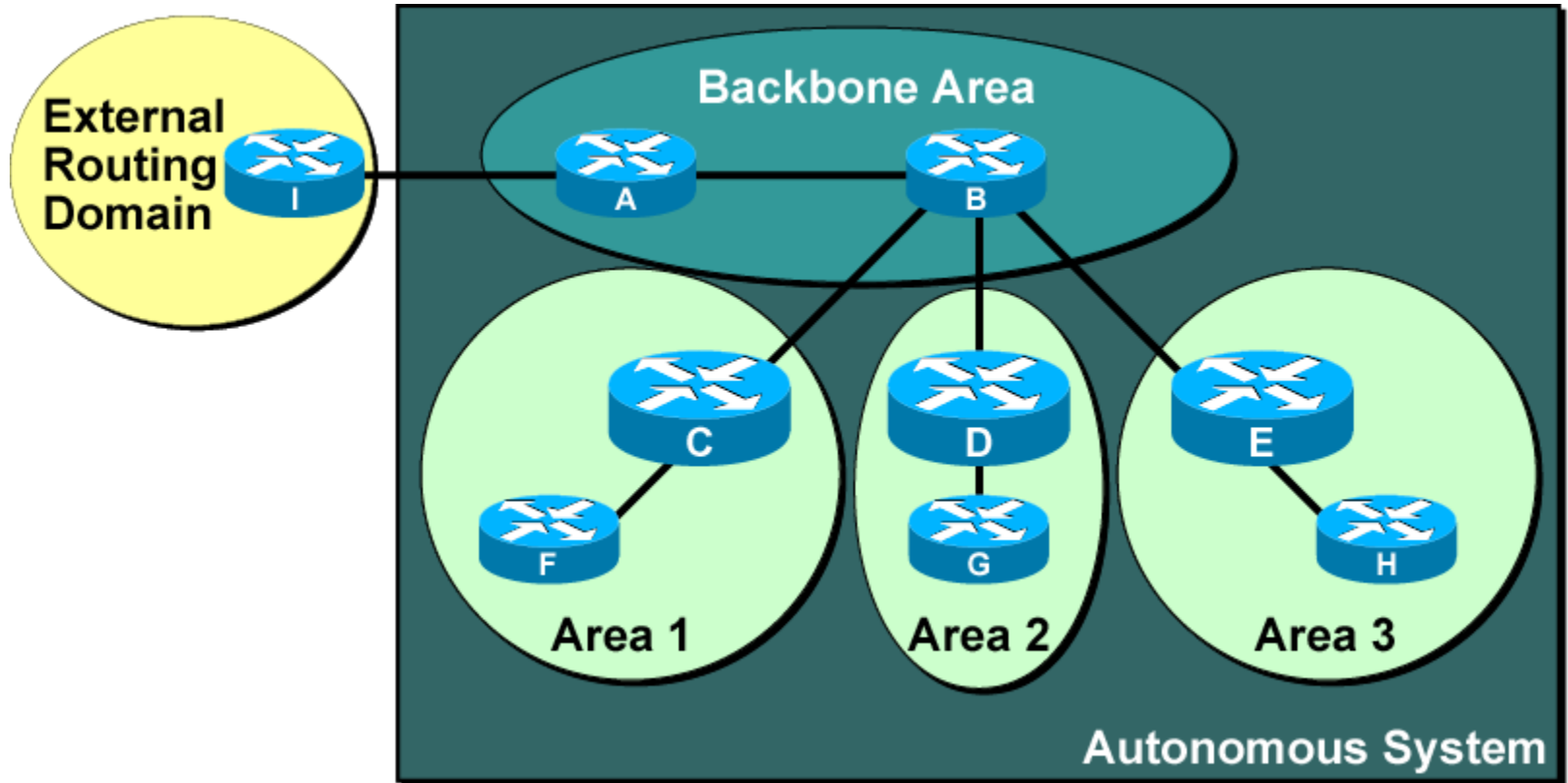
SPF Algorithm

Shortest Path First Tree

Routing Table

ICND20GR_224

- After initial flood, pass small event-triggered link-state updates to all other routers

Link-State Network Hierarchy Example

- Minimizes routing table entries
- Localizes impact of a topology change within an area

Tóm tắt Link State

- Link-state routing uses LSAs, a topological database, the SPF algorithm, the resulting SPF tree, and a routing table of paths and ports to each network.

- Link-state routing algorithms maintain a complex database of the network's topology by exchanging LSAs with other routers in a network.

- Link-state routing may flood the network with LSAs during initial topology discovery and can be both memory- and processor-intensive.

- Balanced hybrid routing protocols combine aspects of both distance vector and link-state protocols.

