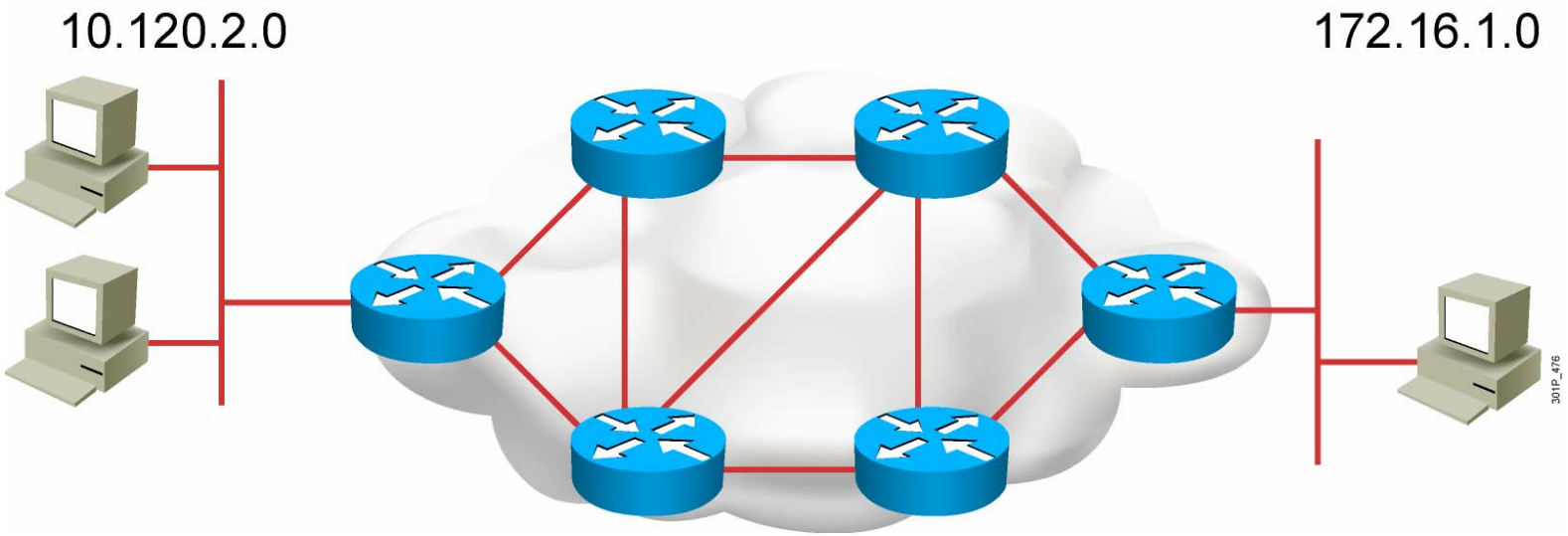
Enabling Static Routing

WAN Connections

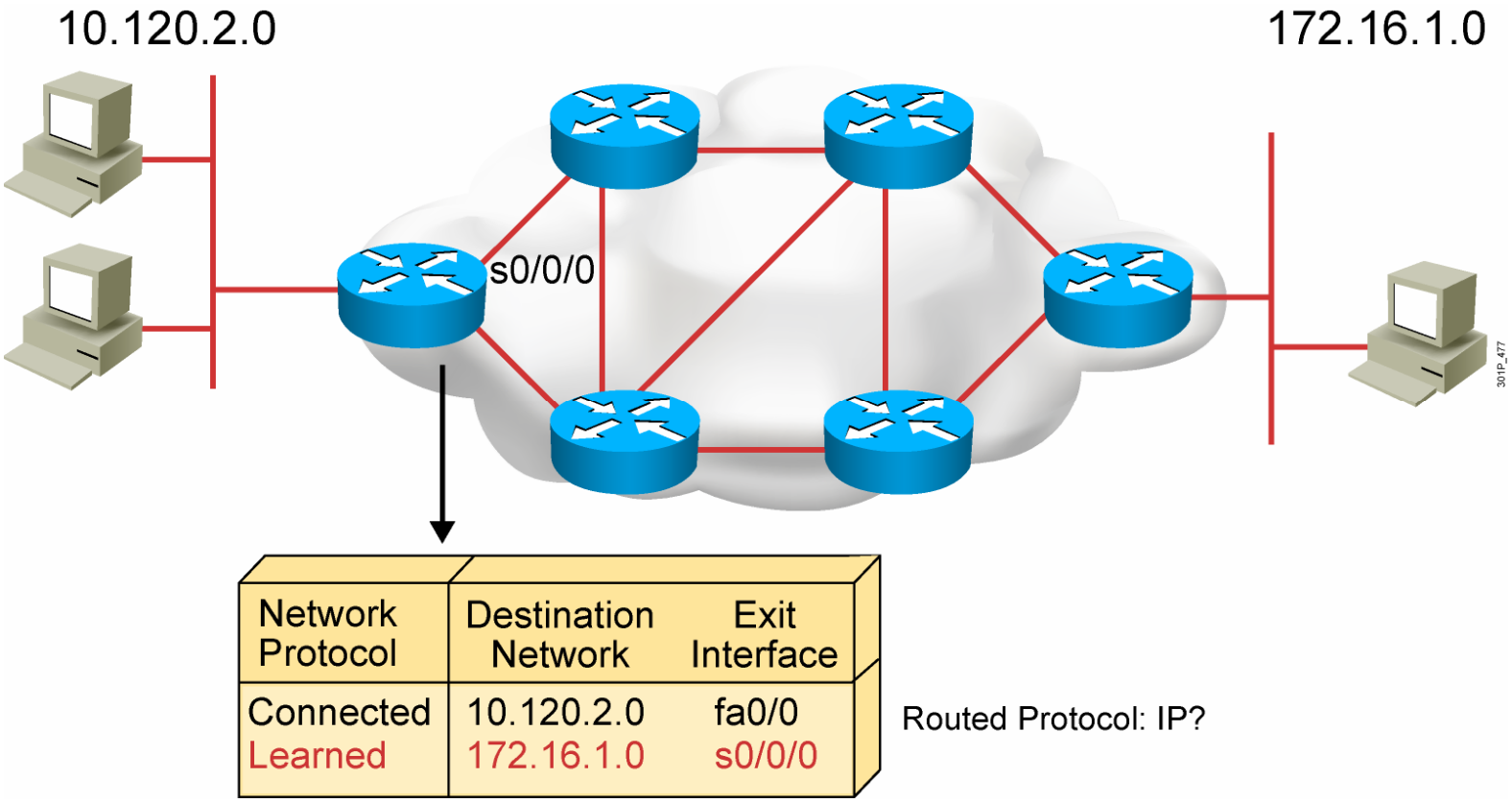
Router Operations



A router needs to do the following:

- Know the destination address.
- Identify the sources from which the router can learn.
- Discover possible routes to the intended destination.
- Select the best route.
- Maintain and verify routing information.

