Chapter 9

Determining IP Routes

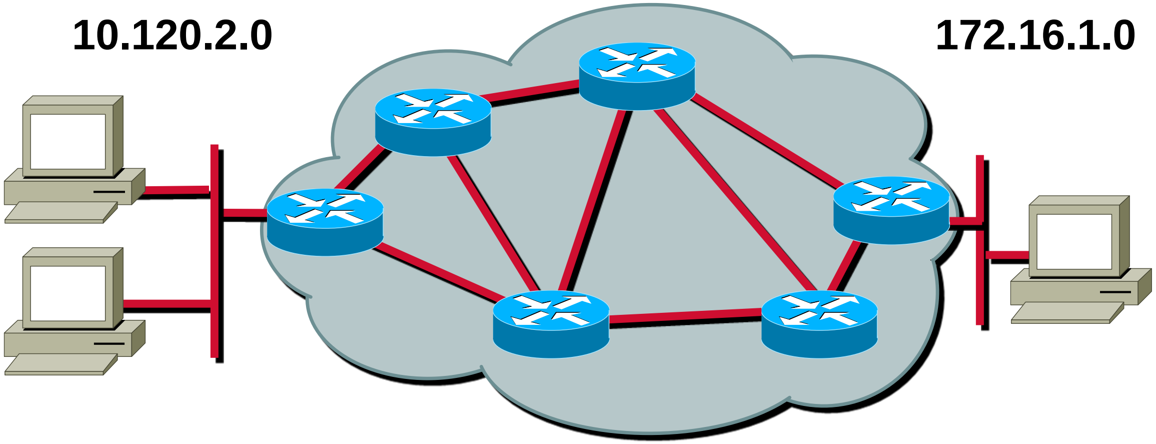
Cisco Systems

Objectives

Upon completion of this chapter, you will be able to complete the following tasks:

- Distinguish the use and operation of static and dynamic routes
- Configure and verify a static route
- Identify how distance vector IP routing protocols such as RIP and IGRP operate on Cisco routers
- Enable Routing Information Protocol (RIP)
- Enable Interior Gateway Routing Protocol (IGRP)
- Verify IP routing with show and debug commands

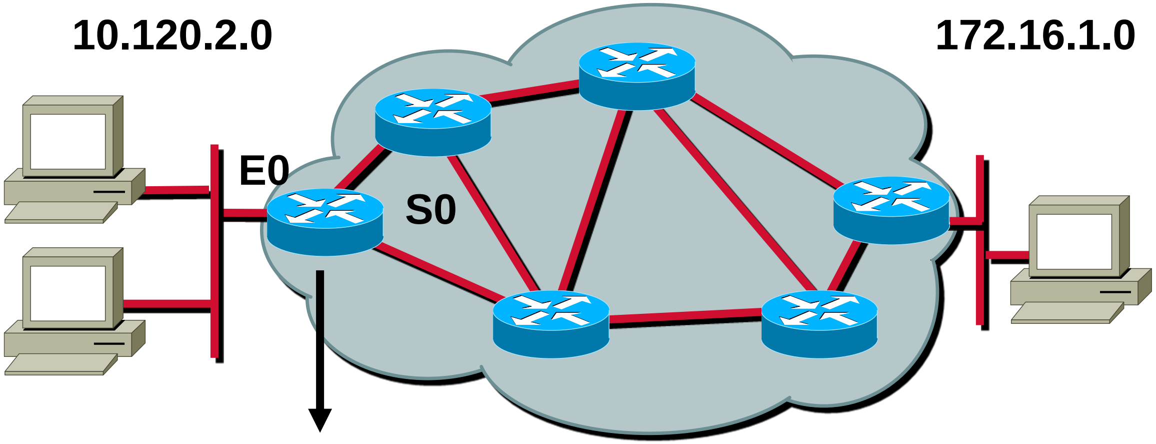
What is Routing?



To route, a router needs to know:

- Destination addresses
- Sources it can learn from
- Possible routes
- Best route
- Maintain and verify routing information

What is Routing? (cont.)



Network Protocol	Destination Network	Exit Interface
Connected	10.120.2.0	E0
Learned	172.16.1.0	S0

Routed Protocol: IP

Routers must learn destinations that are not directly connected

Identifying Static and Dynamic Routes

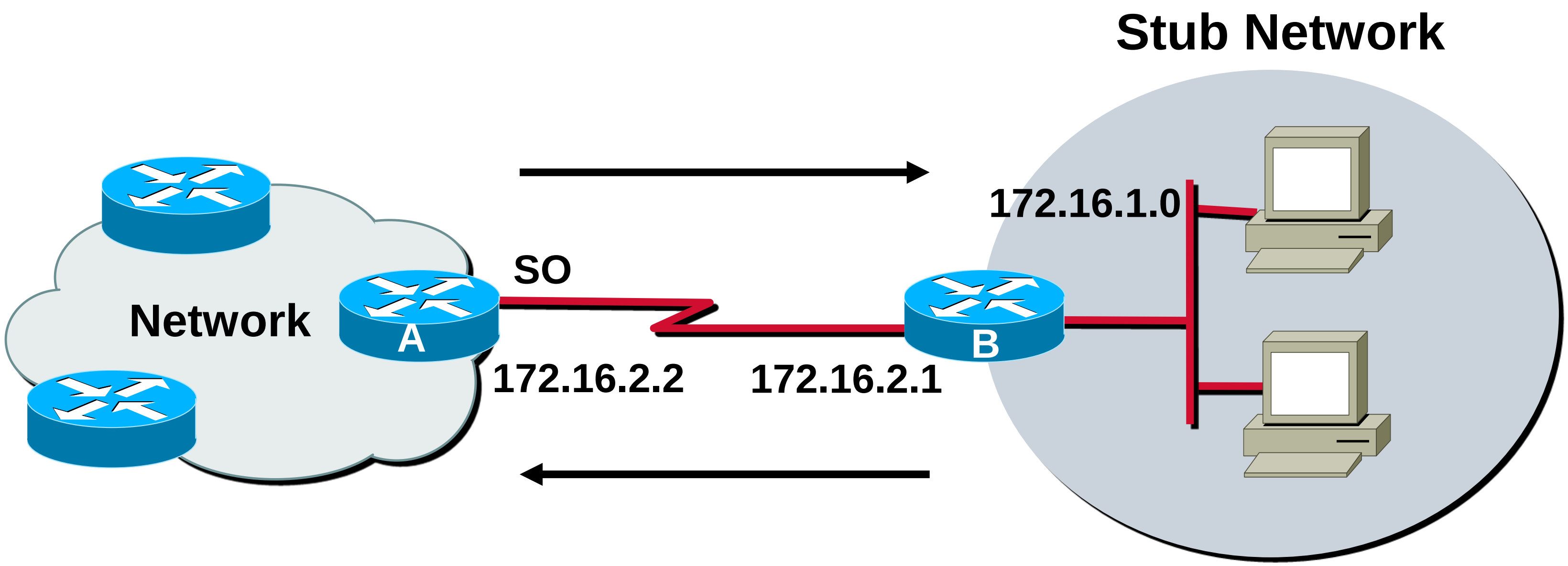
Static Route

Uses a route that a network administrator enters into the router manually

Dynamic Route

Uses a route that a network routing protocol adjusts automatically for topology or traffic changes

Static Routes



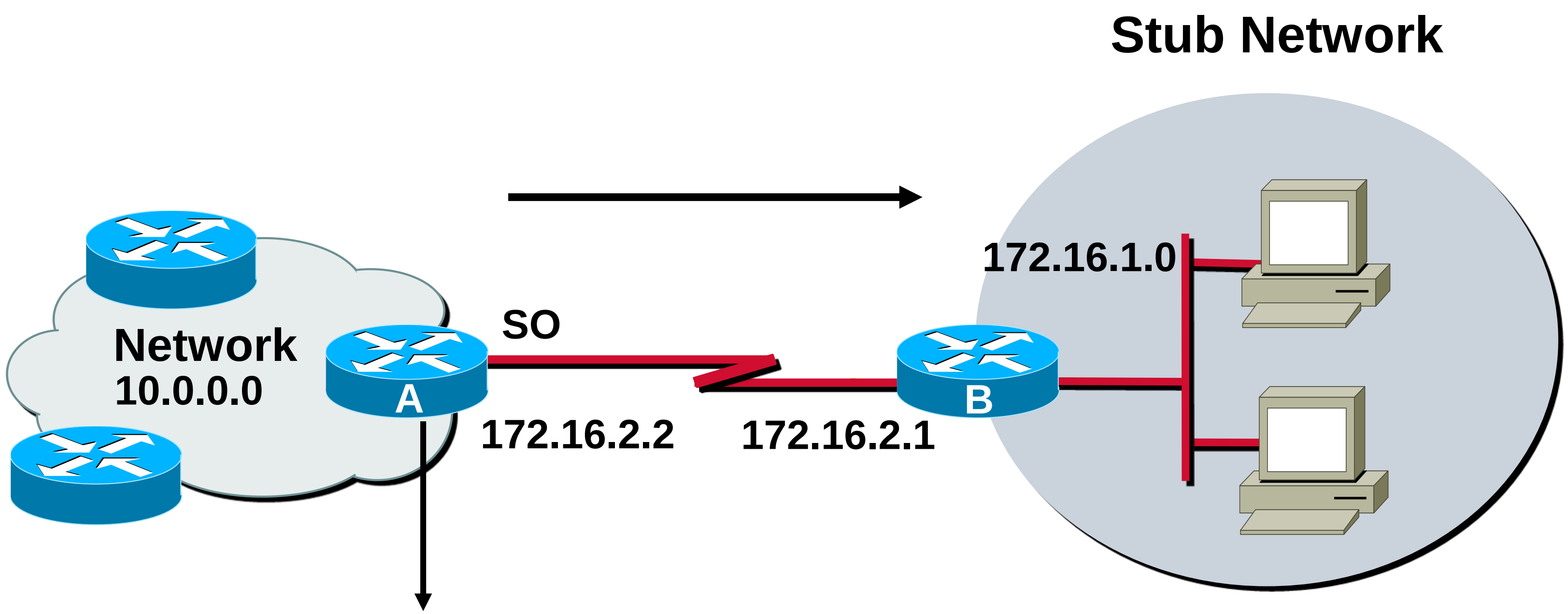
Configure unidirectional static routes to and from a stub network to allow communications to occur.

Static Route Configuration

```
Router(config)#ip route network  [mask]
{address | interface}[distance] [permanent]
```

Defines a path to an IP destination network or subnet

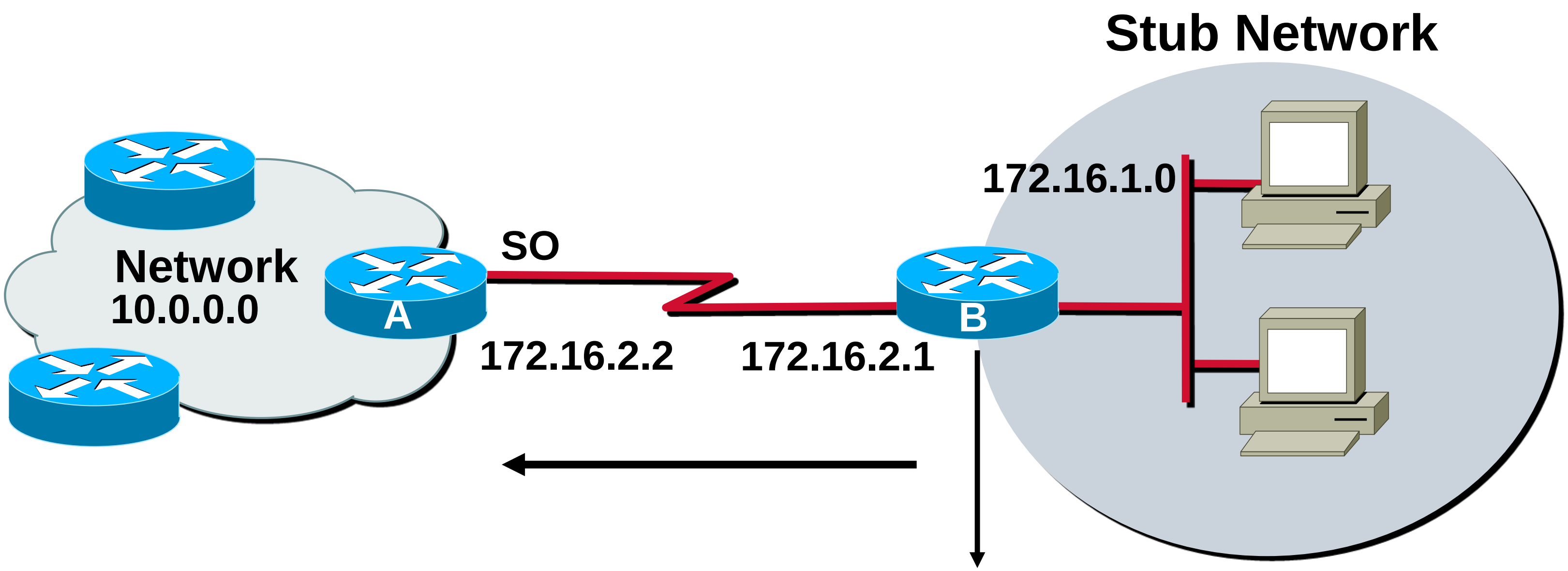
Static Route Example




```
ip route 172.16.1.0 255.255.255.0 172.16.2.1
```

- This is a unidirectional route. You must have a route configured in the opposite direction.

Default Routes



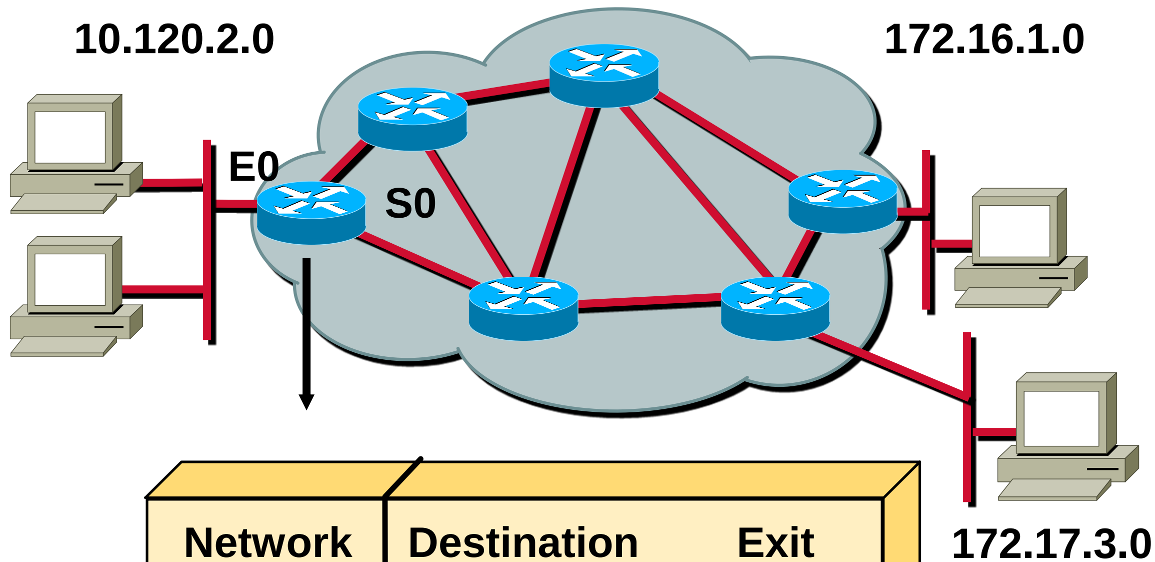

```
ip route 0.0.0.0 0.0.0.0 172.16.2.2
```

- **This route allows the stub network to reach all known networks beyond router A.**

What is a Routing Protocol?

Routing protocols are used between routers to determine paths and maintain routing tables.

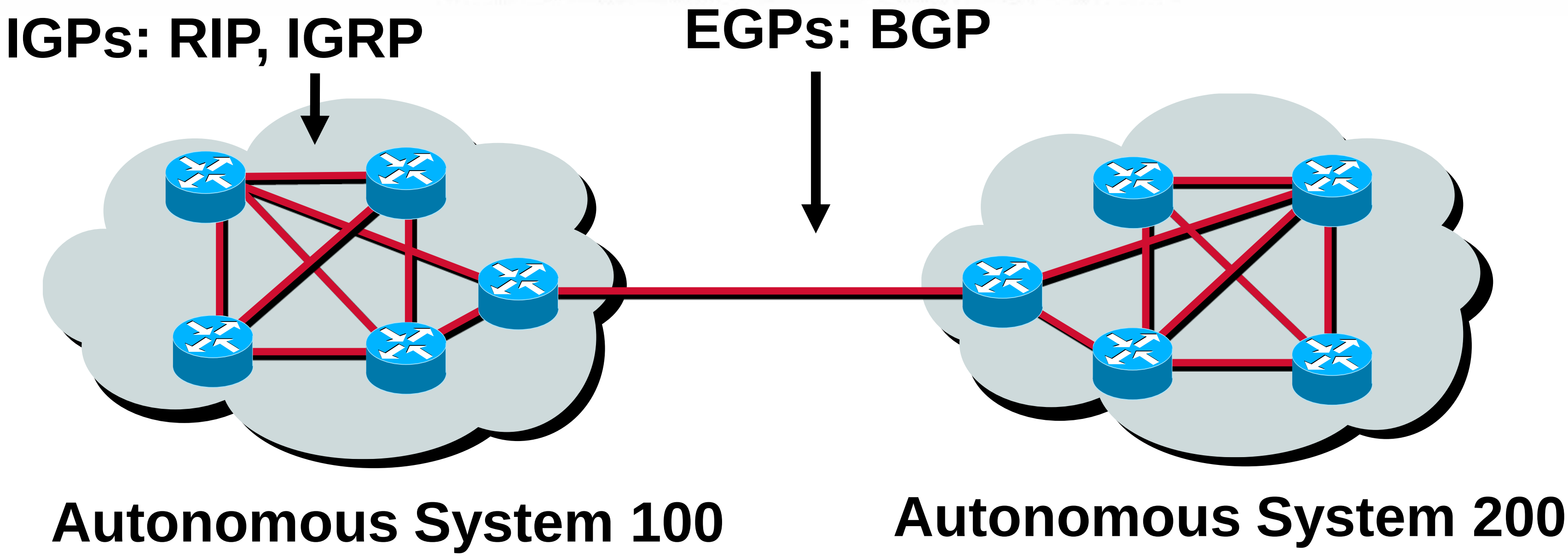
Once the path is determined a router can route a **routed** protocol.