Phần II

Dynamic routing Protocols:

RIP-IGRP và EIGRP-OSPF

RIP Overview

ICND20GR_227
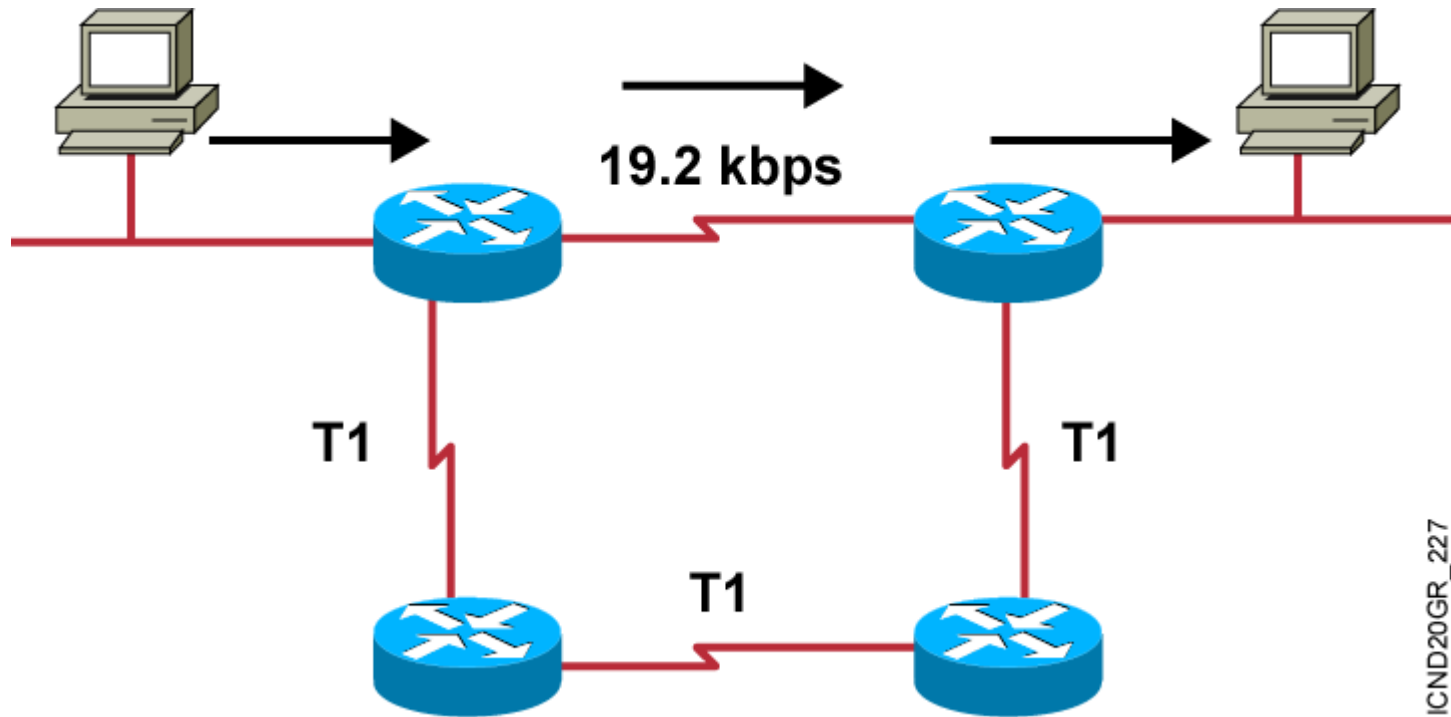
- – Maximum is 6 paths (default = 4)
- – Hop-count metric selects the path
- – Routes update every 30 seconds
- – Routes invalid timer 180 seconds
- – Holdown timer 180 seconds
- – Flush timer 240 seconds