Router Operations (Cont.)



- Routers must learn destinations that are not directly connected.

Identifying Static and Dynamic Routes

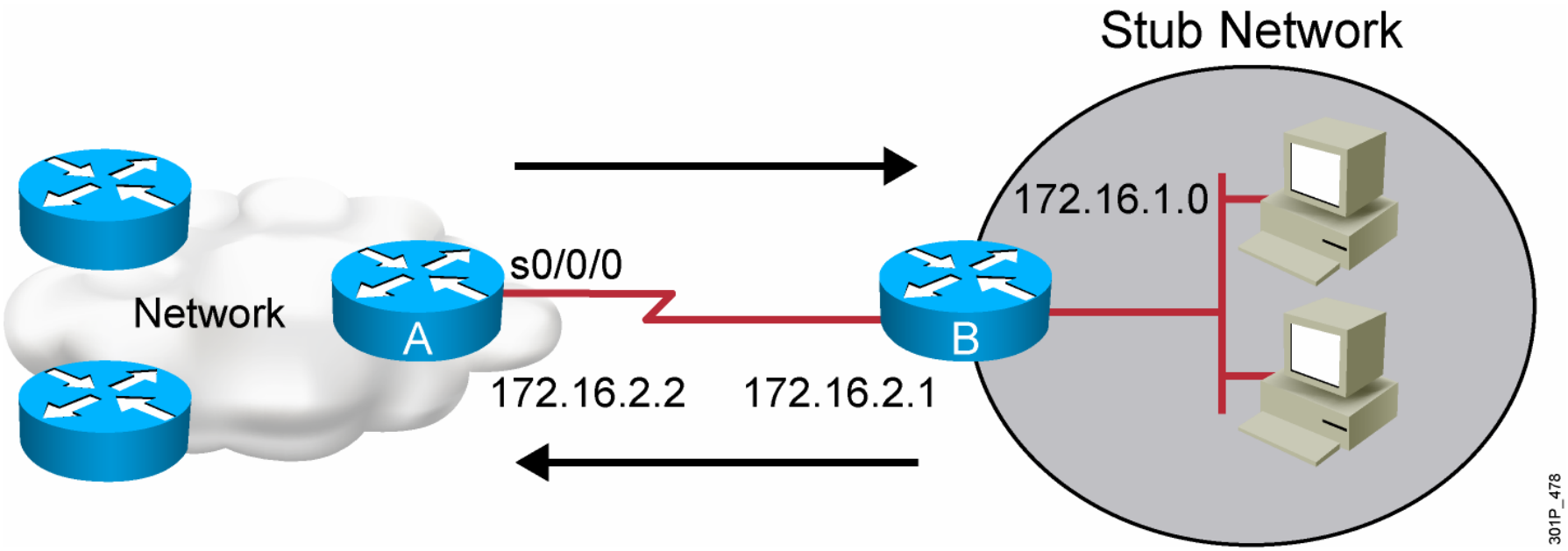
Static route

- 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



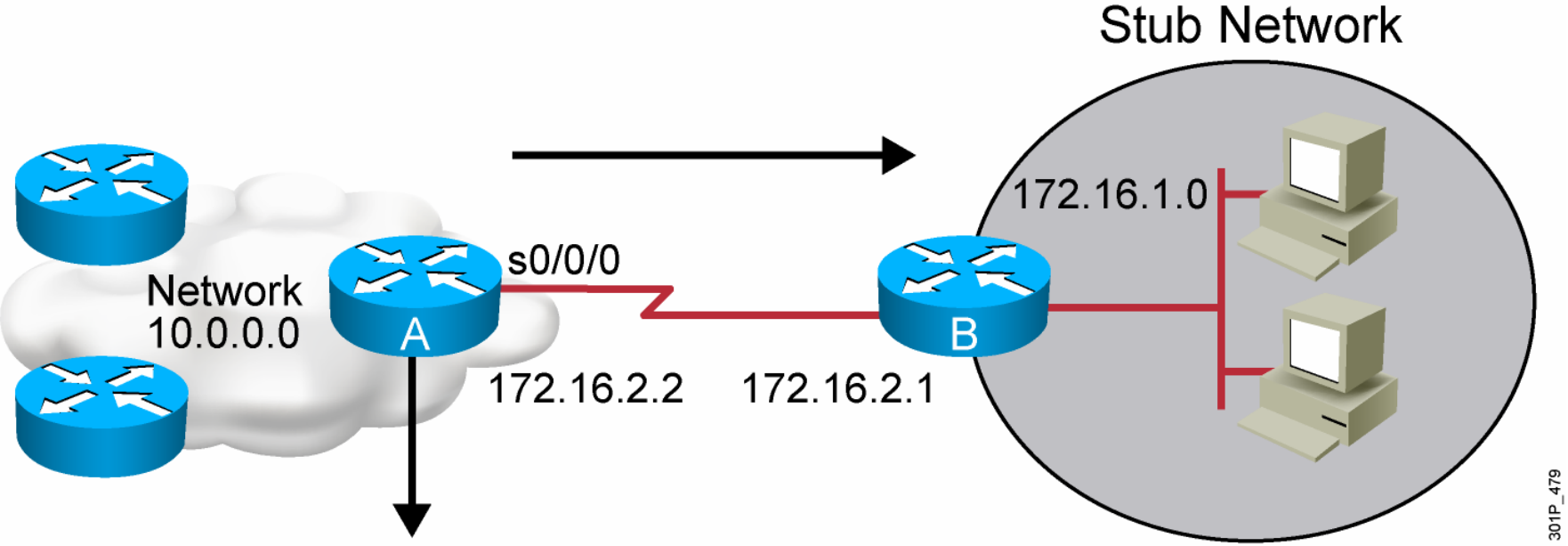
Configure unidirectional static routes to and from a stub network to allow communications to occur.