Network Protocol	Destination Network	Exit Interface
Connected	10.120.2.0	E0
RIP	172.16.2.0	S0
IGRP	172.17.3.0	S1

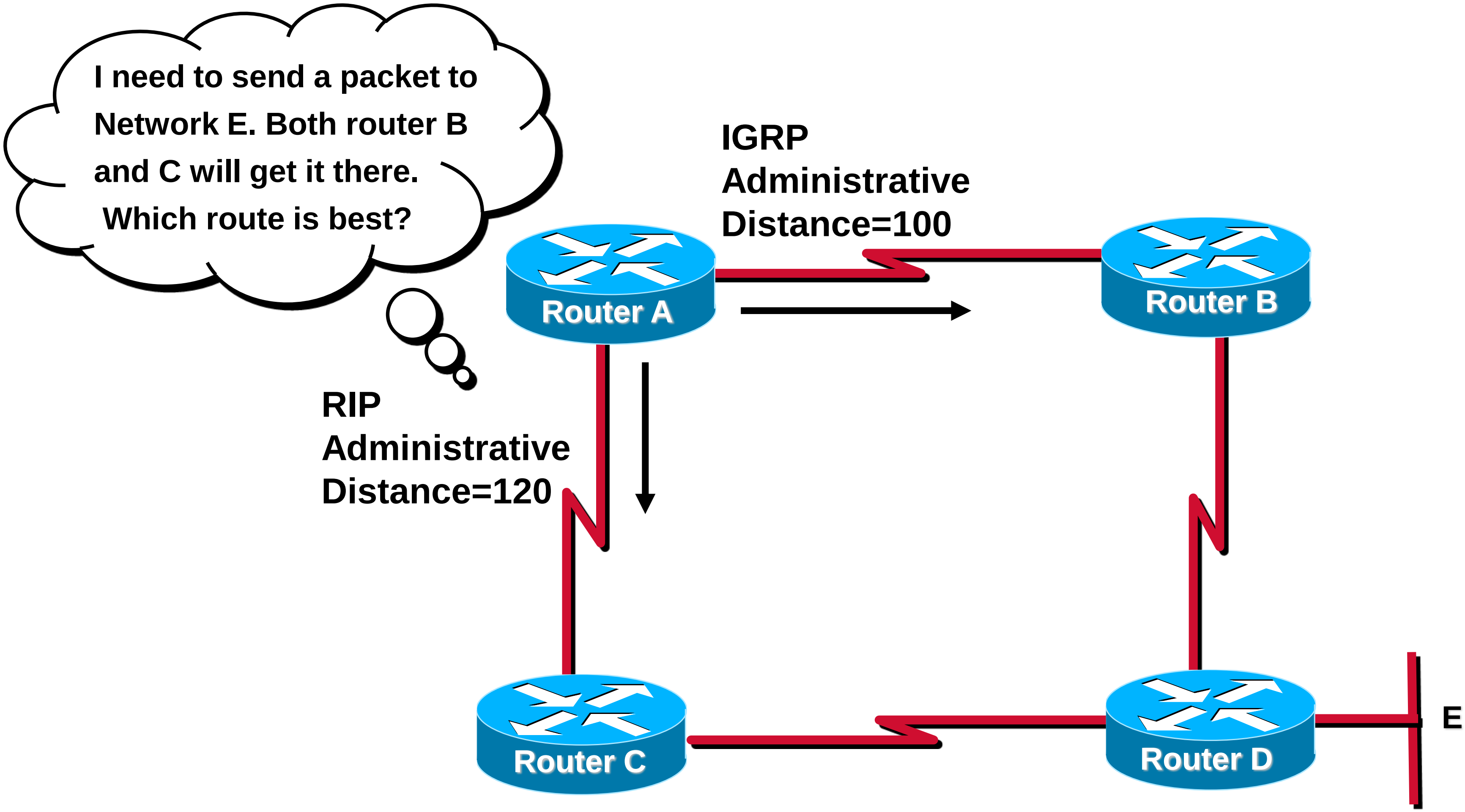
Routed Protocol: IP
Routing protocol: RIP, IGRP

Autonomous Systems: Interior or Exterior Routing Protocols



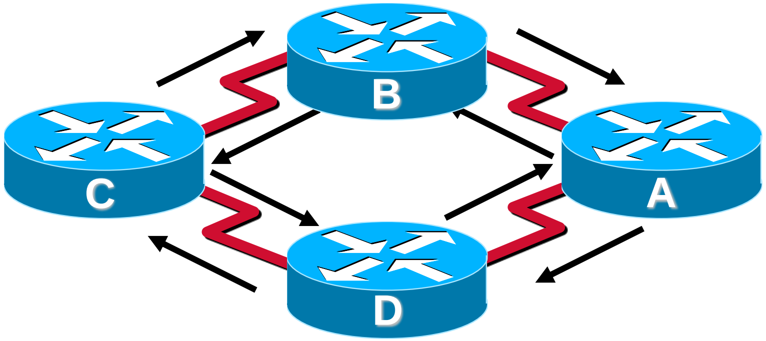
- An autonomous system is a collection of networks under a common administrative domain
- IGPs operate within an autonomous system
- EGPs connect different autonomous systems

Administrative Distance: Ranking Routes

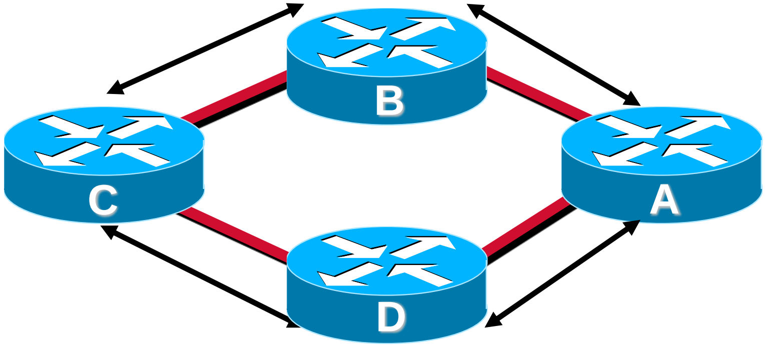


Classes of Routing Protocols

Distance Vector

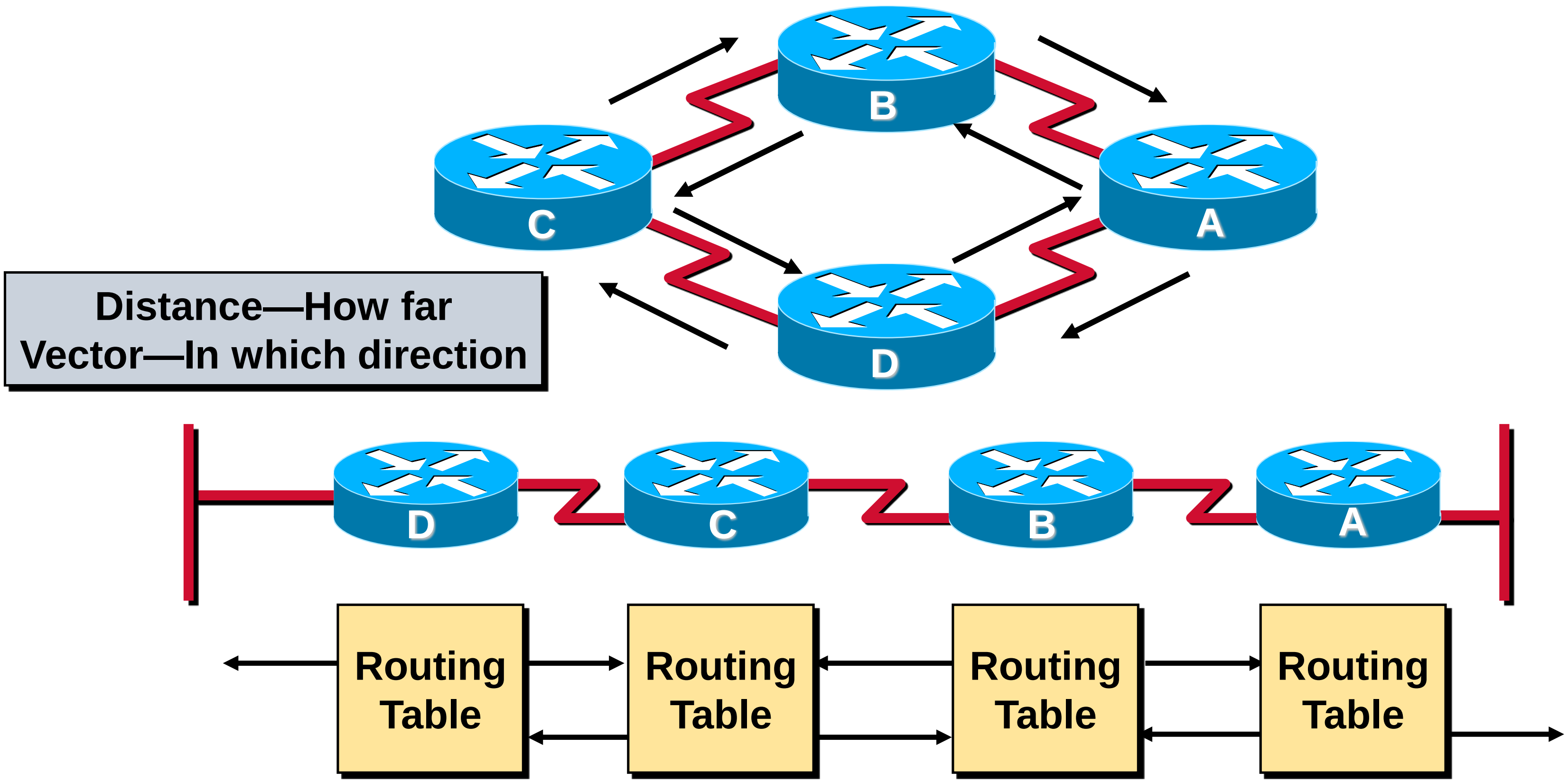


Hybrid Routing



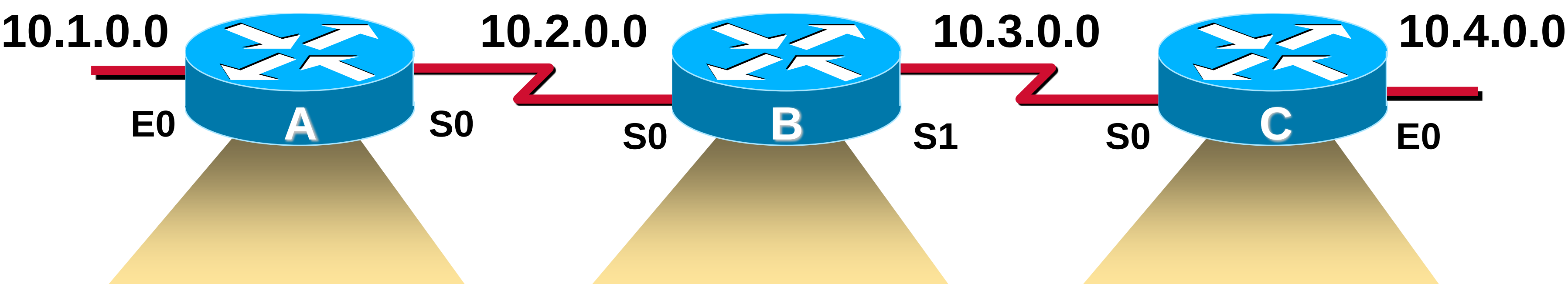
Link State

Distance Vector Routing Protocols



Pass periodic copies of routing table to neighbor routers and accumulate distance vectors

Distance Vector—Sources of Information and Discovering Routes



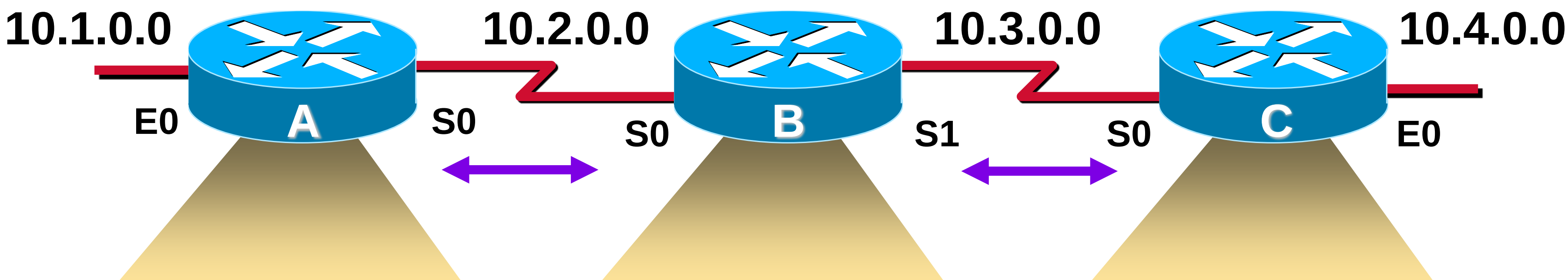
Routing Table		
10.1.0.0	E0	0
10.2.0.0	S0	0

Routing Table		
10.2.0.0	S0	0
10.3.0.0	S1	0

Routing Table		
10.3.0.0	S0	0
10.4.0.0	E0	0

Routers discover the best path to destinations from each neighbor

Distance Vector—Sources of Information and Discovering Routes



Router A – Routing Table

10.1.0.0	E0	0
10.2.0.0	S0	0
10.3.0.0	S0	1

Router B – Routing Table

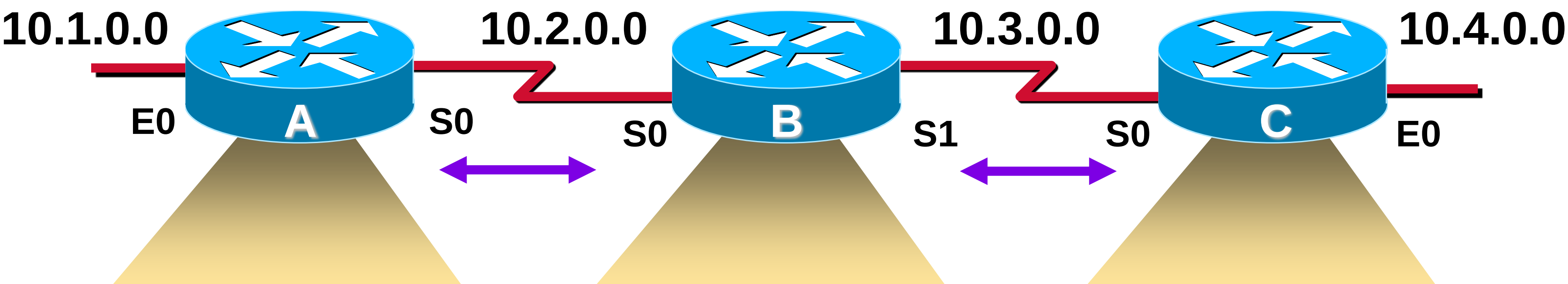
10.2.0.0	S0	0
10.3.0.0	S1	0
10.4.0.0	S1	1
10.1.0.0	S0	1

Router C – Routing Table

10.3.0.0	S0	0
10.4.0.0	E0	0
10.2.0.0	S0	1

Routers discover the best path to destinations from each neighbor

Distance Vector—Sources of Information and Discovering Routes



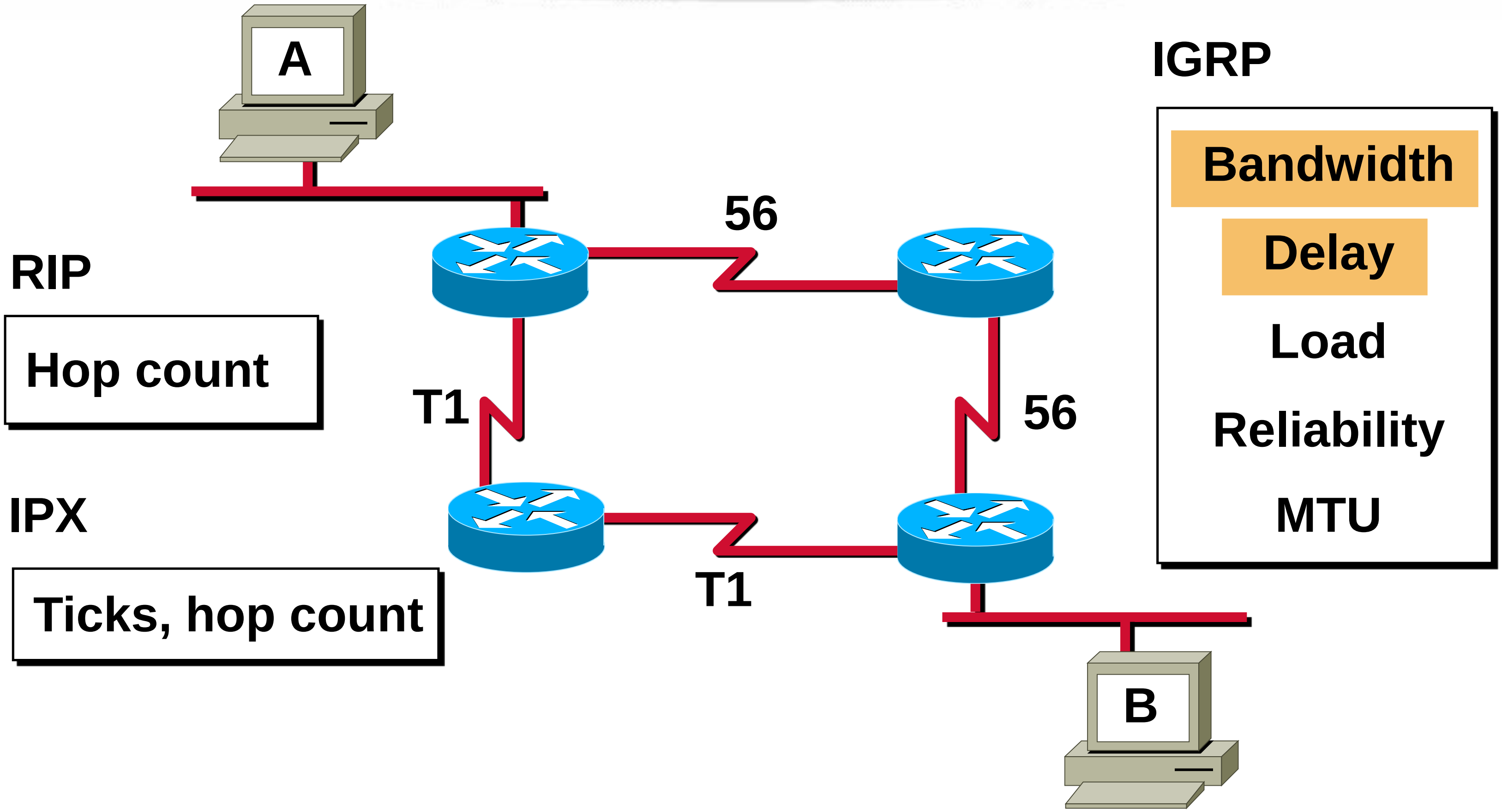
Routing Table		
10.1.0.0	E0	0
10.2.0.0	S0	0
10.3.0.0	S0	1
10.4.0.0	S0	2