Dùng cho hệ mạng tối đa 15 router
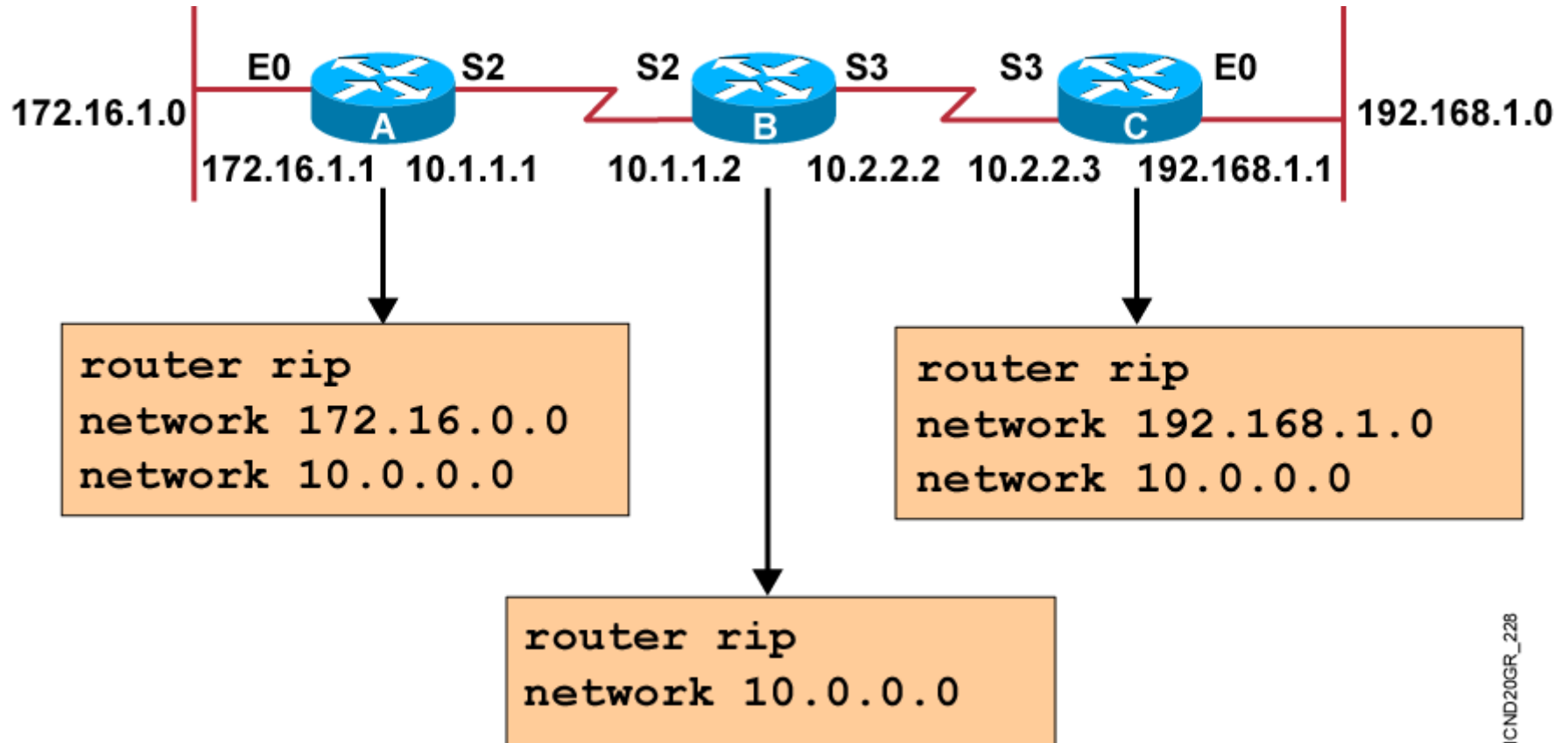
RIP Configuration

```
Router(config)#router rip
```

– Starts the RIP routing process
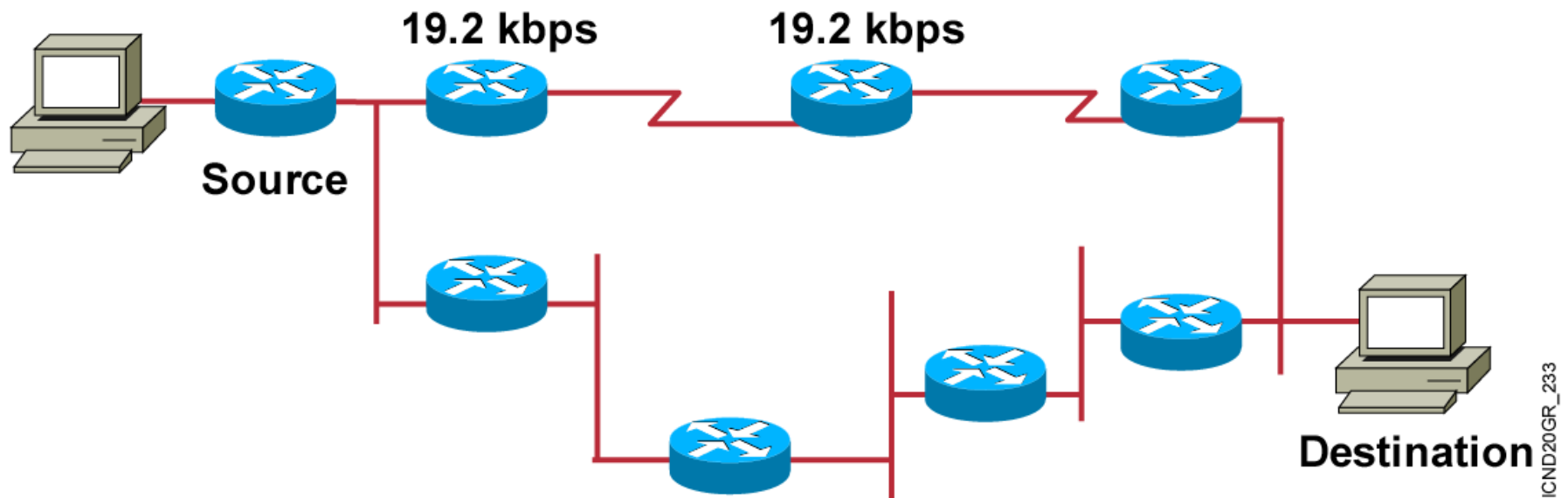
```
Router(config-router)#network network-number
```