Static Route Configuration

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

- Defines a path to an IP destination network or subnet or host
- Address = IP address of the next hop router
- Interface = outbound interface of the local router

Static Route Example



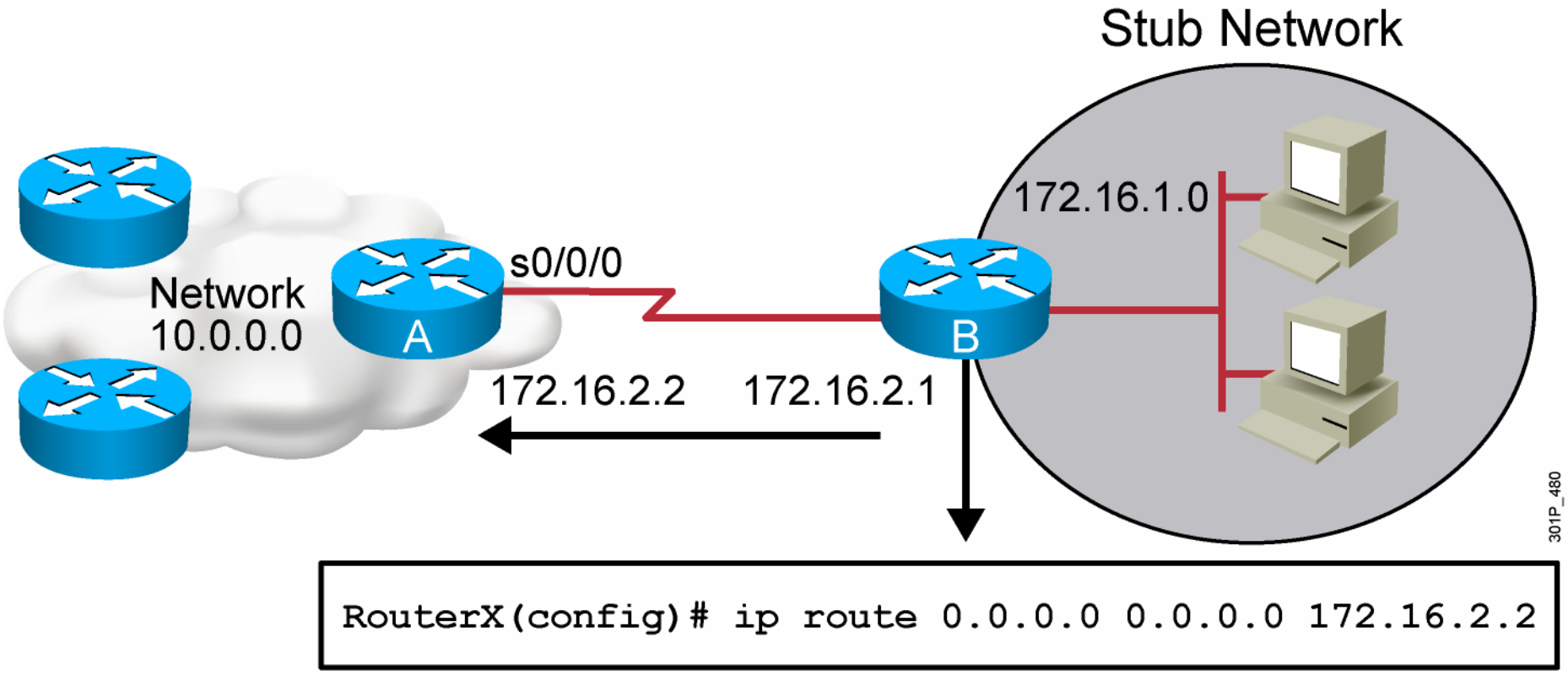

```
RouterX(config)# ip route 172.16.1.0 255.255.255.0 172.16.2.1
```

or

```
Router(config)#ip route 172.16.1.0 255.255.255.0 s0/0/0
```

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

Default Routes




```
RouterX(config)# 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.

Verifying the Static Route Configuration

```
RouterX# show 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
       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