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

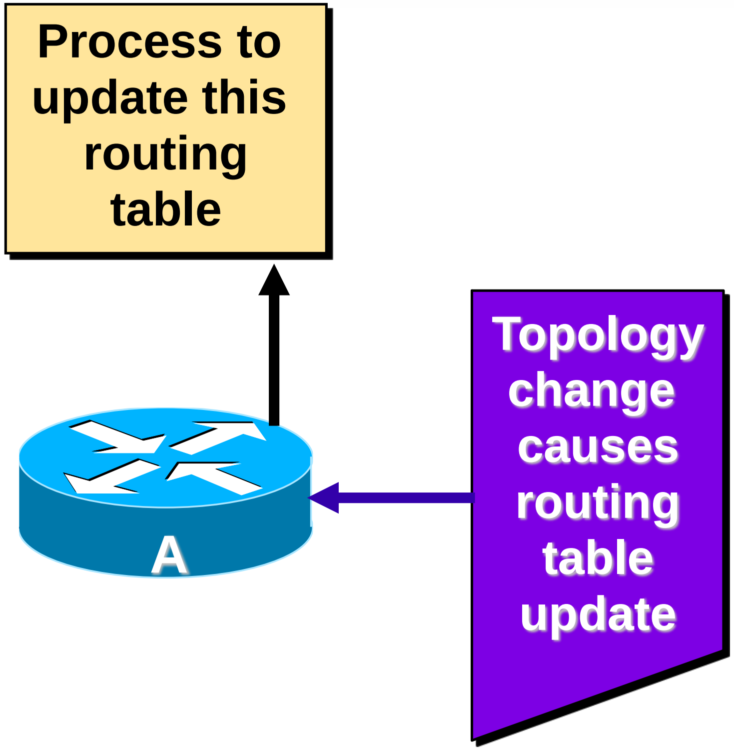
Routers discover the best path to destinations from each neighbor

Distance Vector—Selecting Best Route with Metrics



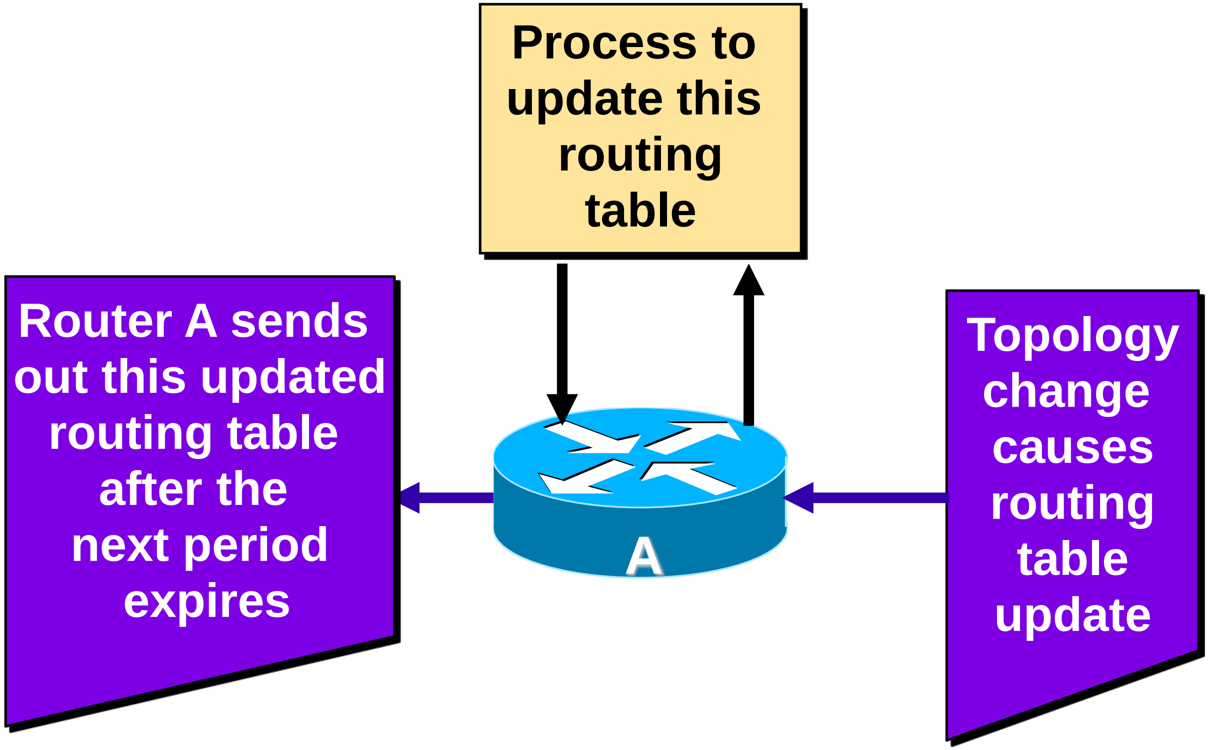
Information used to select the best path for routing

Distance Vector—Maintaining Routing Information



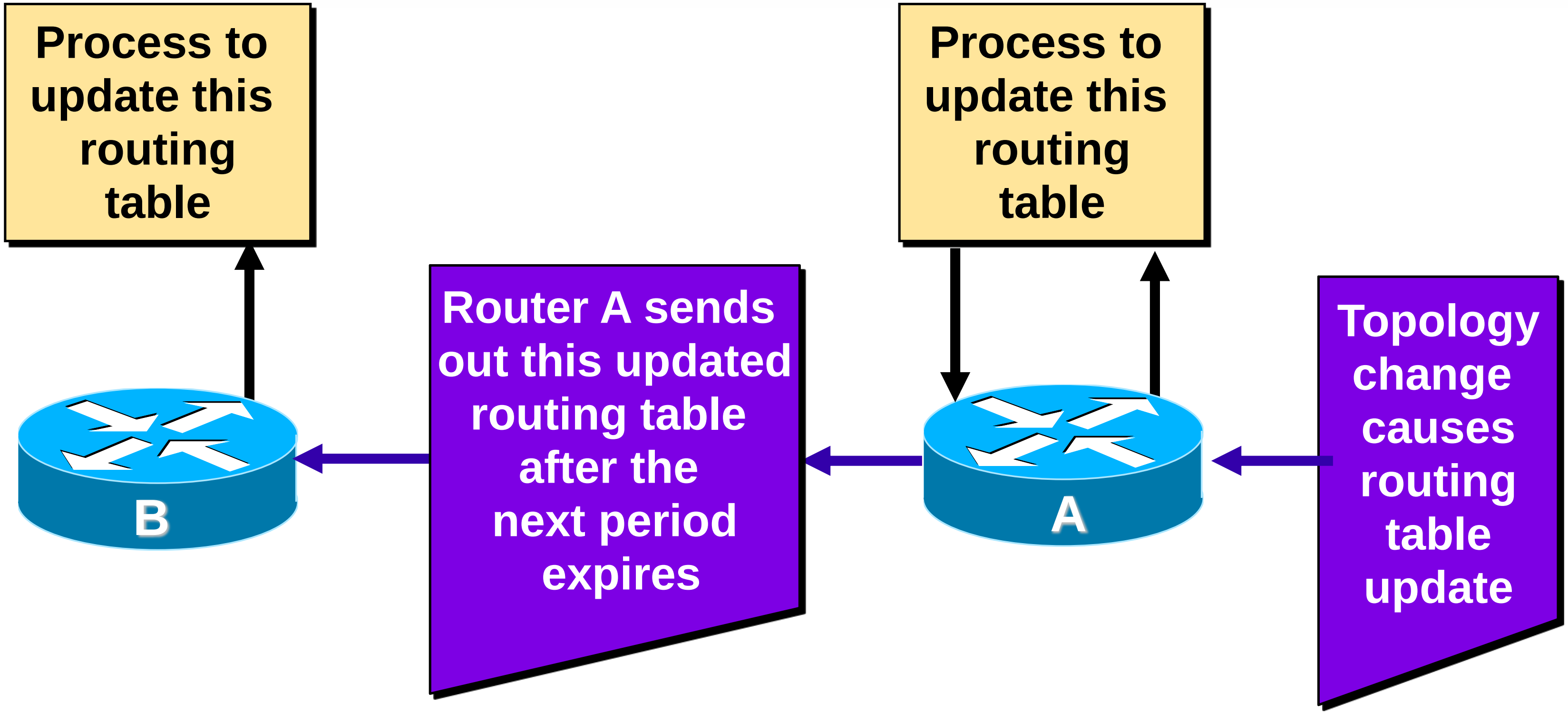
Updates proceed step-by-step from router to router

Distance Vector—Maintaining Routing Information



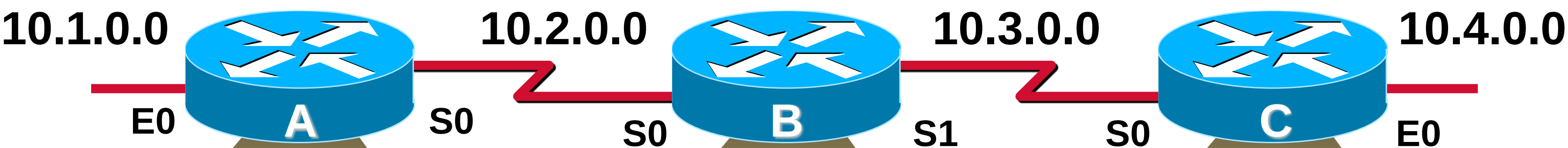
Updates proceed step-by-step from router to router

Distance Vector—Maintaining Routing Information



Updates proceed step-by-step from router to router

Maintaining Routing Information Problem—Routing Loops



Router A — Routing Table

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

Router B — Routing Table

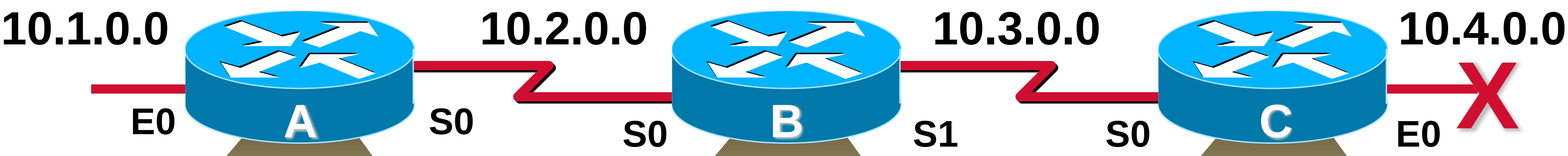
10.2.0.0	S0	0
10.3.0.0	S1	0
10.4.0.0	S1	1
10.1.0.0	S0	1

Router C — Routing Table

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

Each node maintains the distance from itself to each possible destination network

Maintaining Routing Information Problem—Routing Loops



A

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

B

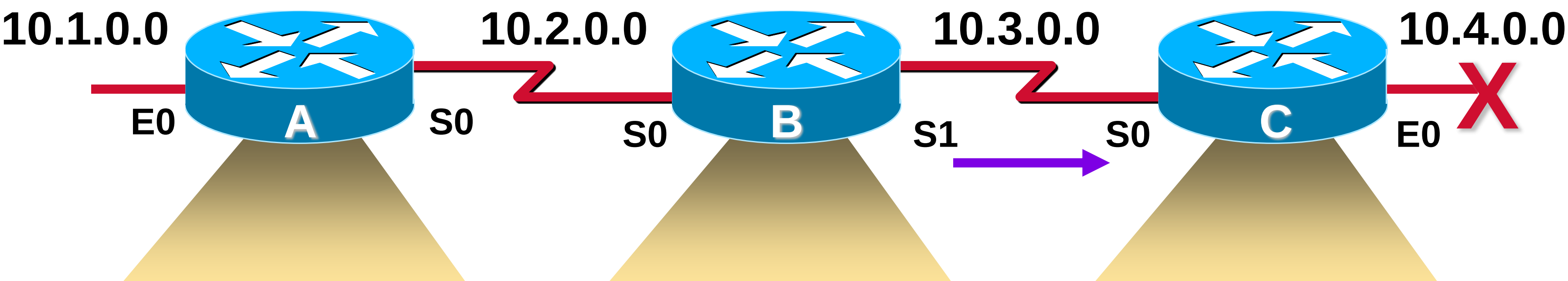
Routing Table		
10.2.0.0	S0	0
10.3.0.0	S1	0
10.4.0.0	S1	1
10.1.0.0	S0	1

C

Routing Table		
10.3.0.0	S0	0
10.4.0.0	E0	Down
10.2.0.0	S0	1
10.1.0.0	S0	2

Slow convergence produces inconsistent routing

Maintaining Routing Information Problem—Routing Loops



Router A — Routing Table

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

Router B — Routing Table

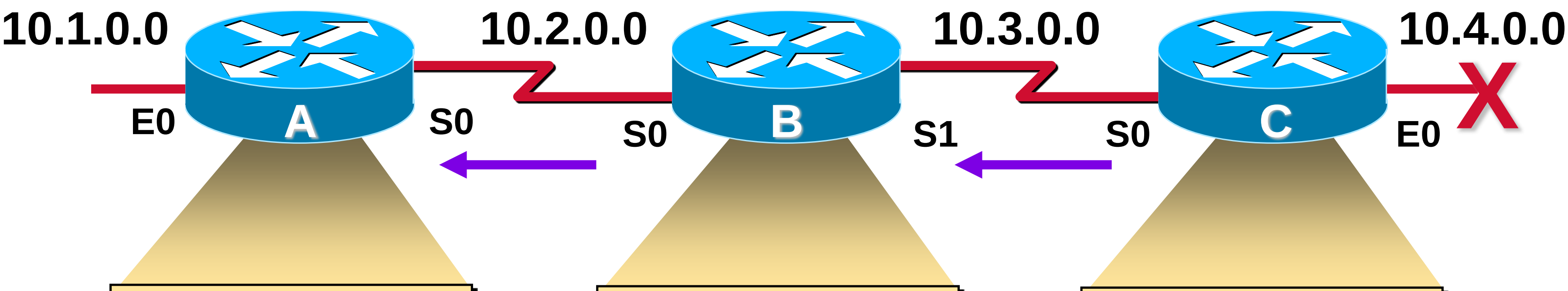
10.2.0.0	S0	0
10.3.0.0	S1	0
10.4.0.0	S1	1
10.1.0.0	S1	1

Router C — Routing Table

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

Router C concludes that the best path to network 10.4.0.0 is through Router B

Maintaining Routing Information Problem—Routing Loops



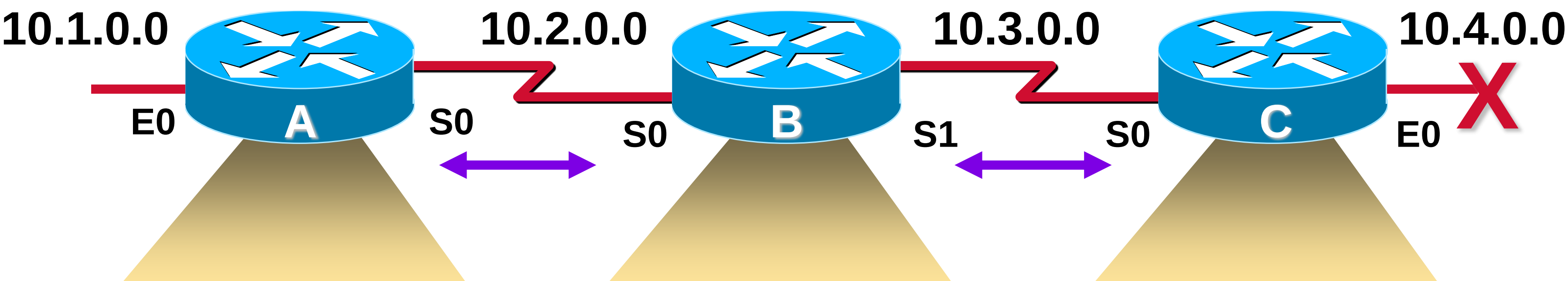
Routing Table		
10.1.0.0	E0	0
10.2.0.0	S0	0
10.3.0.0	S0	1
10.4.0.0	S0	4

Routing Table		
10.2.0.0	S0	0
10.3.0.0	S1	0
10.4.0.0	S1	3
10.1.0.0	S0	1

Routing Table		
10.3.0.0	S0	0
10.4.0.0	S0	2
10.2.0.0	S0	1
10.1.0.0	S0	2

Router A updates its table to reflect the new but erroneous hop count

Symptom: Counting to Infinity



Routing Table (A)

10.1.0.0	E0	0
10.2.0.0	S0	0
10.3.0.0	S0	1
10.4.0.0	S0	6

Routing Table (B)

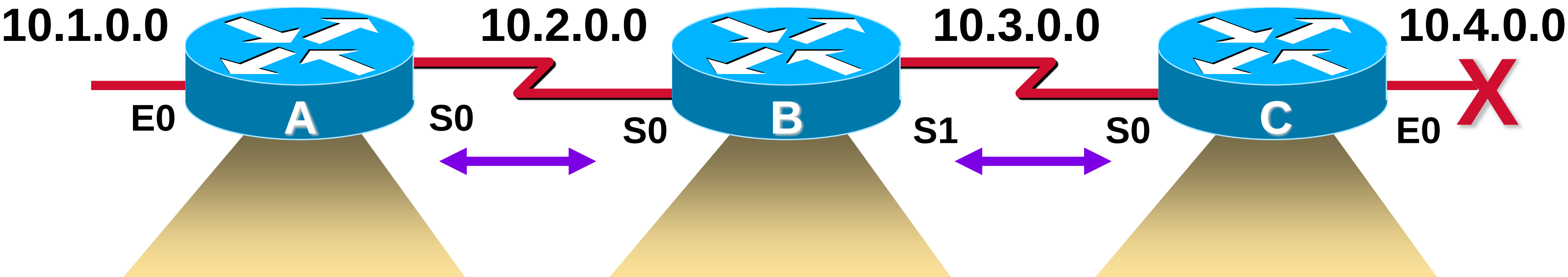
10.2.0.0	S0	0
10.3.0.0	S1	0
10.4.0.0	S1	5
10.1.0.0	S0	1

Routing Table (C)