- **Selects participating attached networks**
- **Requires a major classful network number**

RIP Configuration Example


```
172.16.1.0    E0  A  S2        S2  B  S3        S3  C  E0    192.168.1.0
              172.16.1.1  10.1.1.1    10.1.1.2    10.2.2.2  10.2.2.3  192.168.1.1
```

```
router rip
network 172.16.0.0
network 10.0.0.0
```

```
router rip
network 192.168.1.0
network 10.0.0.0
```

```
router rip
network 10.0.0.0
```

ICND20GR_228

IGRP Composite Metric

(dùng Distance Vector)

19.2 kbps   19.2 kbps

Source

Destination

ICND20GR_233

– Bandwidth
– Delay
– Reliability
– Loading
– MTU

– Routes update default every 90 seconds
– Invalid timer 3x90 seconds
– Holdown timer 3x90 + 10 seconds
– Flush timer 7x90 seconds

IGRP Unequal Multiple Paths

New Route

Source

Initial Route

Destination

ICND20GR_234
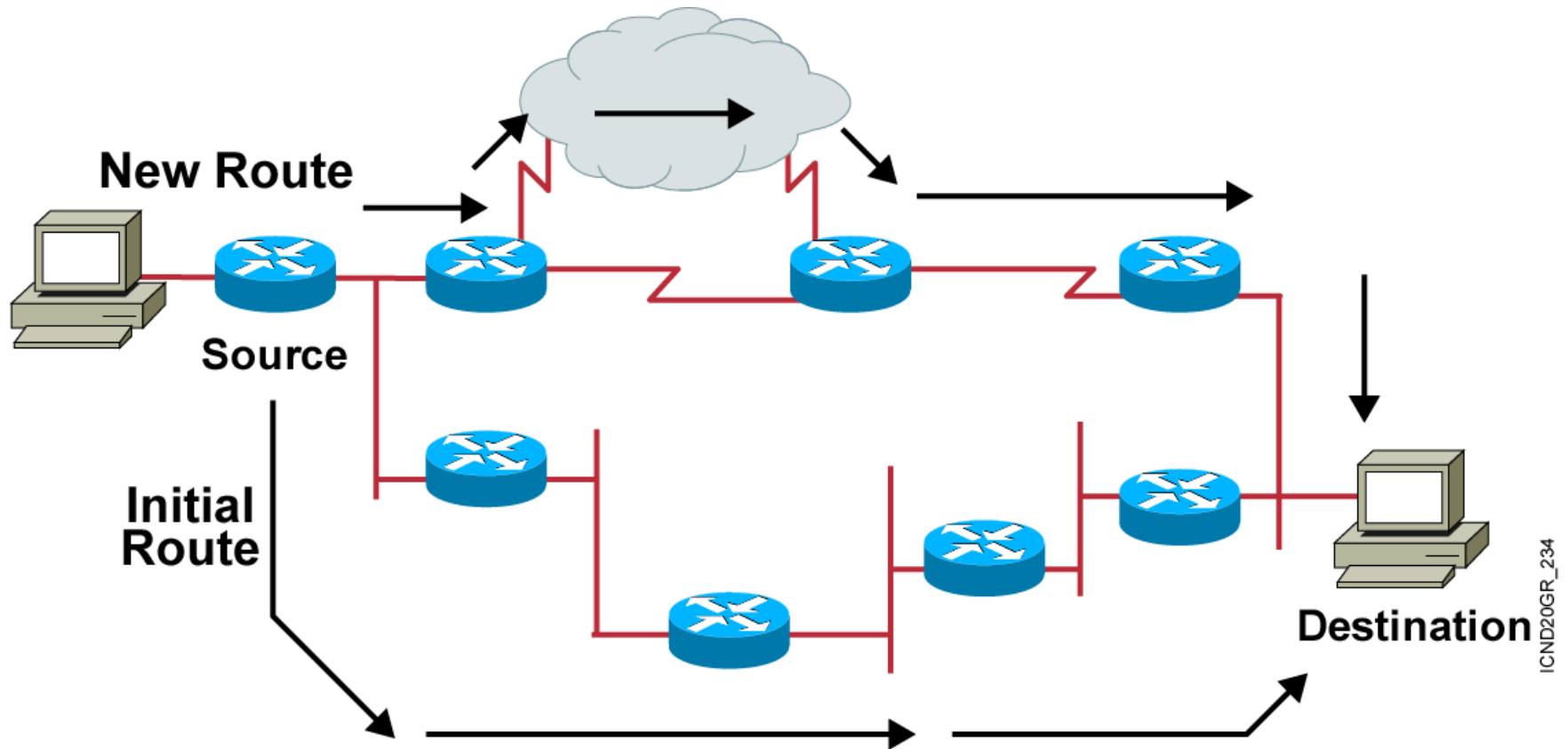
– Maximum 6 paths (default = 4)