Gateway of last resort is 0.0.0.0 to network 0.0.0.0

     10.0.0.0/8 is subnetted, 1 subnets
C       10.1.1.0 is directly connected, Serial0/0/0
S*   0.0.0.0/0 is directly connected, Serial0
```

Summary

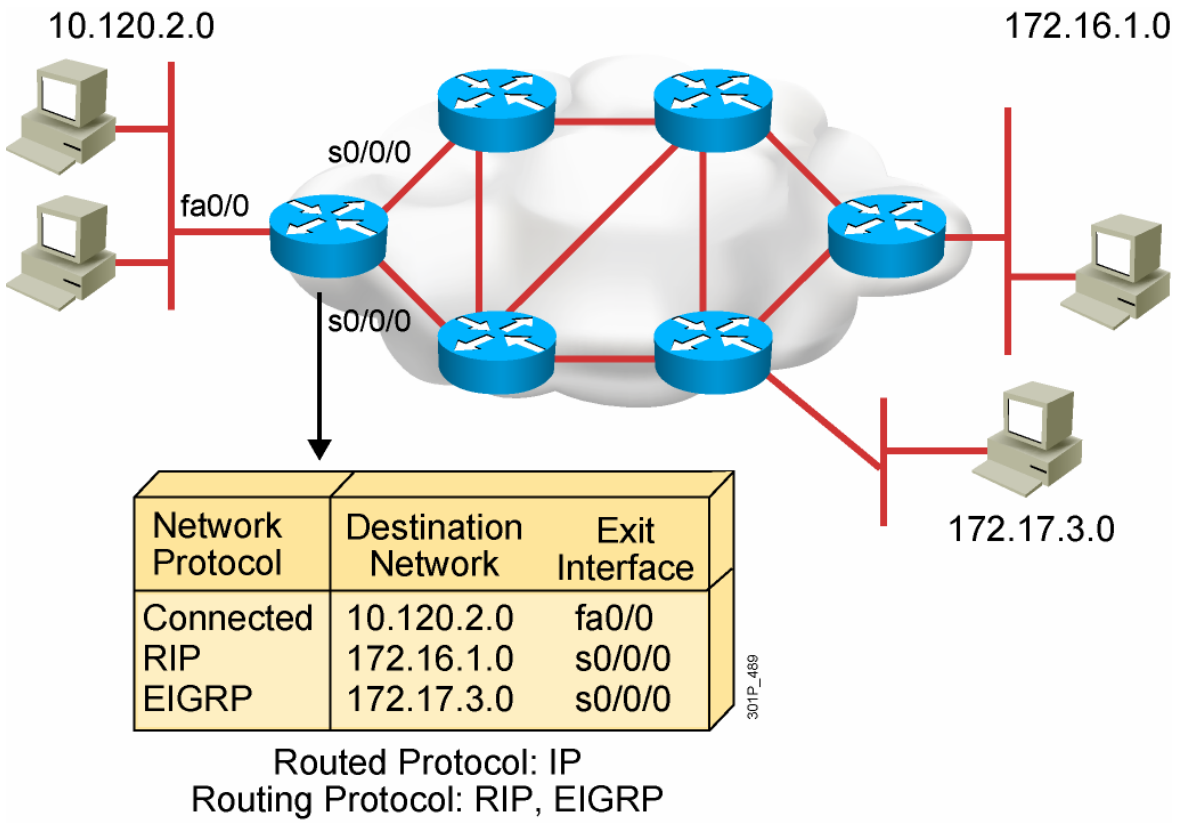
- Routing is the process by which items get from one location to another. In networking, a router is the device used to route traffic. Routers can forward packets over static routes or dynamic routes, based on the router configuration.
- Static routers use a route that a network administrator enters into the router manually. Dynamic routers use a route that a network routing protocol adjusts automatically for topology or traffic changes.
- Unidirectional static routes must be configured to and from a stub network to allow communications to occur.
- The **ip route** command can be used to configure default route forwarding.