10.3.0.0	S0	0
10.4.0.0	S0	4
10.2.0.0	S0	1
10.1.0.0	S0	2

- Packets for network 10.4.0.0 bounce between routers A, B, and C
- Hop count for network 10.4.0.0 counts to infinity

Solution: Defining a Maximum



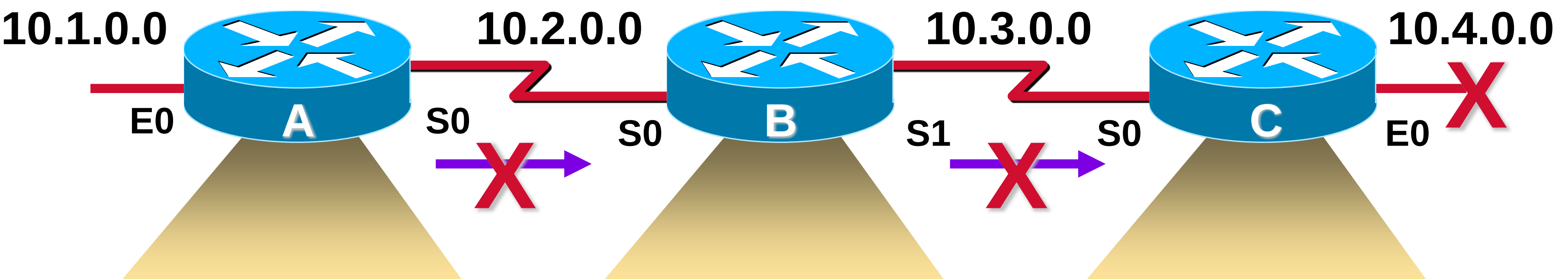
Routing Table		
10.1.0.0	E0	0
10.2.0.0	S0	0
10.3.0.0	S0	1
10.4.0.0	S0	16

Routing Table		
10.2.0.0	S0	0
10.3.0.0	S1	0
10.4.0.0	S1	16
10.1.0.0	S0	1

Routing Table		
10.3.0.0	S0	0
10.4.0.0	S0	16
10.2.0.0	S0	1
10.1.0.0	S0	2

Define a limit on the number of hops to prevent infinite loops

Solution: Split Horizon



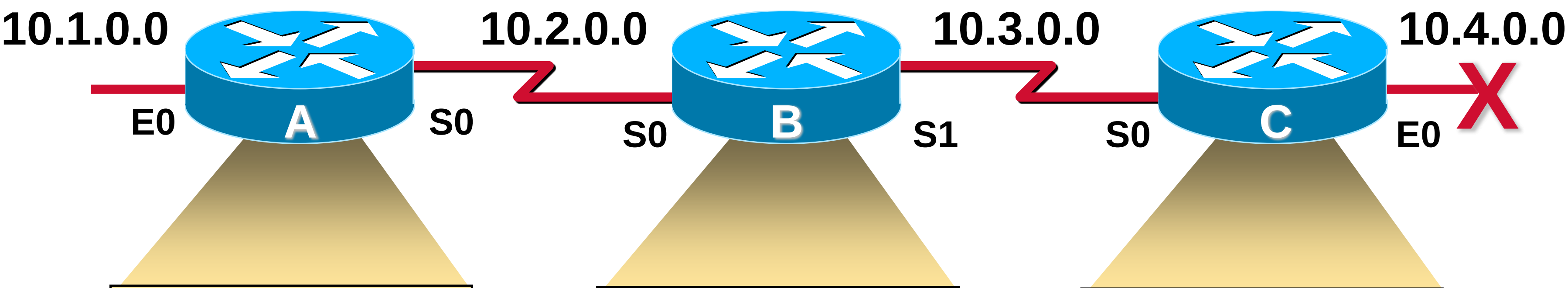
Routing Table		
10.1.0.0	E0	0
10.2.0.0	S0	0
10.3.0.0	S0	1
10.4.0.0	S0	2

Routing Table		
10.2.0.0	S0	0
10.3.0.0	S1	0
10.4.0.0	S1	1
10.1.0.0	E1	2

Routing Table		
10.3.0.0	S0	0
10.4.0.0	S0	0
10.2.0.0	S0	1
10.1.0.0	S0	2

It is never useful to send information about a route back in the direction from which the original packet came

Solution: Route Poisoning



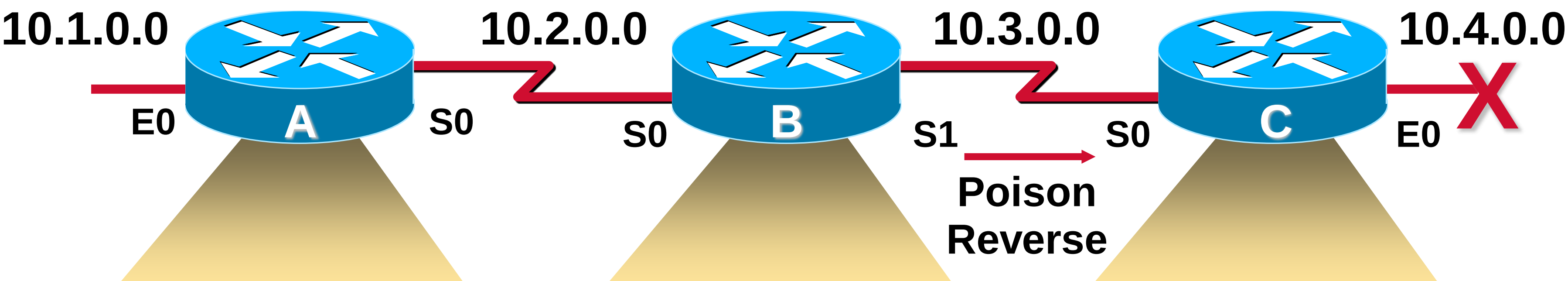
Routing Table		
10.1.0.0	E0	0
10.2.0.0	S0	0
10.3.0.0	S0	1
10.4.0.0	S0	2

Routing Table		
10.2.0.0	S0	0
10.3.0.0	S1	0
10.4.0.0	S1	1
10.1.0.0	E1	2

Routing Table		
10.3.0.0	S0	0
10.4.0.0	S0	Infinity
10.2.0.0	S0	1
10.1.0.0	S0	2

Routers set the distance of routes that have gone down to infinity

Solution: Poison Reverse



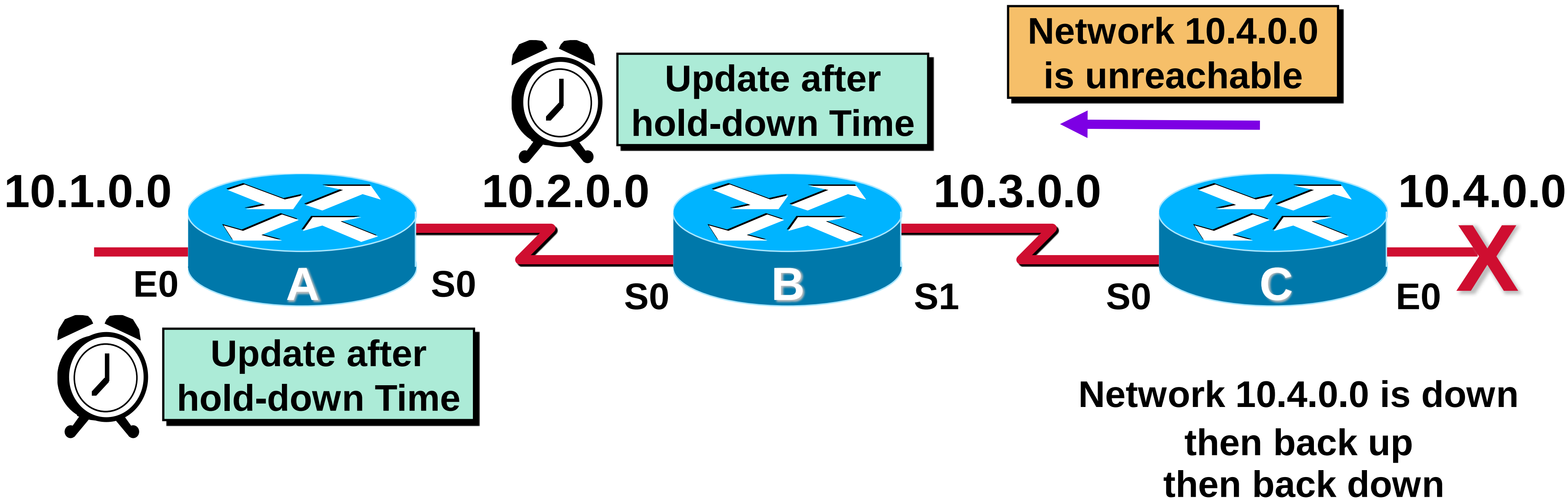
Routing Table		
10.1.0.0	E0	0
10.2.0.0	S0	0
10.3.0.0	S0	1
10.4.0.0	S0	2

Routing Table		
10.2.0.0	S0	0
10.3.0.0	S1	0
10.4.0.0	S1	Possibly Down
10.1.0.0	E1	2

Routing Table		
10.3.0.0	S0	0
10.4.0.0	S0	Infinity
10.2.0.0	S0	1
10.1.0.0	S0	2

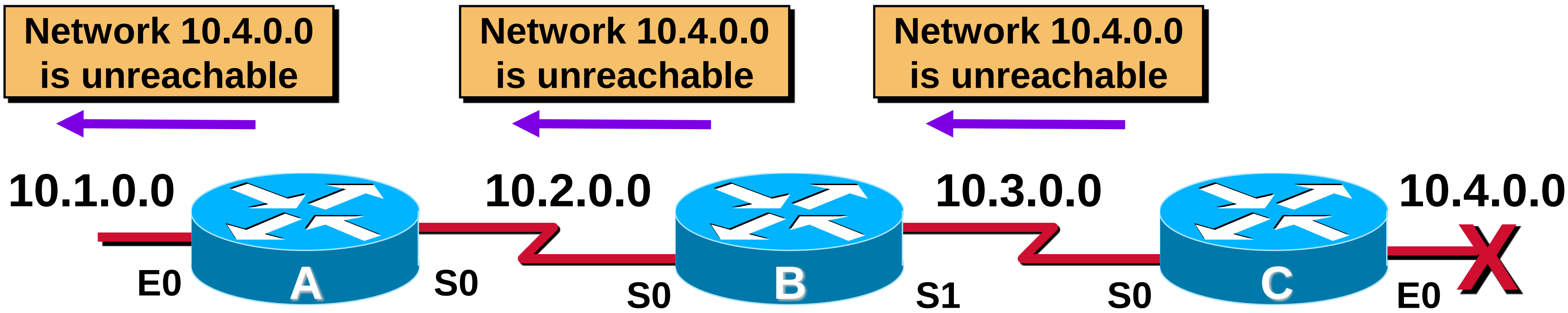
Poison Reverse overrides split horizon

Solution: Hold-Down Timers



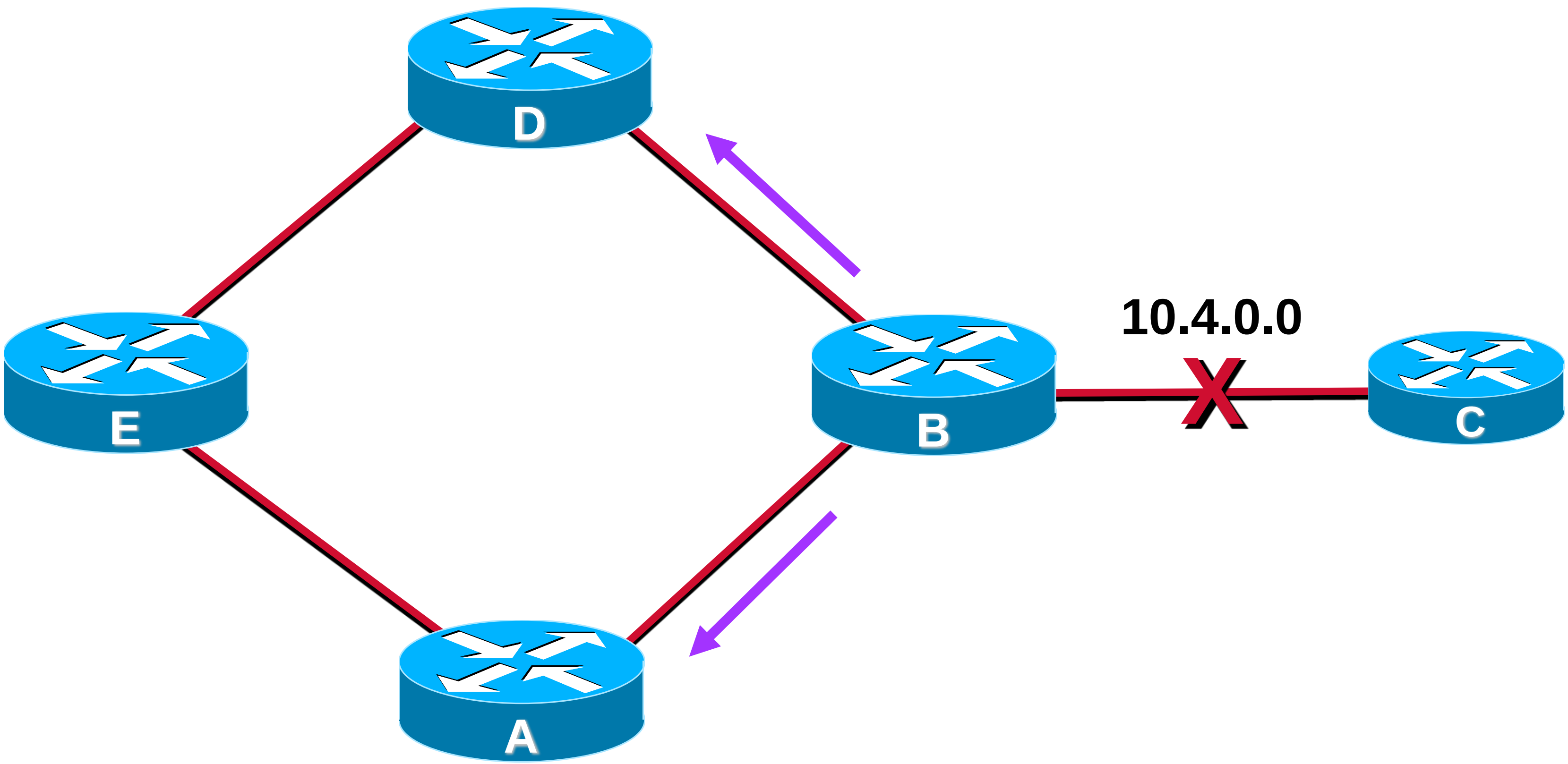
Router keeps an entry for the network possibly down state, allowing time for other routers to recompute for this topology change