– Within metric variance

– Next-hop router closer to destination

Configuring IGRP

```
Router(config)#router igrp autonomous-system
```

- **Defines IGRP as the IP routing protocol**

```
Router(config-router)#network network-number
```

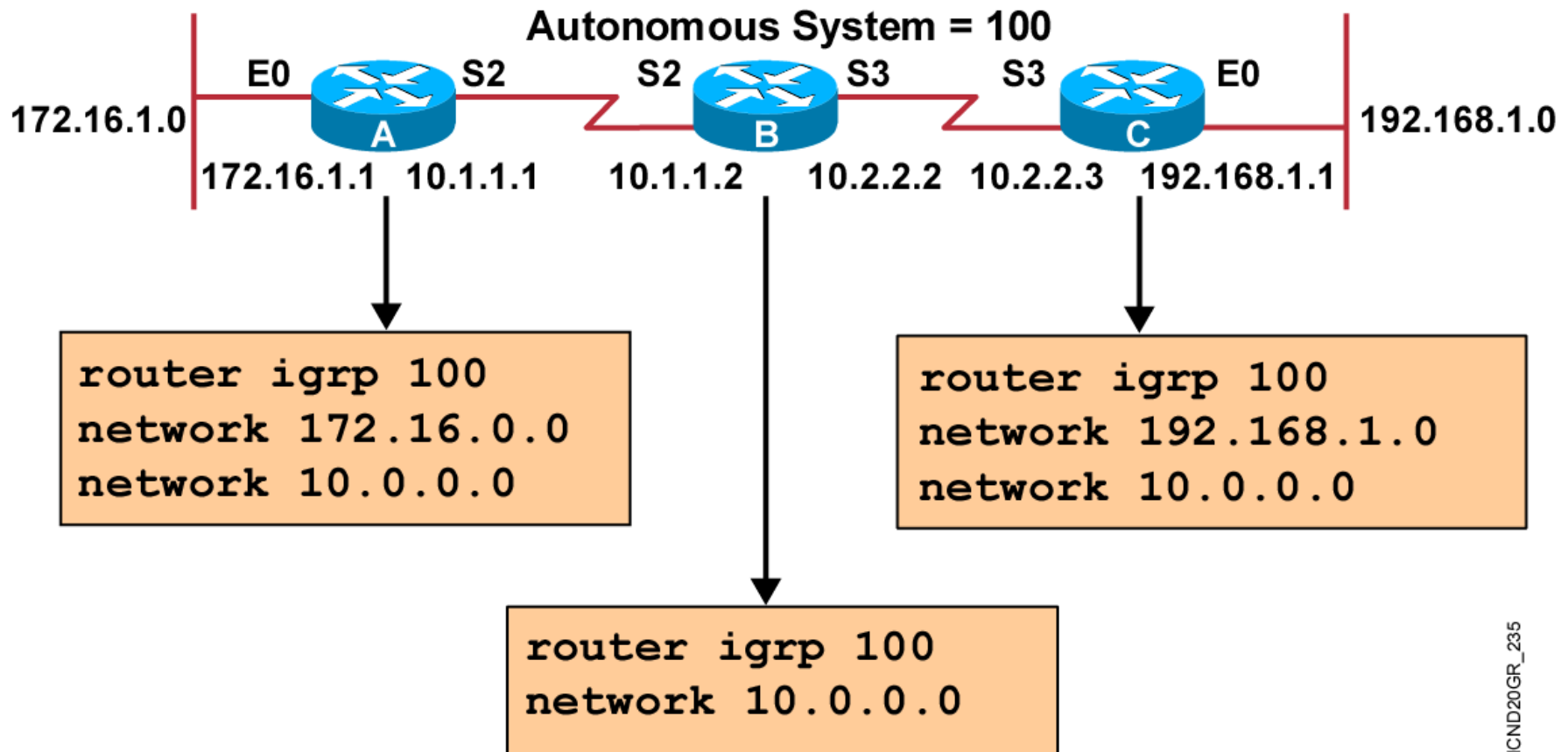- **Selects participating attached networks**

IGRP Configuration Example

(Không dùng IGRP, thay vào đó dùng EIGRP - Kể cả các chứng chỉ)

Autonomous System = 100

172.16.1.0
E0 S2 — S2 B S3 — S3 C E0
172.16.1.1 10.1.1.1 | 10.1.1.2 10.2.2.2 10.2.2.3 192.168.1.1
192.168.1.0

```
router igrp 100
network 172.16.0.0
network 10.0.0.0
```

```
router igrp 100
network 192.168.1.0
network 10.0.0.0
```

```
router igrp 100
network 10.0.0.0
```