- The **show ip** route command is used to verify that static routing is properly configured. Static routes are signified in the command output by “S”.

Enabling RIP

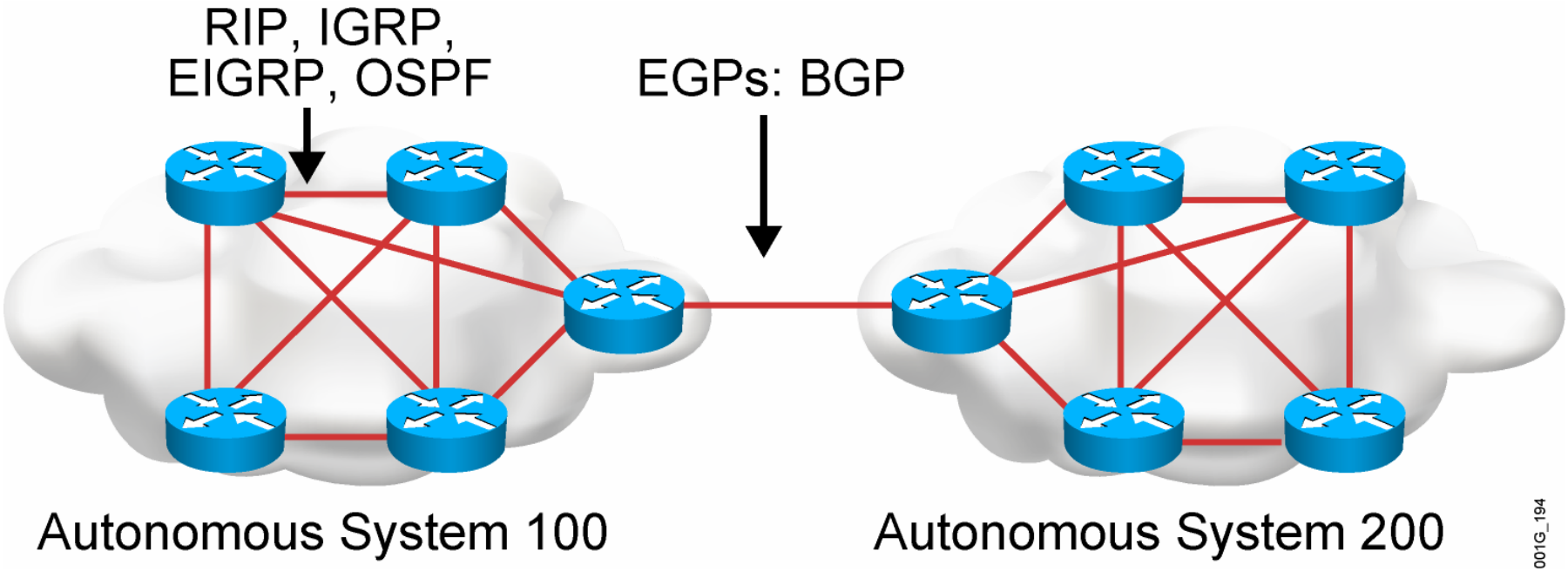
WAN Connections

What Is a Routing Protocol?

- **Routing** protocols are used between routers to determine paths and maintain routing tables.
- After the path is determined, a router can route a **routed** protocol.



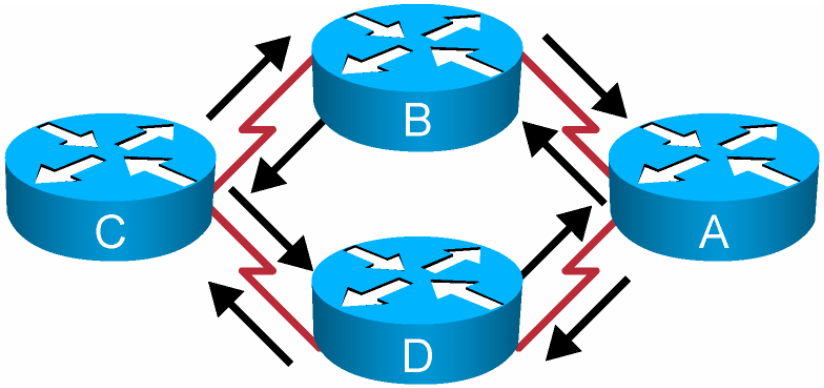
Autonomous Systems: Interior or Exterior Routing Protocols



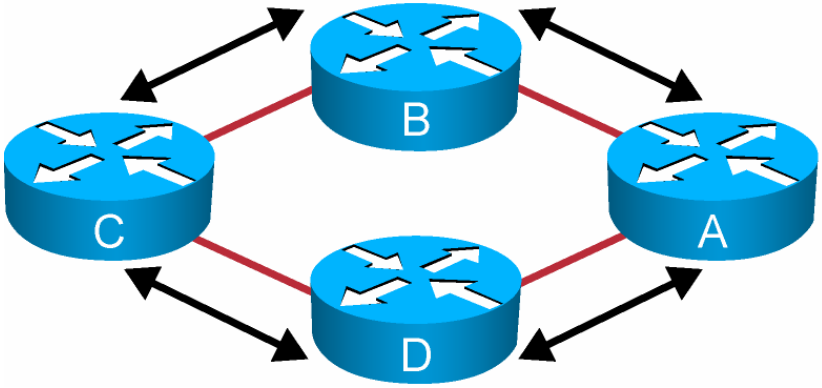
- An autonomous system is a collection of networks under a common administrative domain.
- IGPs operate within an autonomous system.
- EGPs connect different autonomous systems.

Classes of Routing Protocols

Distance Vector



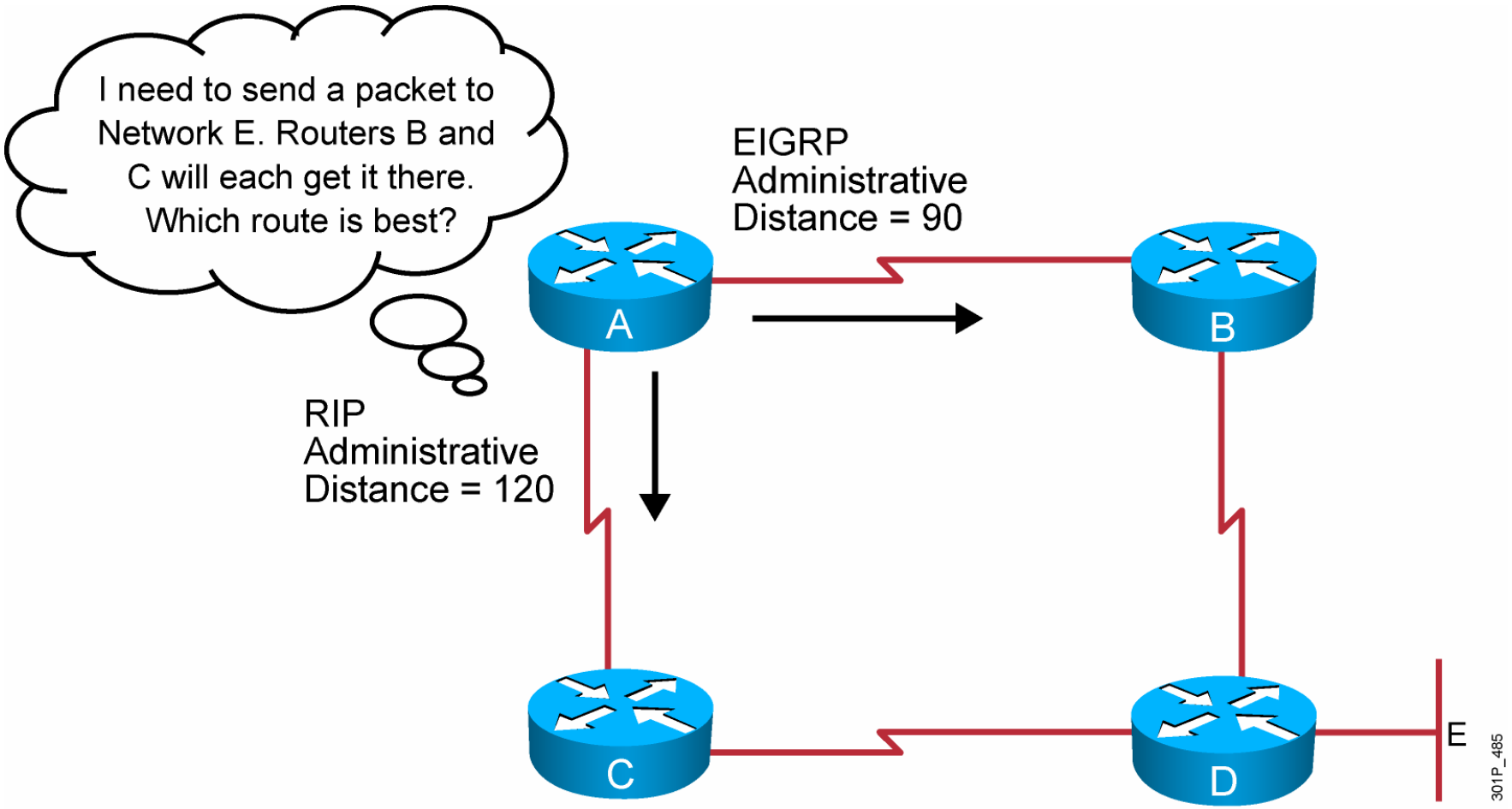
Hybrid Routing



Link-State

301P_196

Administrative Distance: Ranking Routes



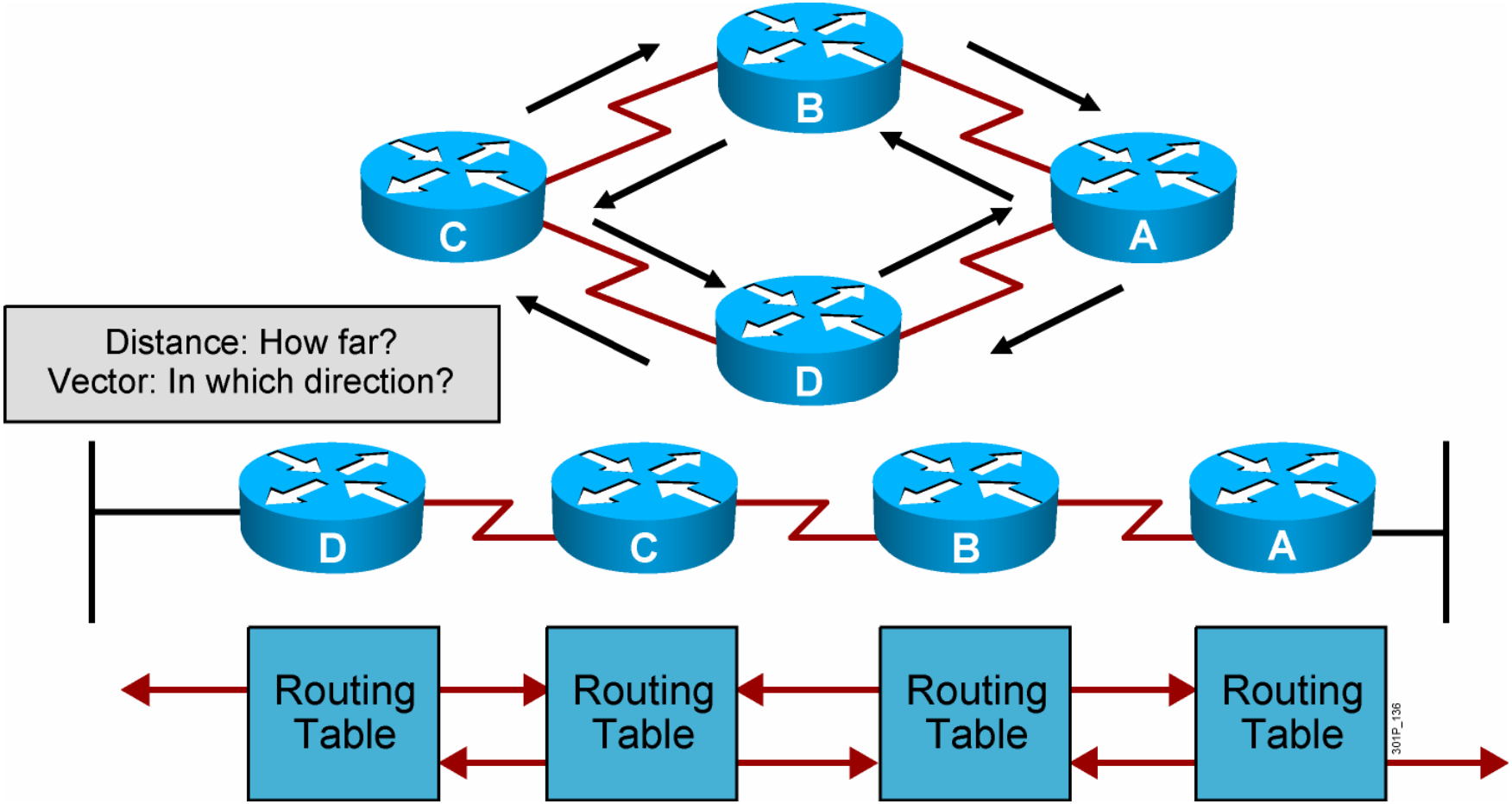
Classful Routing Protocol