Solution: Triggered Updates

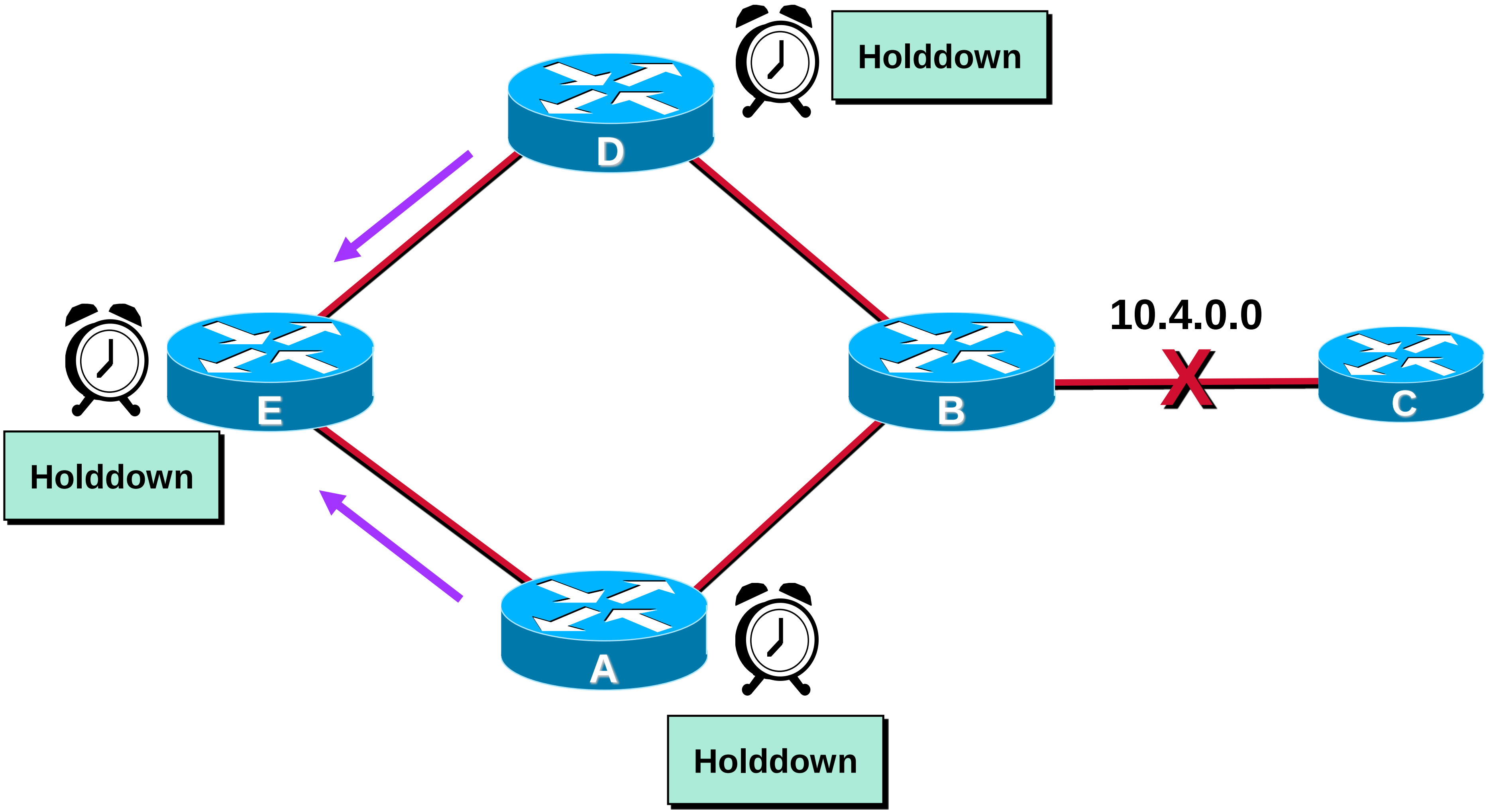


Router sends updates when a change in its routing table occurs

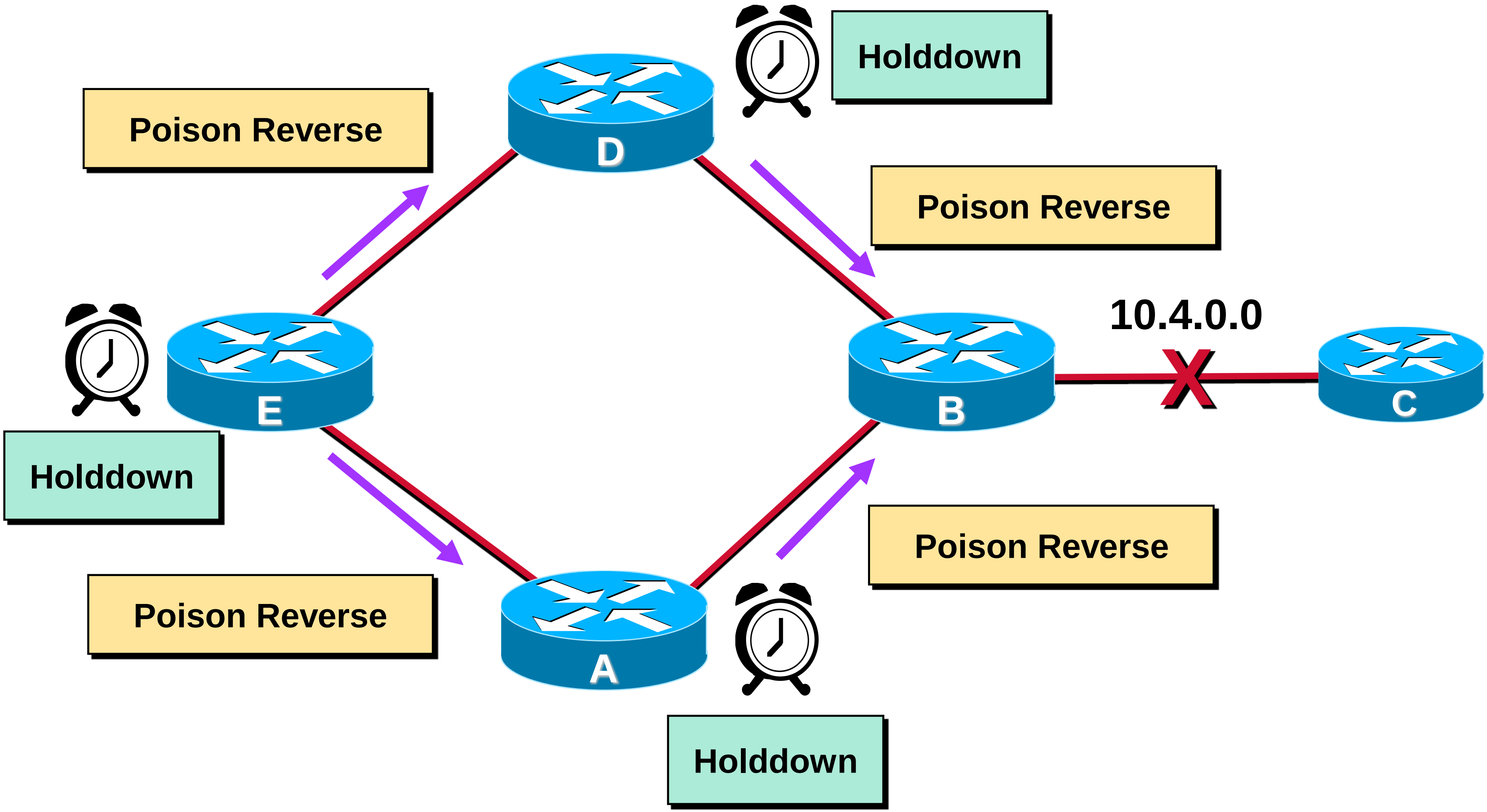
Implementing Solutions in Multiple Routes



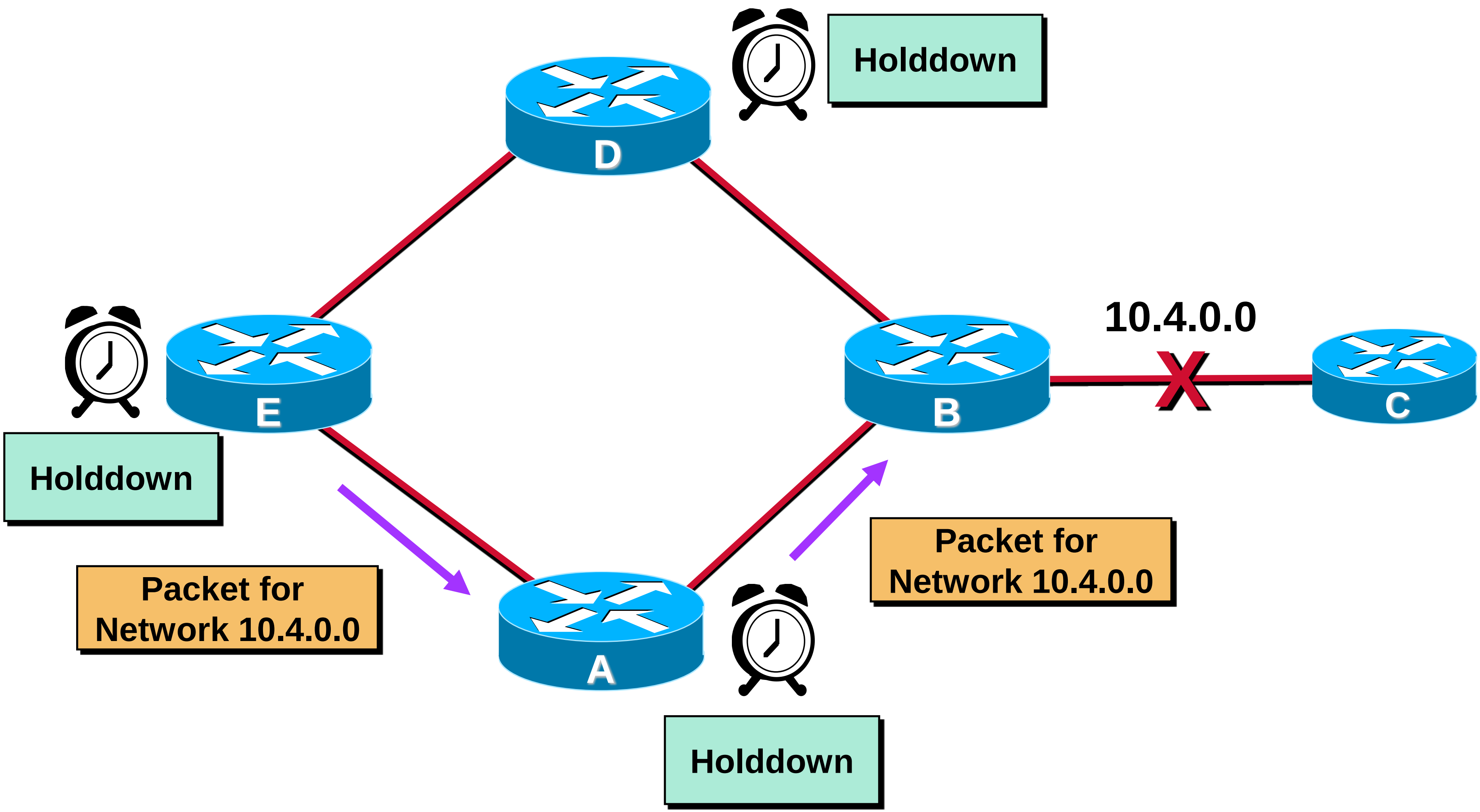
Implementing Solutions in Multiple Routes (cont.)



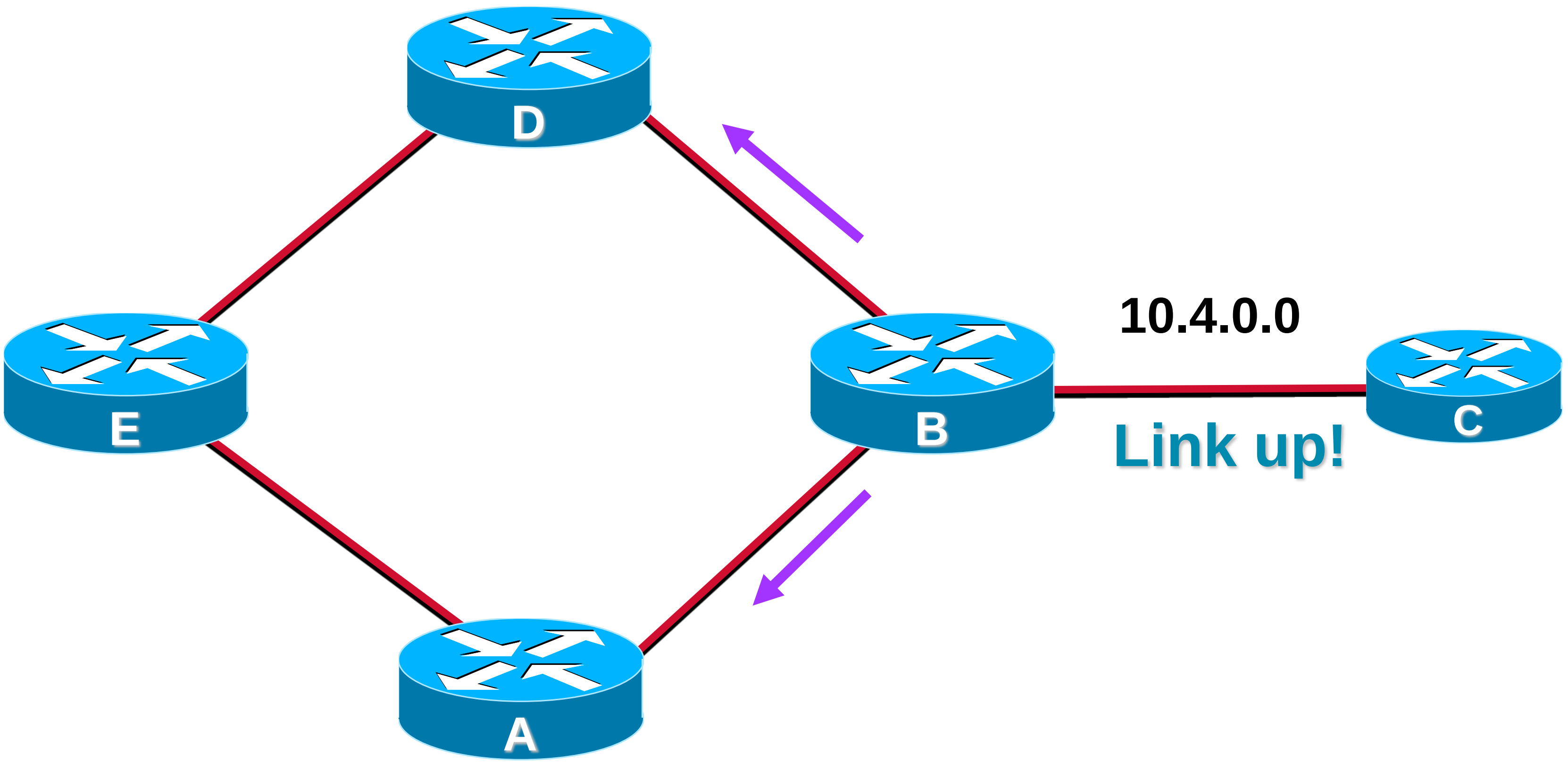
Implementing Solutions in Multiple Routes (cont.)



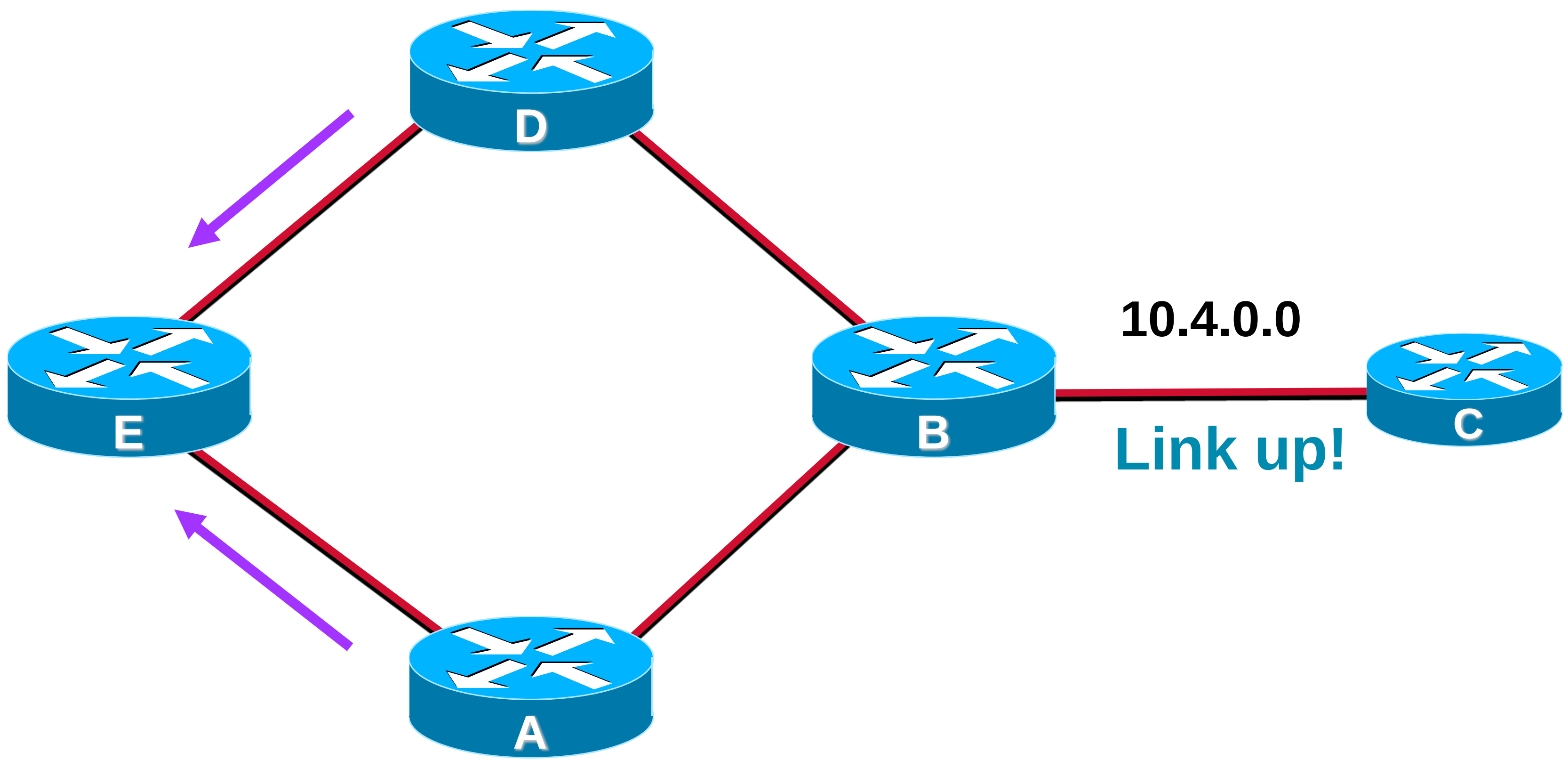
Implementing Solutions in Multiple Routes (cont.)



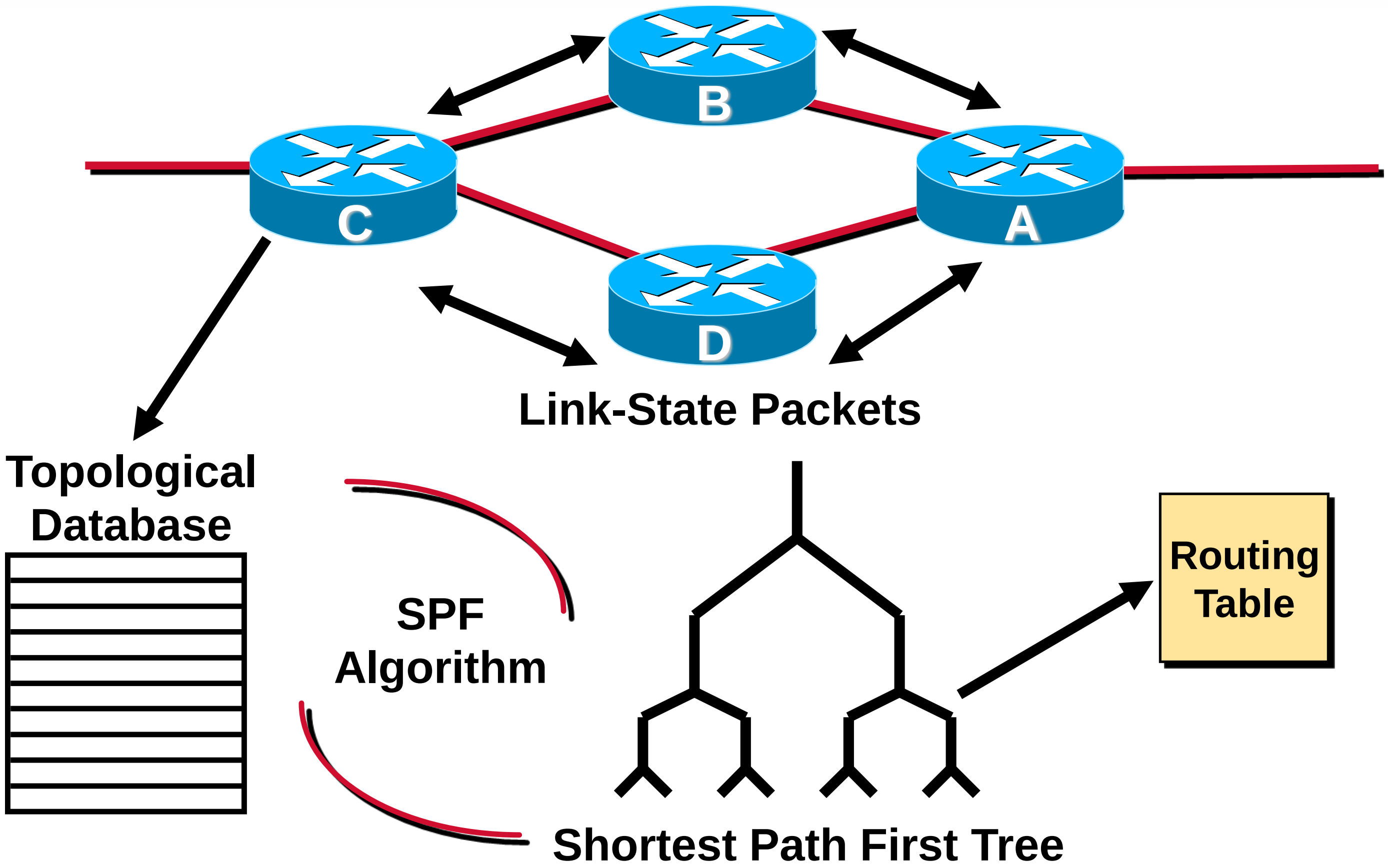
Implementing Solutions in Multiple Routes (cont.)