ICND20GR_235

Verifying the IGRP Configuration

```
Router#show ip protocols
```

```
Router#show ip route
```

```
Router#show ip igrp transactions
```

```
Router#debug ip igrp events
```

```
Router#debug ip igrp transactions
```

EIGRP routing protocol

- Before EIGRP routers are willing to exchange routes with each other, they must become neigh-bors. There are three conditions that must be met for neighborship establishment:
  - Hello or ACK received
  - AS numbers match
  - Identical metrics (K values)

- EIGRP metric uses a combination of four:
  - Bandwidth
  - Delay
  - Load
  - Reliability

(Sử dụng cho mạng vừa và nhỏ <= 100 routers)

So sánh EIGRP và IGRP

– Similar metric
– Same load balancing
– Improved convergence time
– Reduced network overhead
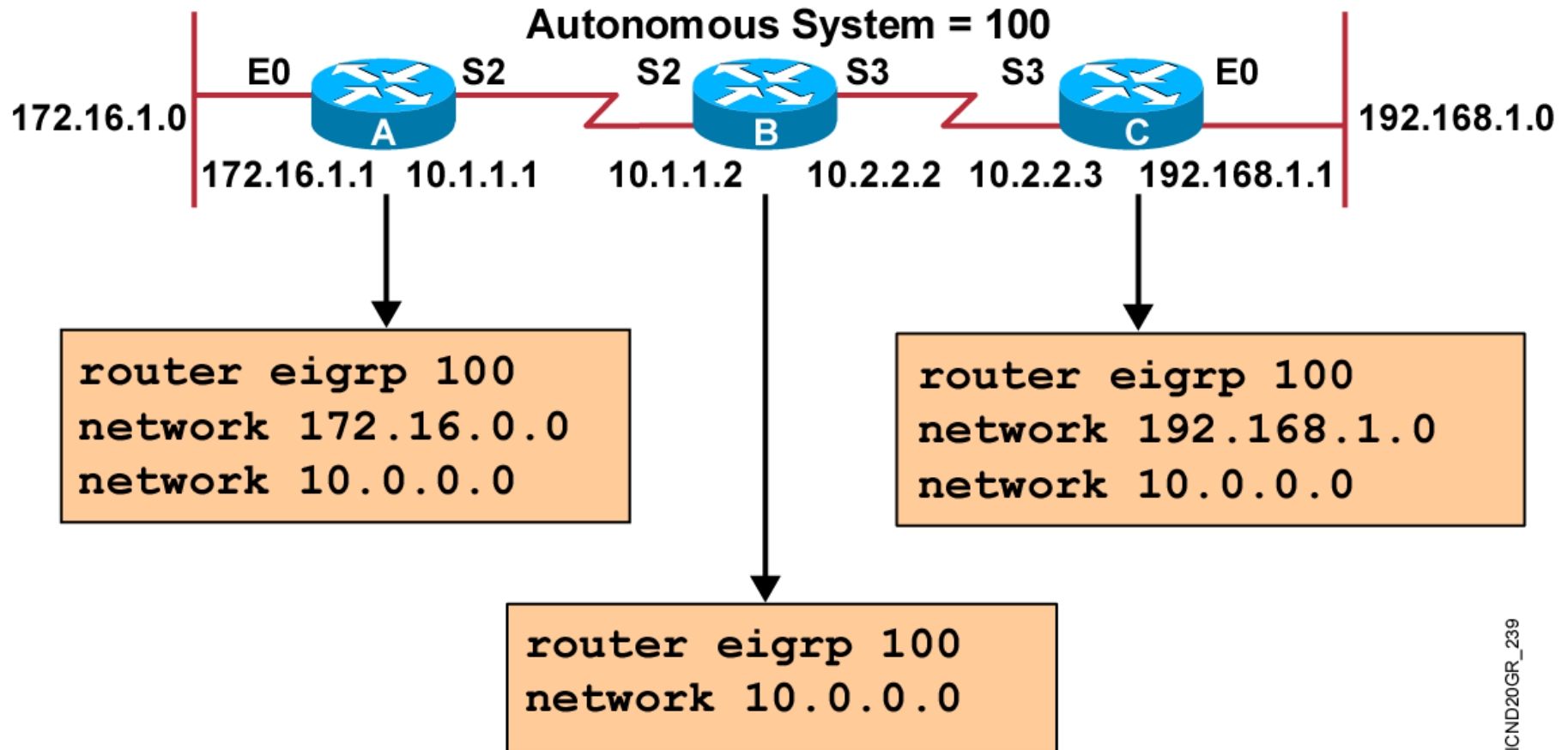
Configuring EIGRP

```
Router(config)#router eigrp autonomous-system
```