- Classful routing protocols do not include the subnet mask with the route advertisement.
- Within the same network, consistency of the subnet masks is assumed.
- Summary routes are exchanged between foreign networks.
- These are examples of classful routing protocols:
  - RIPv1
  - IGRP

Classless Routing Protocol

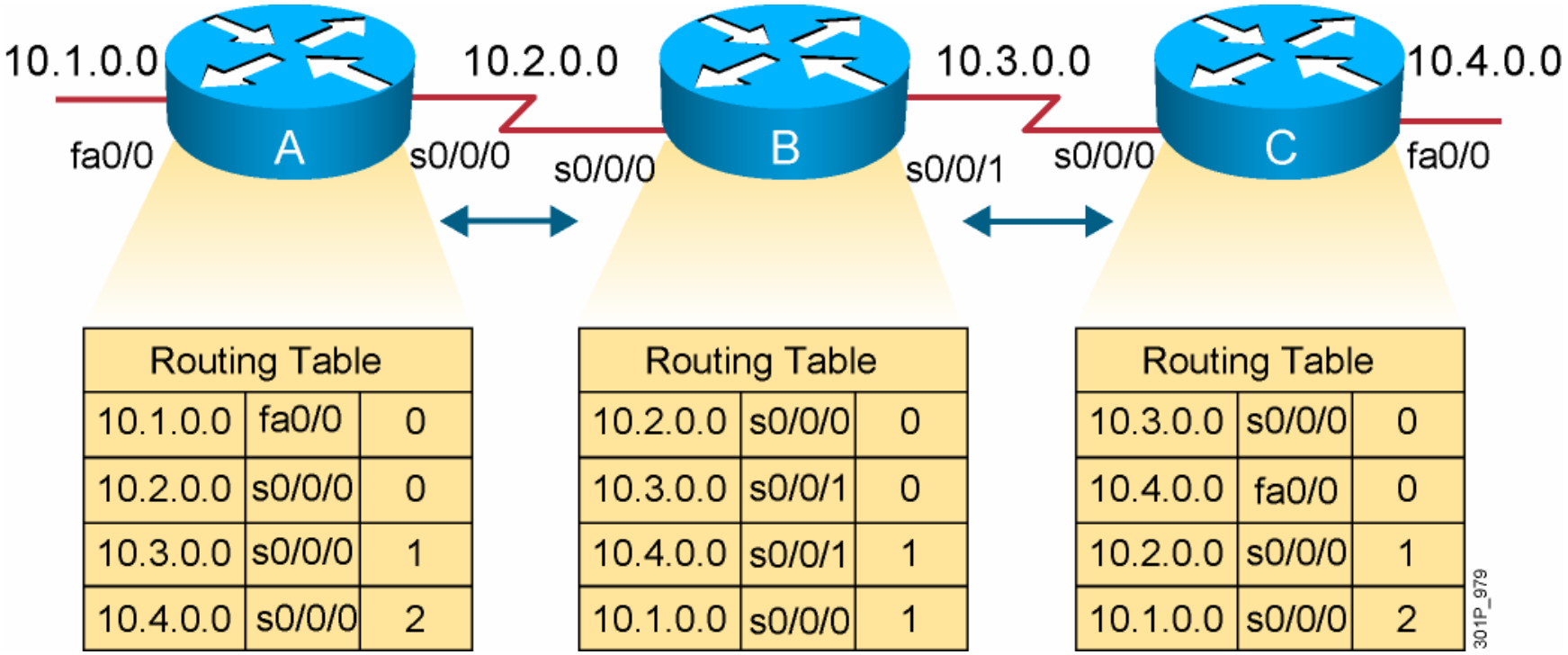
- Classless routing protocols include the subnet mask with the route advertisement.
- Classless routing protocols support a variable-length subnet mask (VLSM).
- Summary routes can be manually controlled within the network.
- These are examples of classless routing protocols:
  - RIPv2
  - EIGRP
  - OSPF
  - IS-IS

Distance Vector Routing Protocols



- Routers pass periodic copies of their routing table to neighboring routers and accumulate distance vectors

Sources of Information and Discovering Routes



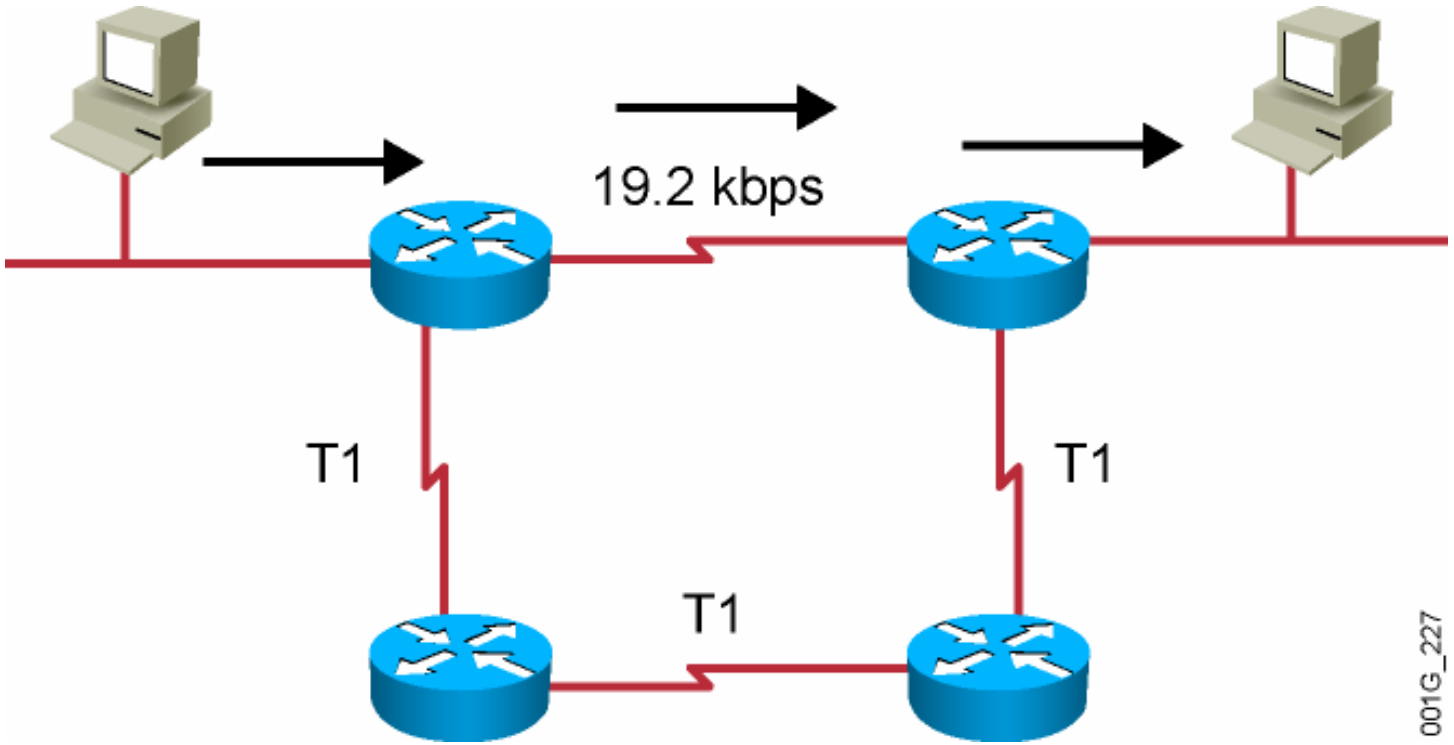
Routing Table		
10.1.0.0	fa0/0	0
10.2.0.0	s0/0/0	0