Implementing Solutions in Multiple Routes (cont.)

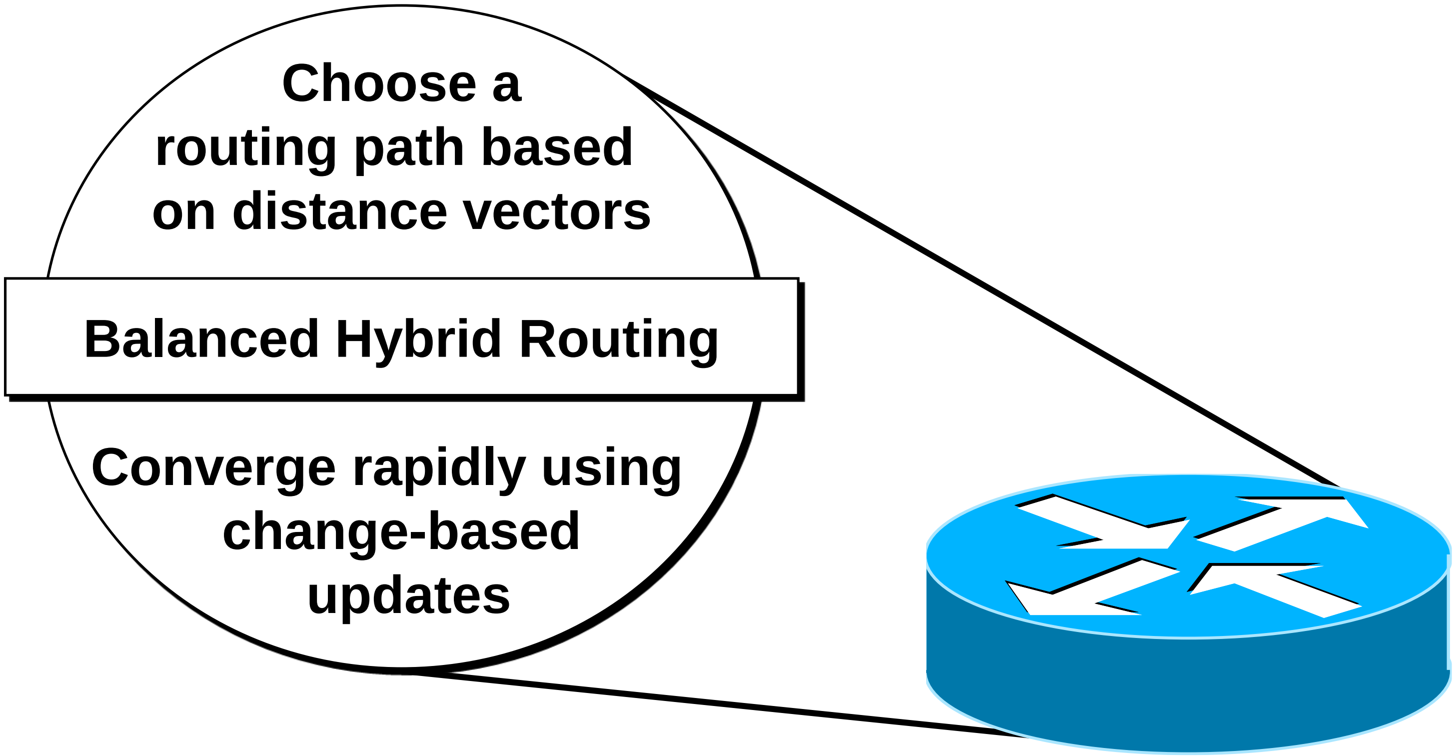


Link-State Routing Protocols



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

Hybrid Routing

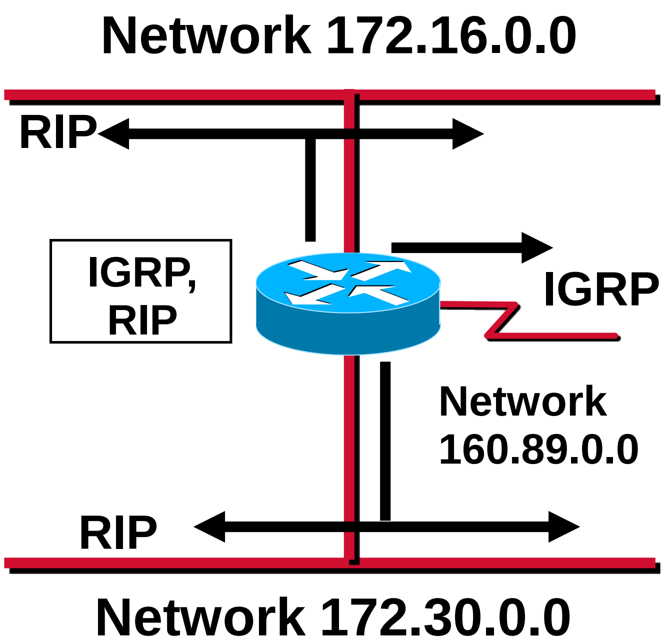


Share attributes of both distance-vector and link-state routing

IP Routing Configuration Tasks

Router configuration

- Select routing protocols
- Specify networks or interfaces



Dynamic Routing Configuration

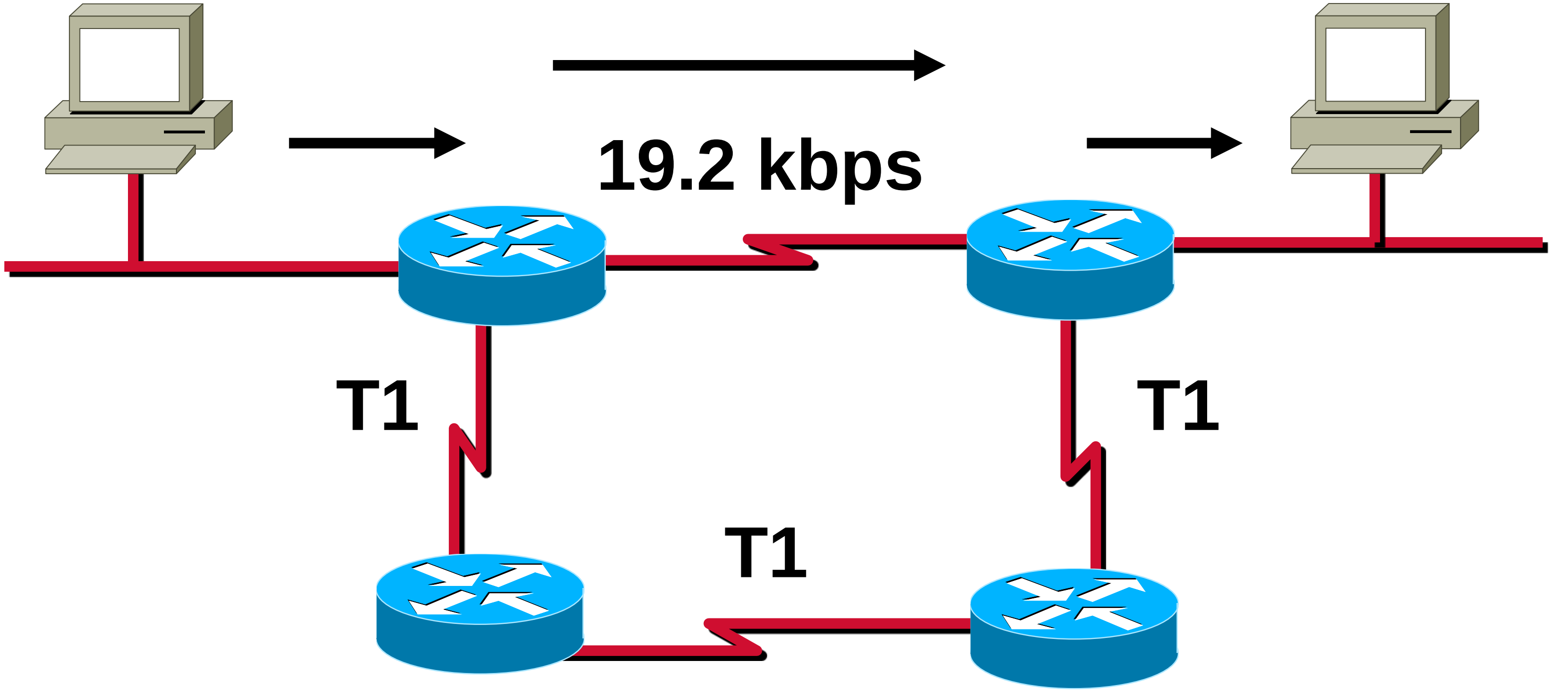
```
Router(config)#router protocol [keyword]
```

- Defines an IP routing protocol

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

- Mandatory configuration command for each IP routing process
- Identifies the physically connected network that routing updates are forwarded to

RIP Overview



- Maximum six paths (default = 4)
- Hop count metric selects the path
- Routes update every 30 seconds

RIP Configuration

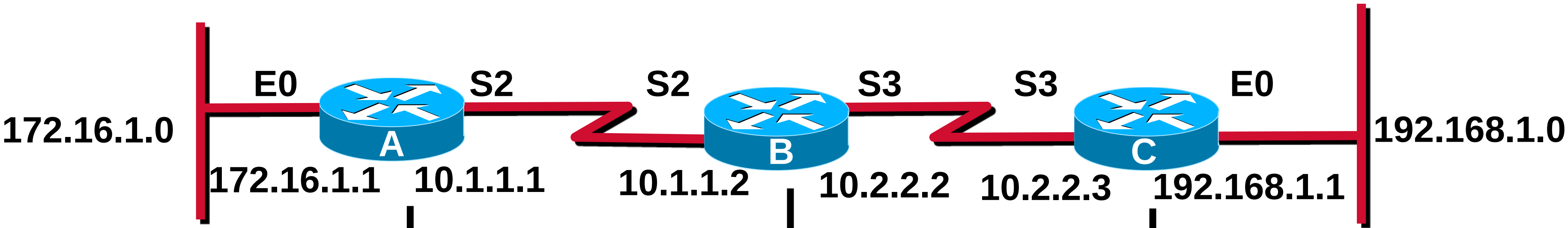
```
Router(config)#router rip
```

- Starts the RIP routing process

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

- Selects participating attached networks
- The network number must be a major classful network number

RIP Configuration Example

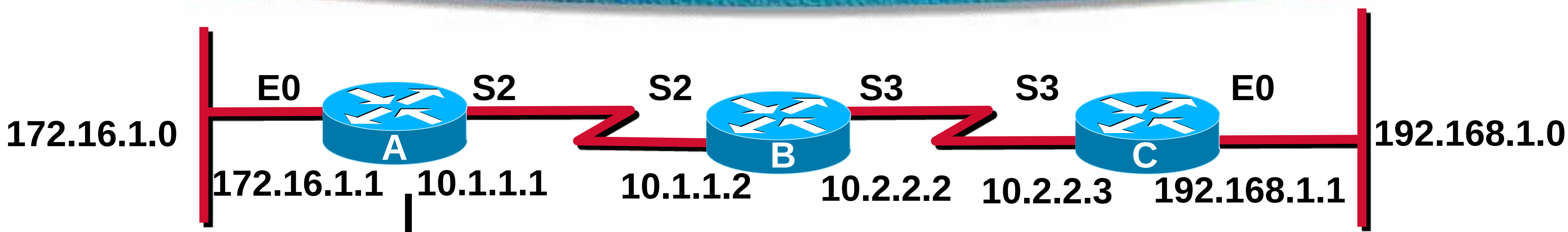



```
router rip
network 172.16.0.0
network 10.0.0.0
```

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

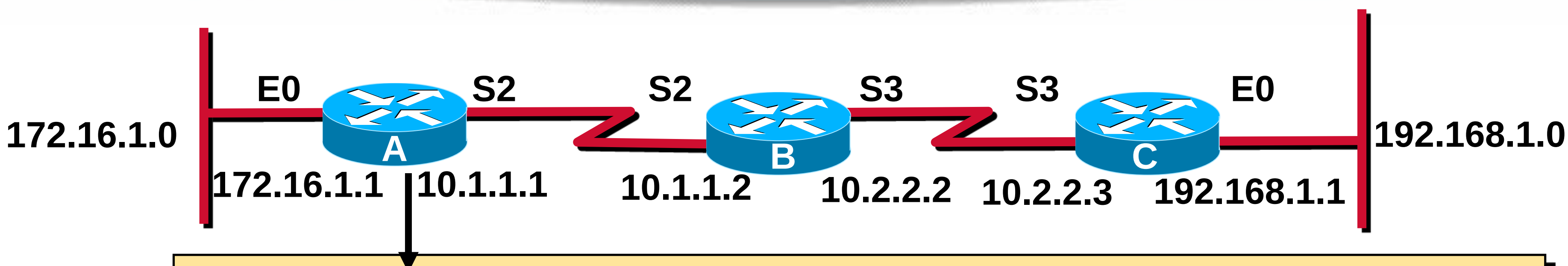
```
router rip
network 10.0.0.0
```

Verifying the Routing Protocol—RIP



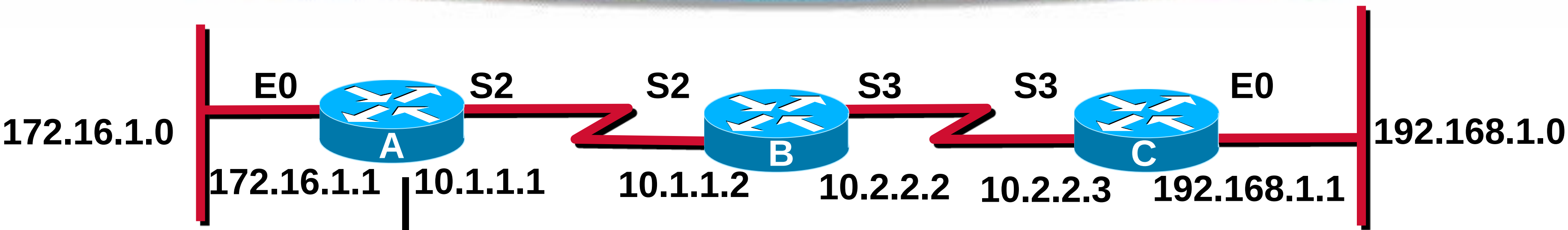

```
RouterA#sh ip protocols
Routing Protocol is "rip"
  Sending updates every 30 seconds, next due in 0 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Outgoing update filter list for all interfaces is
  Incoming update filter list for all interfaces is
  Redistributing: rip
  Default version control: send version 1, receive any version
    Interface        Send   Recv   Key-chain
    Ethernet0        1      1 2
    Serial2          1      1 2
  Routing for Networks:
    10.0.0.0
    172.16.0.0
  Routing Information Sources:
    Gateway          Distance      Last Update
    10.1.1.2              120      00:00:10
  Distance: (default is 120)
```

Displaying the IP Routing Table



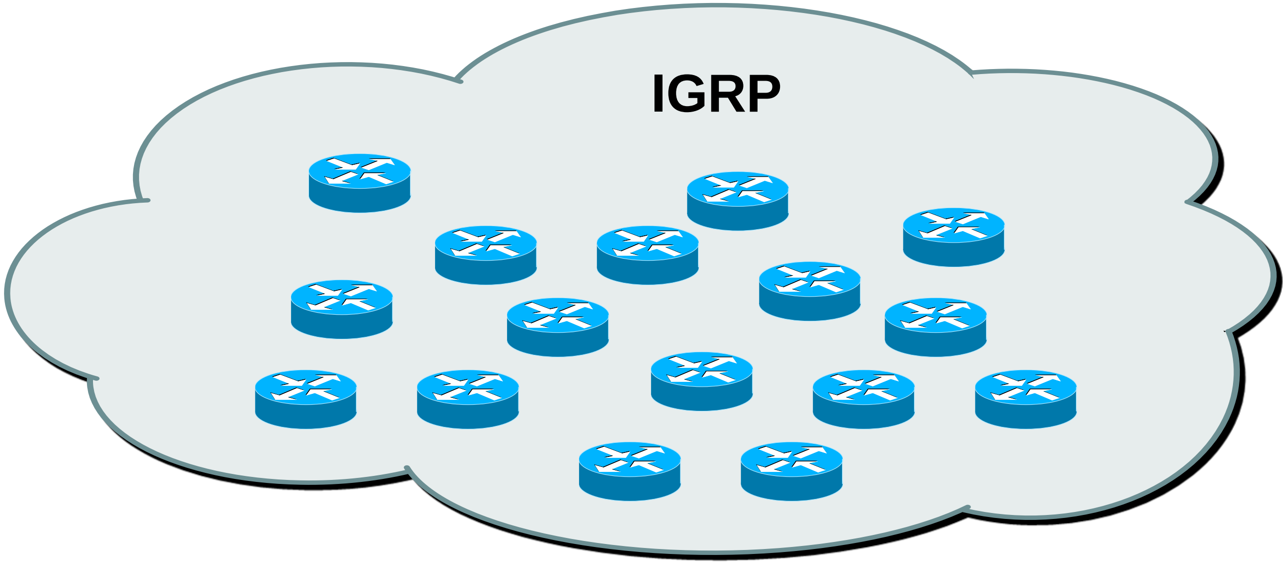

```
RouterA#sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B -
BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, * - candidate
default
       U - per-user static route, o - ODR
       T - traffic engineered route

Gateway of last resort is not set

     172.16.0.0/24 is subnetted, 1 subnets
C       172.16.1.0 is directly connected, Ethernet0
     10.0.0.0/24 is subnetted, 2 subnets
R       10.2.2.0 [120/1] via 10.1.1.2, 00:00:07, Serial2
C       10.1.1.0 is directly connected, Serial2
R    192.168.1.0/24 [120/2] via 10.1.1.2, 00:00:07, Serial2
```

debug ip rip Command



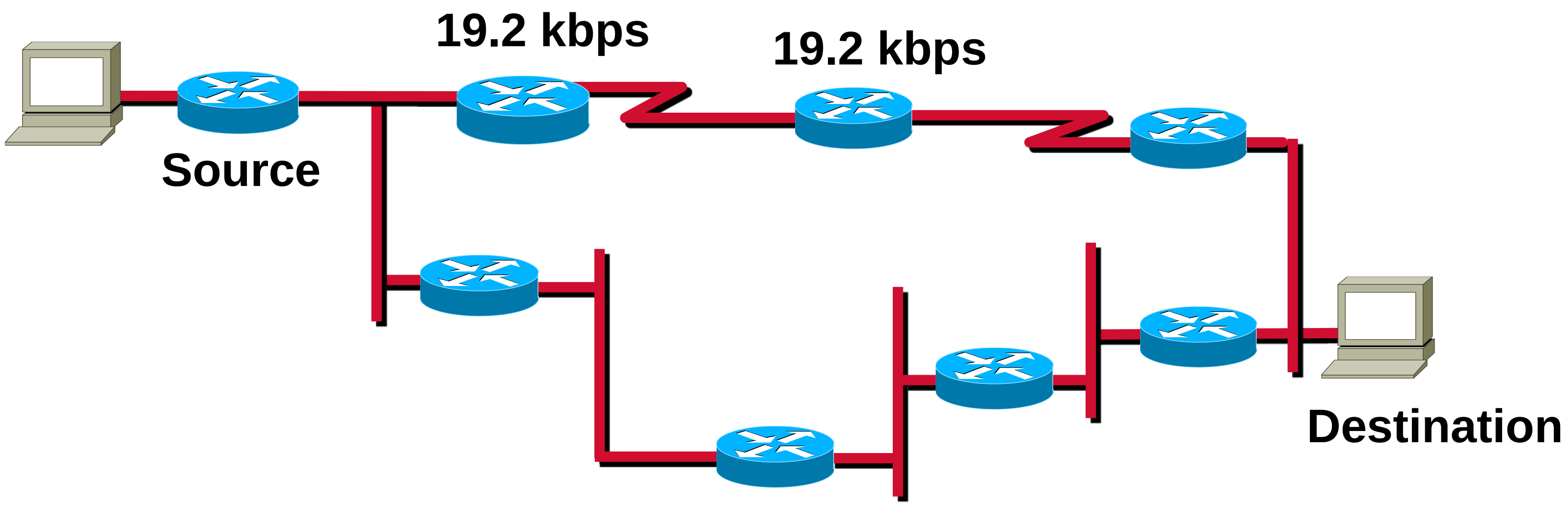

```
RouterA#debug ip rip
RIP protocol debugging is on
RouterA#
00:06:24: RIP: received v1 update from 10.1.1.2 on Serial2
00:06:24:      10.2.2.0 in 1 hops
00:06:24:      192.168.1.0 in 2 hops
00:06:33: RIP: sending v1 update to 255.255.255.255 via
Ethernet0 (172.16.1.1)
00:06:34:      network 10.0.0.0, metric 1
00:06:34:      network 192.168.1.0, metric 3
00:06:34: RIP: sending v1 update to 255.255.255.255 via
Serial2 (10.1.1.1)
00:06:34:      network 172.16.0.0, metric 1
```