- **Defines EIGRP as the IP routing protocol**

```
Router(config-router)#network network-number
```

- **Selects participating attached networks**

EIGRP Configuration Example

Autonomous System = 100

172.16.1.0

E0 — A — S2   S2 — B — S3   S3 — C — E0

192.168.1.0

172.16.1.1   10.1.1.1   10.1.1.2   10.2.2.2   10.2.2.3   192.168.1.1

```
router eigrp 100
network 172.16.0.0
network 10.0.0.0
```

```
router eigrp 100
network 192.168.1.0
network 10.0.0.0
```

```
router eigrp 100
network 10.0.0.0
```

ICND20GR_239

Verifying the EIGRP Configuration

```
Router#show ip eigrp neighbors
```

- **Displays the neighbors discovered by IP EIGRP**

```
Router#show ip eigrp topology
```

- **Displays the IP EIGRP topology table**

```
Router#show ip route eigrp
```

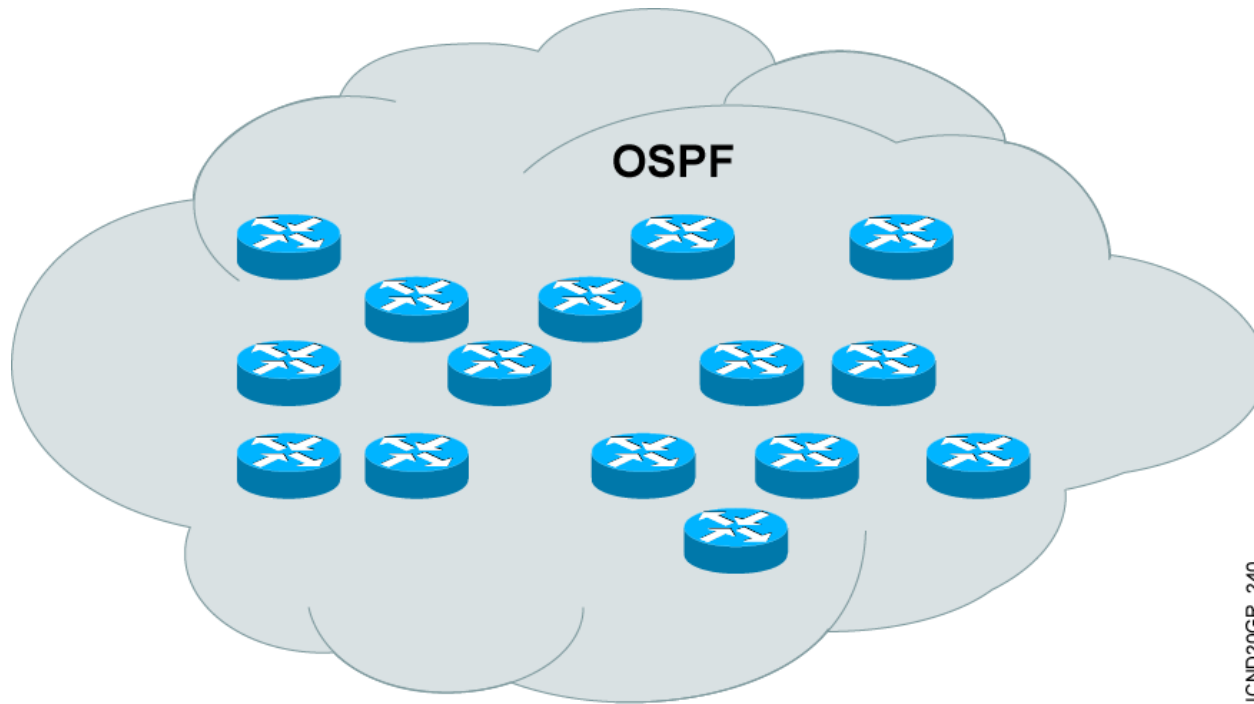- **Displays current EIGRP entries in the routing table**

```
Router#show ip protocols
```

- **Displays the parameters and current state of the active routing protocol process**

```
Router#show ip eigrp traffic
```