10.3.0.0	s0/0/0	1
10.4.0.0	s0/0/0	2

Routing Table		
10.2.0.0	s0/0/0	0
10.3.0.0	s0/0/1	0
10.4.0.0	s0/0/1	1
10.1.0.0	s0/0/0	1

Routing Table		
10.3.0.0	s0/0/0	0
10.4.0.0	fa0/0	0
10.2.0.0	s0/0/0	1
10.1.0.0	s0/0/0	2

- Routers discover the best path to destinations from each neighbor.

RIP Overview



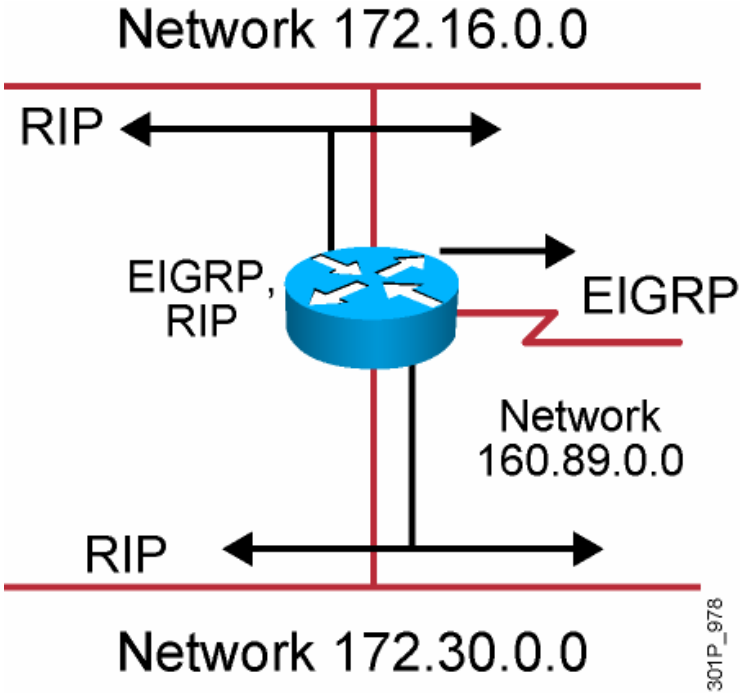
- Maximum is 16 equal-cost paths (default = 4)
- Hop-count metric selects the path
- Routes update every 30 seconds

RIPv1 and RIPv2 Comparison

	RIPv1	RIPv2
Routing protocol	Classful	Classless
Supports variable-length subnet mask?	No	Yes
Sends the subnet mask along with the routing update?	No	Yes
Addressing type	Broadcast	Multicast
Defined in …	RFC 1058	RFCs 1721, 1722, and 2453
Supports manual route summarization?	No	Yes
Authentication support?	No	Yes

IP Routing Configuration Tasks

- Router configuration
  - Select routing protocols
  - Specify networks or interfaces



RIP Configuration