Introduction to IGRP



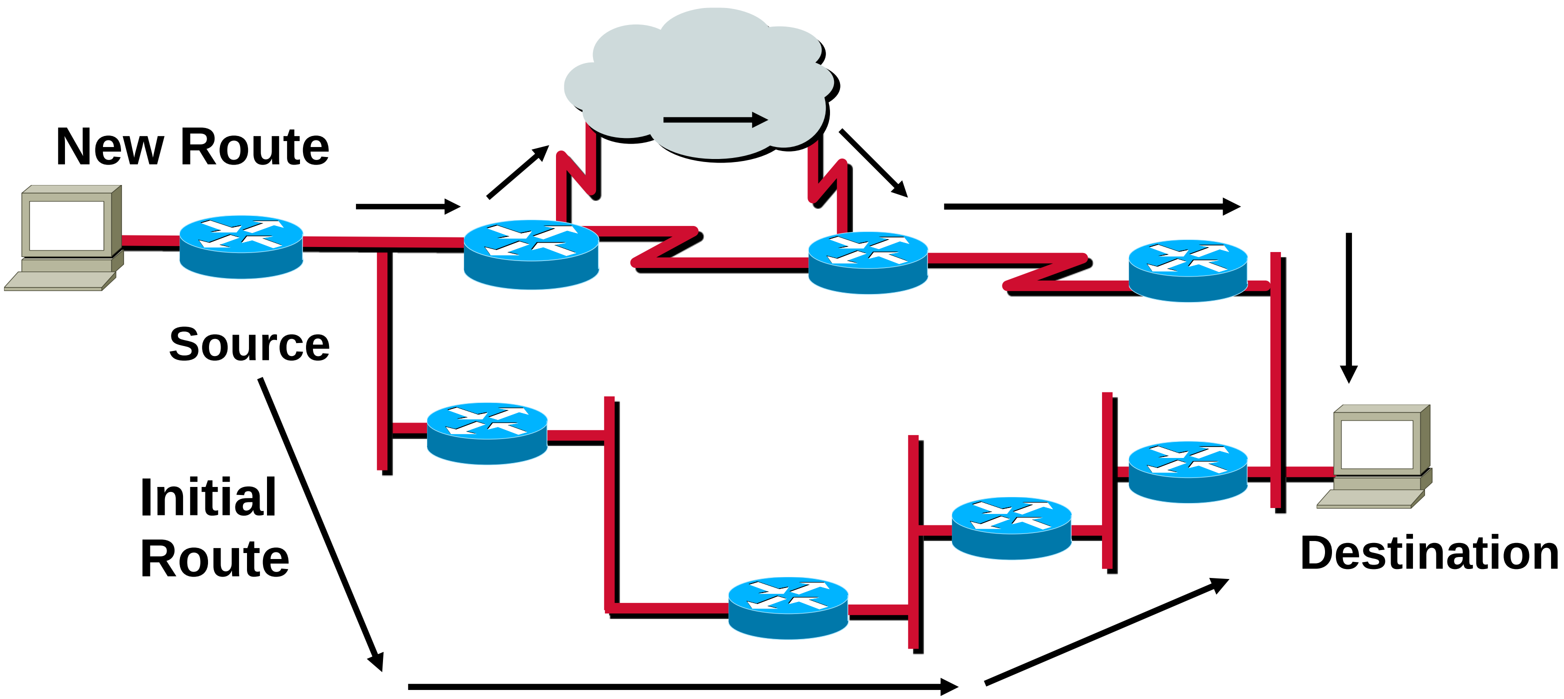
- More scalable than RIP
- Sophisticated metric
- Multiple-path support

IGRP Composite Metric



- Bandwidth
- Delay
- Reliability
- Loading
- MTU

IGRP Unequal Multiple Paths



- Maximum six 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**

Configuring IGRP (cont.)

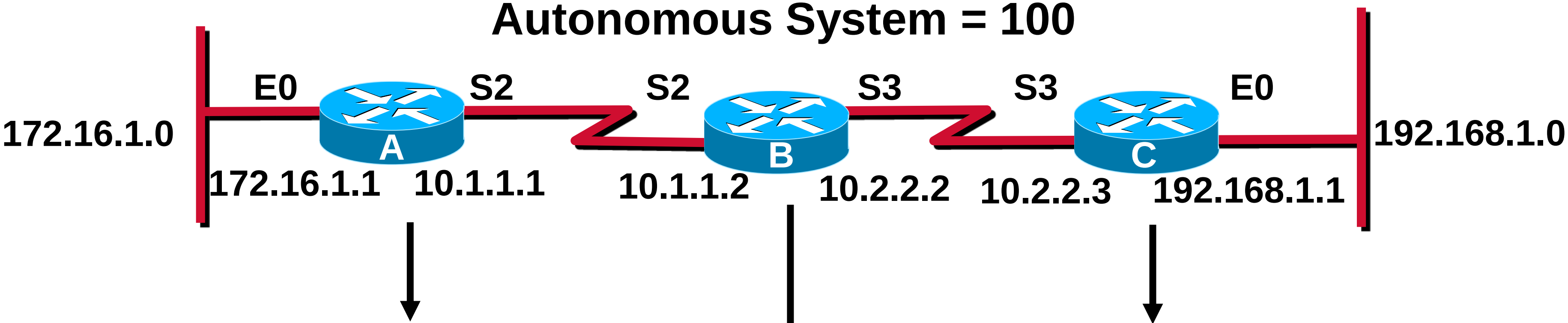
```
Router(config-router)#variance multiplier
```

- Control IGRP load balancing

```
Router(config-router)#traffic-share
{ balanced | min }
```

- Control how load-balanced traffic is distributed

IGRP Configuration Example

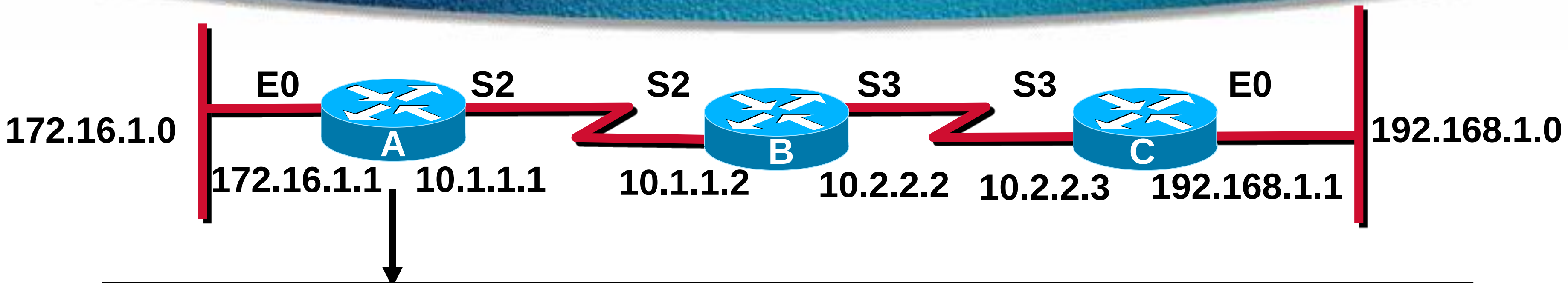



```
router igrp 100
network 172.16.0.0
network 10.0.0.0
```

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

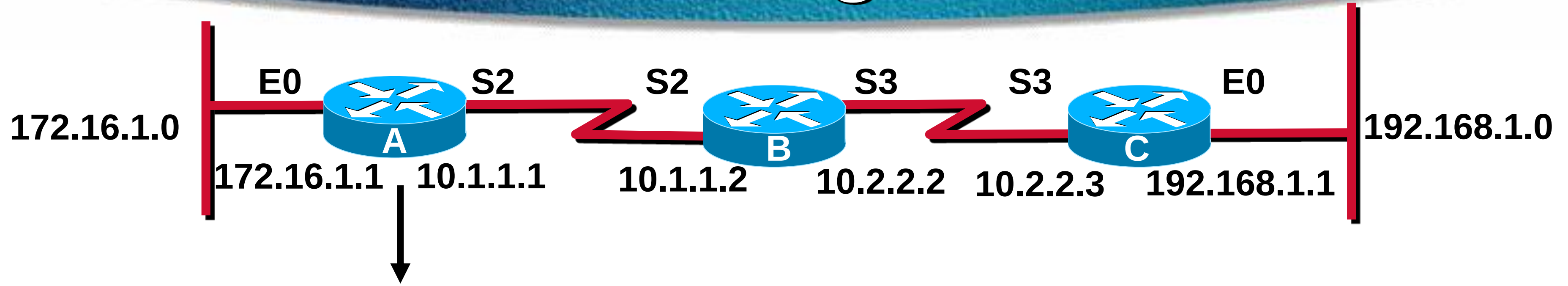
```
router igrp 100
network 10.0.0.0
```

Verifying the Routing Protocol—IGRP



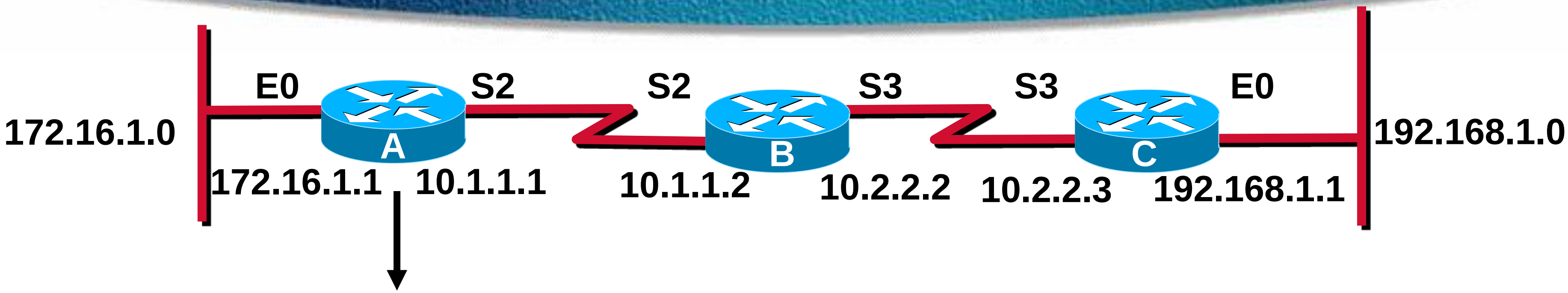

```
RouterA#sh ip protocols
Routing Protocol is "igrp 100"
  Sending updates every 90 seconds, next due in 21 seconds
  Invalid after 270 seconds, hold down 280, flushed after 630
  Outgoing update filter list for all interfaces is
  Incoming update filter list for all interfaces is
  Default networks flagged in outgoing updates
  Default networks accepted from incoming updates
  IGRP metric weight K1=1, K2=0, K3=1, K4=0, K5=0
  IGRP maximum hopcount 100
  IGRP maximum metric variance 1
  Redistributing: igrp 100
  Routing for Networks:
    10.0.0.0
    172.16.0.0
  Routing Information Sources:
    Gateway         Distance      Last Update
    10.1.1.2             100      00:01:01
  Distance: (default is 100)
```

Displaying the IP Routing Table



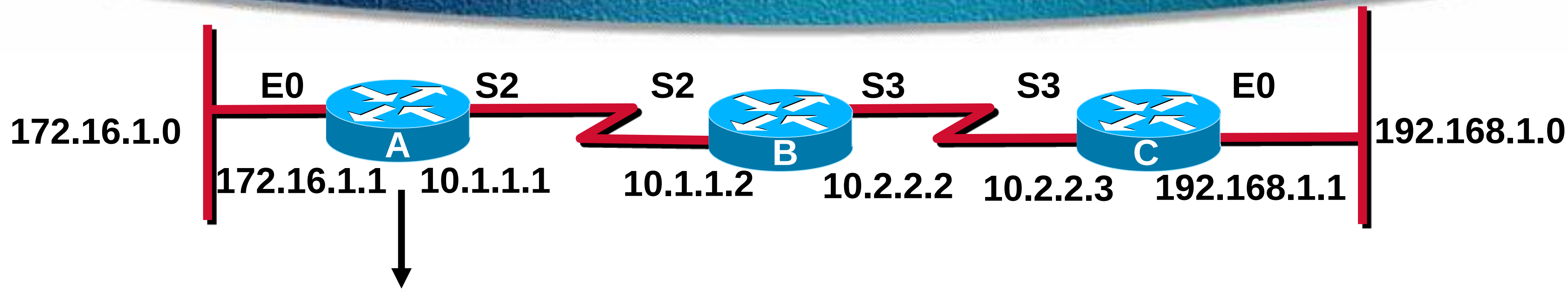

```
RouterA#sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, * - candidate default
       U - per-user static route, o - ODR
       T - traffic engineered route

Gateway of last resort is not set

     172.16.0.0/24 is subnetted, 1 subnets
C       172.16.1.0 is directly connected, Ethernet0
     10.0.0.0/24 is subnetted, 2 subnets
I       10.2.2.0 [100/90956] via 10.1.1.2, 00:00:23, Serial2
C       10.1.1.0 is directly connected, Serial2
I    192.168.1.0/24 [100/91056] via 10.1.1.2, 00:00:23, Serial2
```

debug ip igrp transaction Command



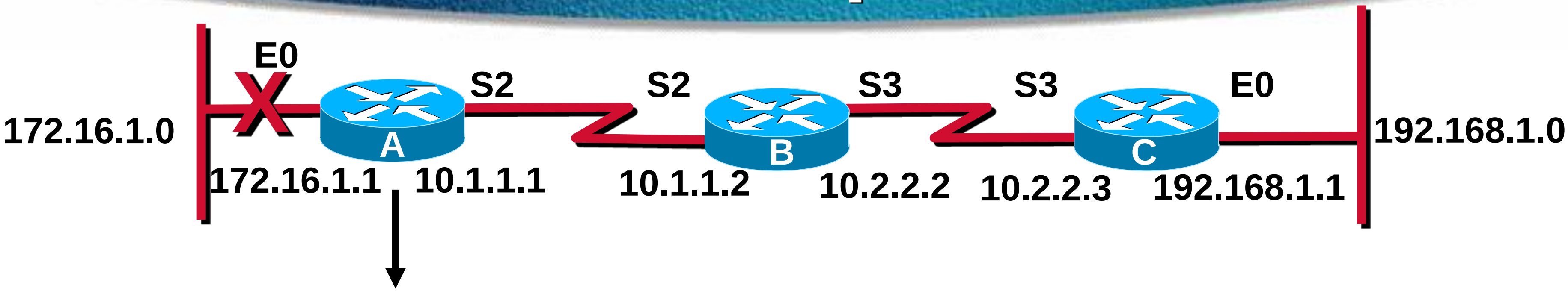

```
RouterA#debug ip igrp transactions
IGRP protocol debugging is on
RouterA#
00:21:06: IGRP: sending update to 255.255.255.255 via Ethernet0 (172.16.1.1)
00:21:06:       network 10.0.0.0, metric=88956
00:21:06:       network 192.168.1.0, metric=91056
00:21:07: IGRP: sending update to 255.255.255.255 via Serial2 (10.1.1.1)
00:21:07:       network 172.16.0.0, metric=1100
00:21:16: IGRP: received update from 10.1.1.2 on Serial2
00:21:16:       subnet 10.2.2.0, metric 90956 (neighbor 88956)
00:21:16:       network 192.168.1.0, metric 91056 (neighbor 89056)
```

debug ip igrp events Command



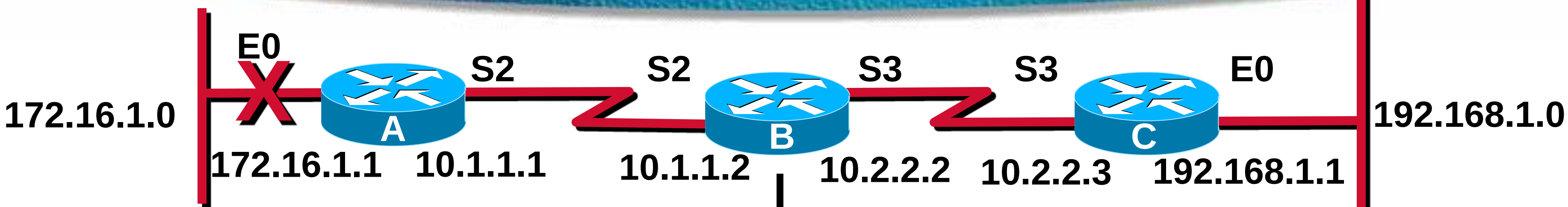

```
RouterA#debug ip igrp events
IGRP event debugging is on
RouterA#
00:23:44: IGRP: sending update to 255.255.255.255 via Ethernet0 (172.16.1.1)
00:23:44: IGRP: Update contains 0 interior, 2 system, and 0 exterior routes.
00:23:44: IGRP: Total routes in update: 2
00:23:44: IGRP: sending update to 255.255.255.255 via Serial2 (10.1.1.1)
00:23:45: IGRP: Update contains 0 interior, 1 system, and 0 exterior routes.
00:23:45: IGRP: Total routes in update: 1
00:23:48: IGRP: received update from 10.1.1.2 on Serial2
00:23:48: IGRP: Update contains 1 interior, 1 system, and 0 exterior routes.
00:23:48: IGRP: Total routes in update: 2
```