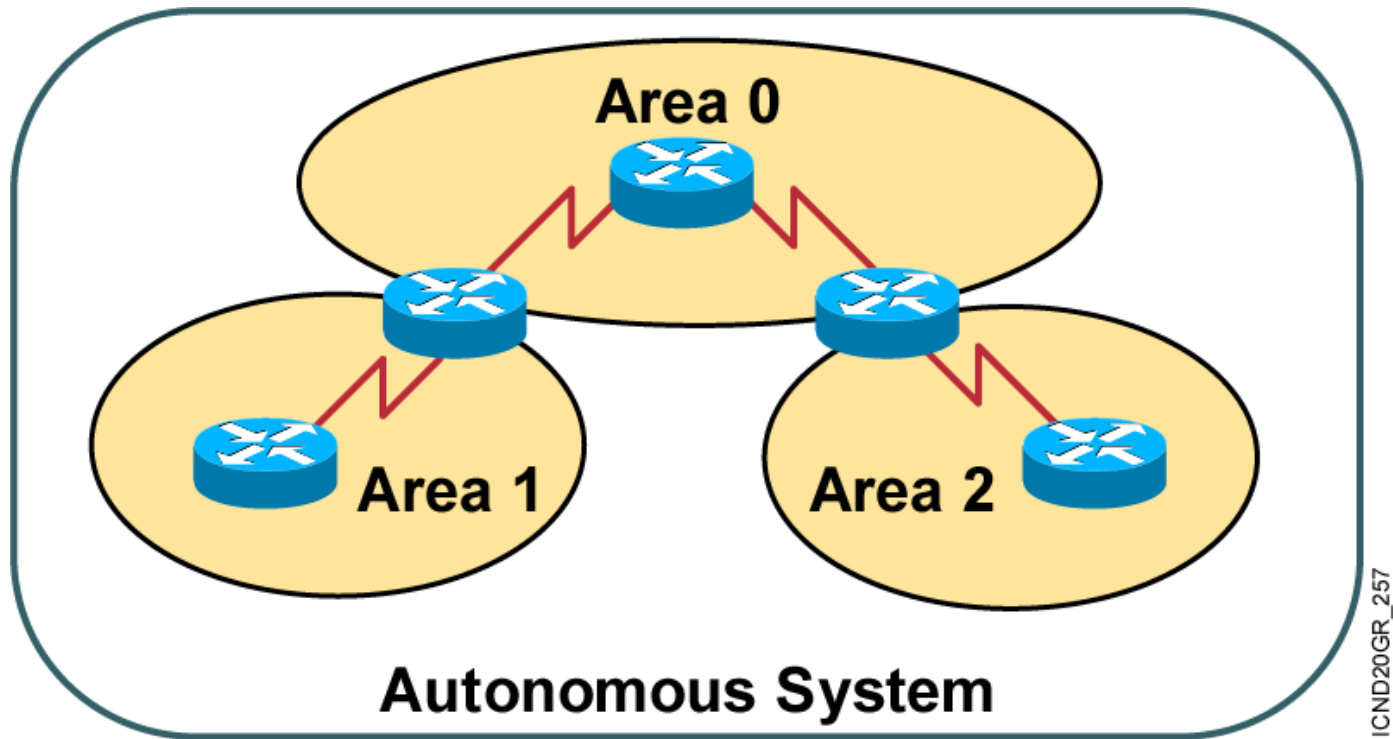- **Displays the number of IP EIGRP packets sent and received**

Introducing OSPF

ICND20GR_240

- **Open standard**
- **Shortest path first (SPF) algorithm**
- **<mark>Link-state routing protocol</mark> (vs. distance vector)**

OSPF Hierarchical Routing

– Consists of areas and autonomous systems
– Minimizes routing update traffic

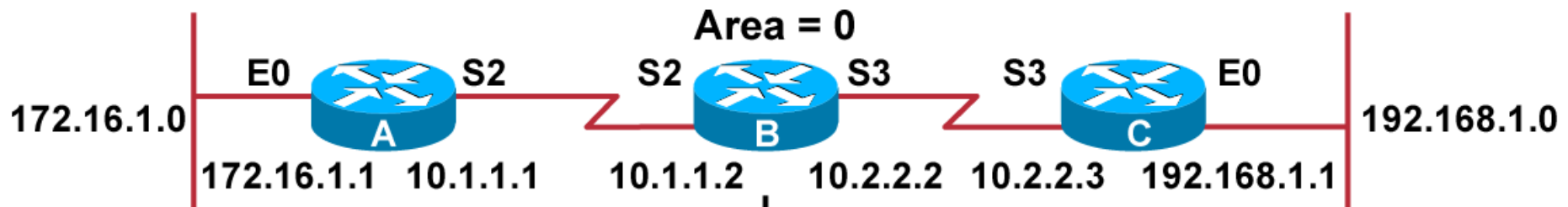# Configuring Single Area OSPF

```
Router(config)#router ospf process-id
```

- **Defines OSPF as the IP routing protocol**

```
Router(config-router)#network address wildcardmask area area-id
```

- **Assigns networks to a specific OSPF area**

OSPF Configuration Example


```
router ospf 100
network 10.1.1.2 0.0.0.0 area 0
network 10.2.2.2 0.0.0.0 area 0
```

ICND20GR_242

Verifying the OSPF Configuration

```
Router#show ip protocols
```

- **Verifies that OSPF is configured**

```
Router#show ip route
```

- **Displays all the routes learned by the router**

```
Router#show ip ospf interface
```

- **Displays area-ID and adjacency information**

```
Router#show ip ospf neighbor
```

- **Displays OSPF-neighbor information on a per-interface basis**