Updating Routing Information Example



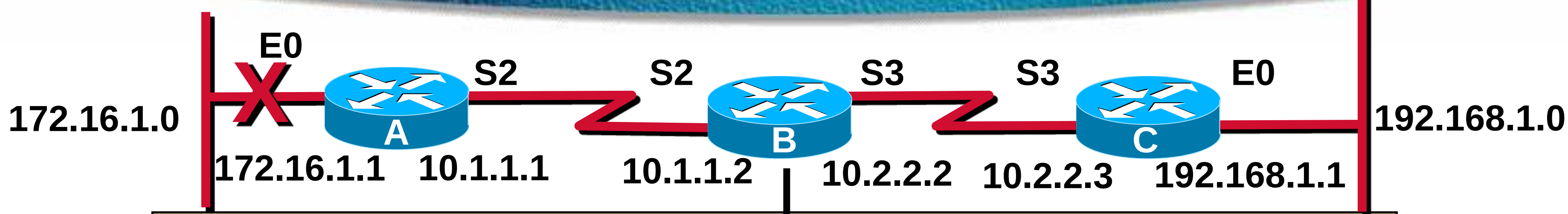

```
RouterA# debug ip igrp trans
00:31:15: %LINEPROTO-5-UPDOWN: Line protocol on Interface Ethernet0, changed state to down
00:31:15: IGRP: edition is now 3
00:31:15: IGRP: sending update to 255.255.255.255 via Serial2 (10.1.1.1)
00:31:15:       network 172.16.0.0, metric=4294967295
00:31:16: IGRP: Update contains 0 interior, 1 system, and 0 exterior routes.
00:31:16: IGRP: Total routes in update: 1
00:31:16: IGRP: broadcasting request on Serial2
00:31:16: IGRP: received update from 10.1.1.2 on Serial2
00:31:16:       subnet 10.2.2.0, metric 90956 (neighbor 88956)
00:31:16:       network 172.16.0.0, metric 4294967295 (inaccessible)
00:31:16:       network 192.168.1.0, metric 91056 (neighbor 89056)
00:31:16: IGRP: Update contains 1 interior, 2 system, and 0 exterior routes.
00:31:16: IGRP: Total routes in update: 3
```

Updating Routing Information Example (cont.)



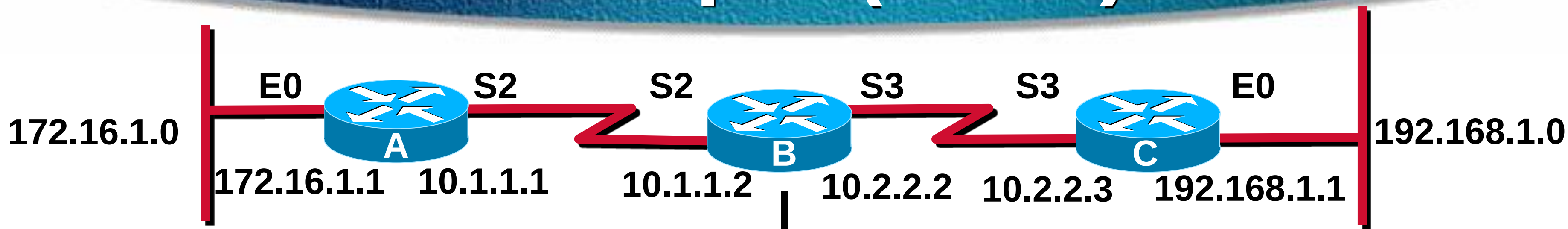

```
RouterB#debug ip igrp trans
IGRP protocol debugging is on
RouterB#
1d19h: IGRP: sending update to 255.255.255.255 via Serial2 (10.1.1.2)
1d19h:       subnet 10.2.2.0, metric=88956
1d19h:       network 192.168.1.0, metric=89056
1d19h: IGRP: sending update to 255.255.255.255 via Serial3 (10.2.2.2)
1d19h:       subnet 10.1.1.0, metric=88956
1d19h:       network 172.16.0.0, metric=89056
1d19h: IGRP: received update from 10.1.1.1 on Serial2
1d19h:       network 172.16.0.0, metric 4294967295 (inaccessible)
1d19h: IGRP: edition is now 10
1d19h: IGRP: sending update to 255.255.255.255 via Serial2 (10.1.1.2)
1d19h:       subnet 10.2.2.0, metric=88956
1d19h:       network 172.16.0.0, metric=4294967295
1d19h:       network 192.168.1.0, metric=89056
1d19h: IGRP: sending update to 255.255.255.255 via Serial3 (10.2.2.2)
1d19h:       subnet 10.1.1.0, metric=88956
1d19h:       network 172.16.0.0, metric=4294967295
```

Updating Routing Information Example (cont.)



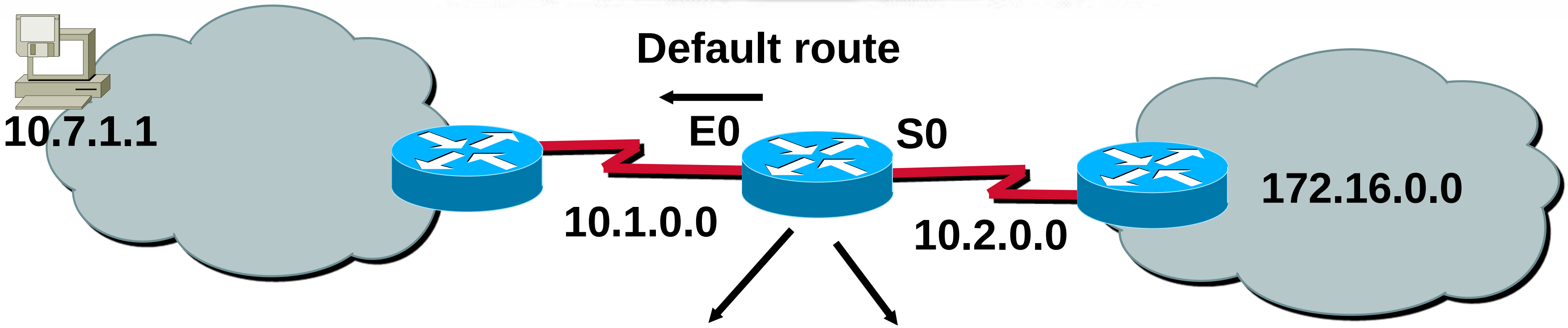

```
RouterB#sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, * - candidate default
       U - per-user static route, o - ODR
       T - traffic engineered route

Gateway of last resort is not set

I    172.16.0.0/16 is possibly down, routing via 10.1.1.1, Serial2
     10.0.0.0/24 is subnetted, 2 subnets
C       10.1.1.0 is directly connected, Serial2
C       10.2.2.0 is directly connected, Serial3
I    192.168.1.0/24 [100/89056] via 10.2.2.3, 00:00:14, Serial3
RouterB#ping 172.16.1.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.1.1, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
RouterB#
```

Updating Routing Information Example (cont.)




```
RouterB#debug ip igrp transactions
RouterB#
1d20h: IGRP: received update from 10.1.1.1 on Serial2
1d20h:       network 172.16.0.0, metric 89056 (neighbor 1100)
RouterB#
RouterB#sh ip route
Codes: C - connected, S - static, I - IGRP, 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, * - candidate default
       U - per-user static route, o - ODR
       T - traffic engineered route

Gateway of last resort is not set

I    172.16.0.0/16 is possibly down, routing via 10.1.1.1, Serial2
     10.0.0.0/24 is subnetted, 2 subnets
C       10.1.1.0 is directly connected, Serial2
C       10.2.2.0 is directly connected, Serial3
I    192.168.1.0/24 [100/89056] via 10.2.2.3, 00:00:18, Serial3
RouterB#ping 172.16.1.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/38/48 ms
```

ip classless Command



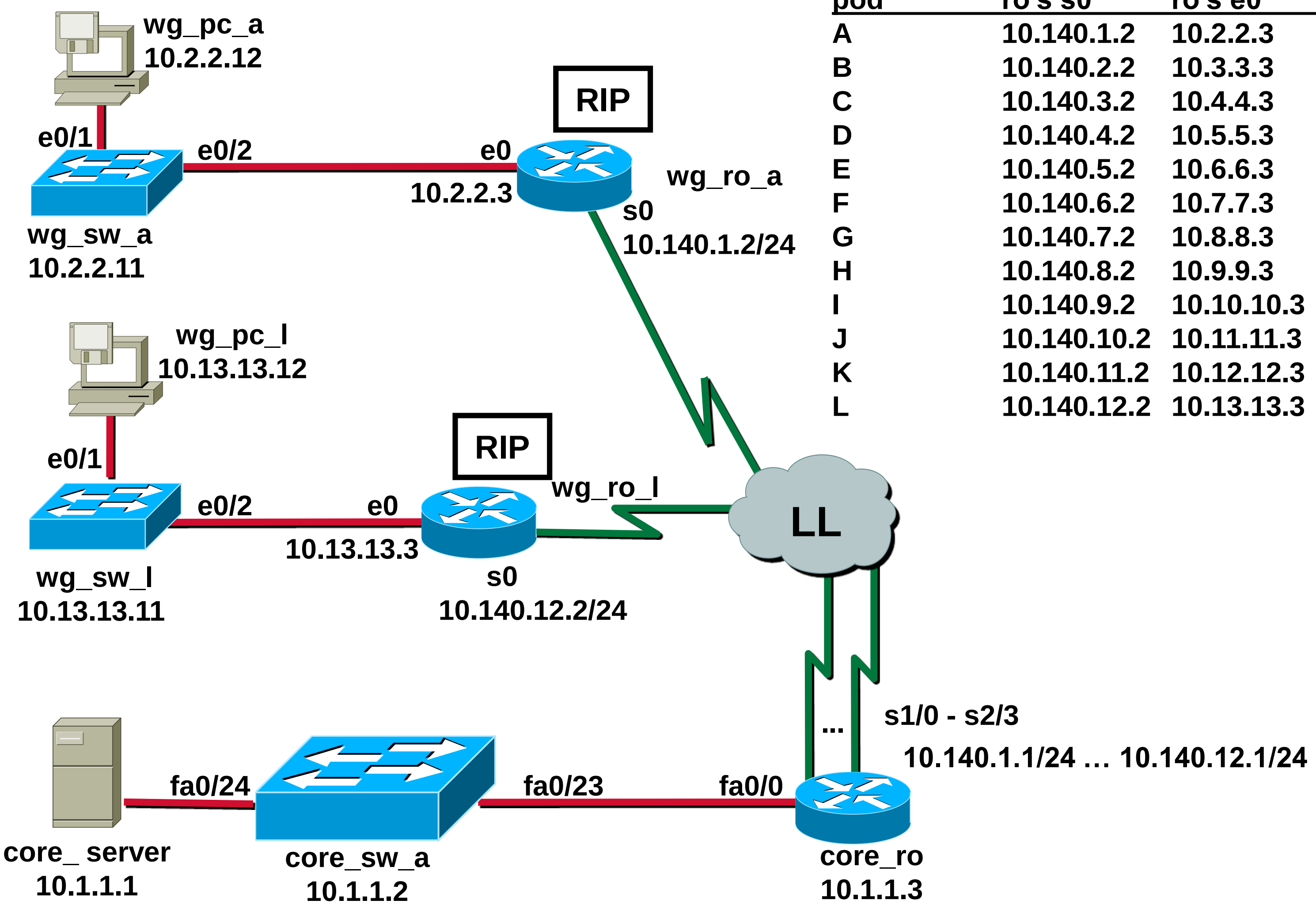

```
Router(config)#ip classless
```

Network Protocol	Destination Network	Exit Interface
C	10.1.0.0	E0
C	10.2.0.0	S0
RIP	172.16.0.0 via	S0
	0.0.0.0	E0

To get to 10.7.1.1:

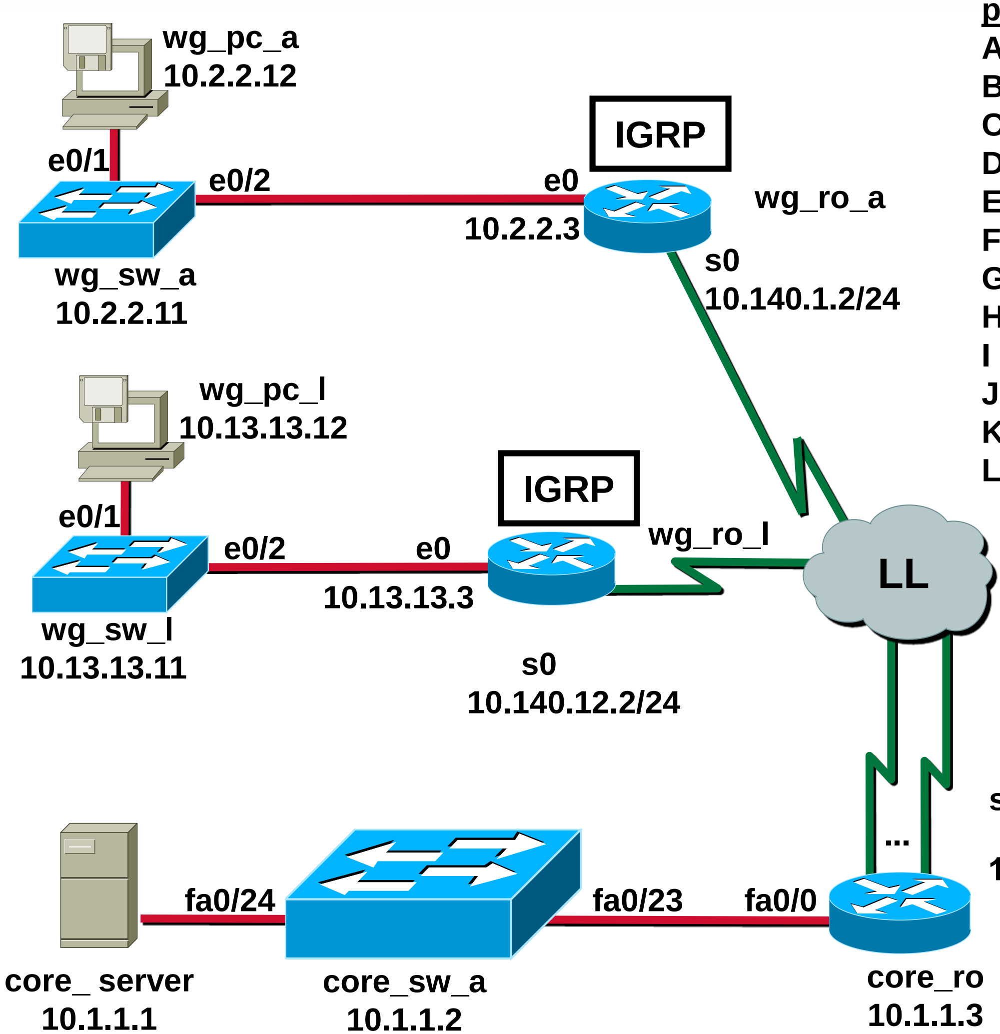
- **With *ip classless* → Default**
- **With *no ip classless* → Drop**

Visual Objective



pod	ro's s0	ro's e0	sw
A	10.140.1.2	10.2.2.3	10.2.2.11
B	10.140.2.2	10.3.3.3	10.10.10.11
C	10.140.3.2	10.4.4.3	10.4.4.11
D	10.140.4.2	10.5.5.3	10.5.5.11
E	10.140.5.2	10.6.6.3	10.6.6.11
F	10.140.6.2	10.7.7.3	10.7.7.11
G	10.140.7.2	10.8.8.3	10.8.8.11
H	10.140.8.2	10.9.9.3	10.9.9.11
I	10.140.9.2	10.10.10.3	10.3.3.11
J	10.140.10.2	10.11.11.3	10.11.11.11
K	10.140.11.2	10.12.12.3	10.12.12.11
L	10.140.12.2	10.13.13.3	10.13.13.11

Visual Objective



pod	ro’s s0	ro’s e0	sw
A	10.140.1.2	10.2.2.3	10.2.2.11
B	10.140.2.2	10.3.3.3	10.10.10.11
C	10.140.3.2	10.4.4.3	10.4.4.11
D	10.140.4.2	10.5.5.3	10.5.5.11
E	10.140.5.2	10.6.6.3	10.6.6.11
F	10.140.6.2	10.7.7.3	10.7.7.11
G	10.140.7.2	10.8.8.3	10.8.8.11
H	10.140.8.2	10.9.9.3	10.9.9.11
I	10.140.9.2	10.10.10.3	10.3.3.11
J	10.140.10.2	10.11.11.3	10.11.11.11
K	10.140.11.2	10.12.12.3	10.12.12.11
L	10.140.12.2	10.13.13.3	10.13.13.11

Summary

After completing this chapter, you should be able to perform the following tasks:

- **Determine when to use a static or dynamic route.**
- **Configure a static route on a Cisco Router.**
- **Describe how distance vector routing protocols operate.**
- **Configure the RIP and IGRP routing protocols on a Cisco router.**
- **Use *show ip route*, *show ip protocols,* and other show and debug commands to verify proper routing operation.**

Review Questions

1. What is an advantage of using a static route rather than a dynamic route? What is a disadvantage?
2. What is the advantage of using IGRP rather then RIP? What is a possible disadvantage?
3. To scale up to very large IP networks, what routing protocols are recommended?