```
RouterX(config)# router rip
```

- Starts the RIP routing process

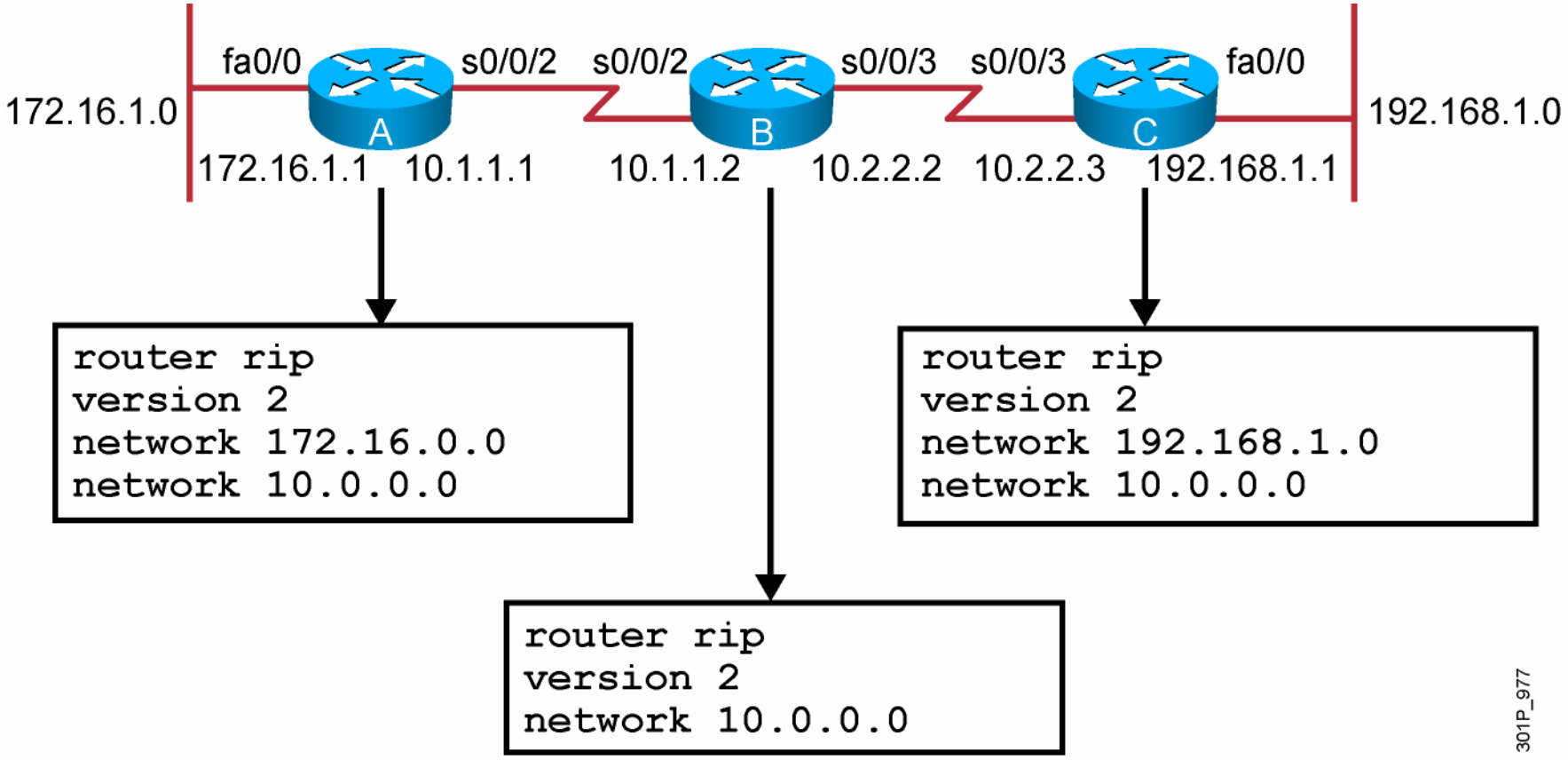
```
RouterX(config-router)# version 2
```

- Enables RIP version 2

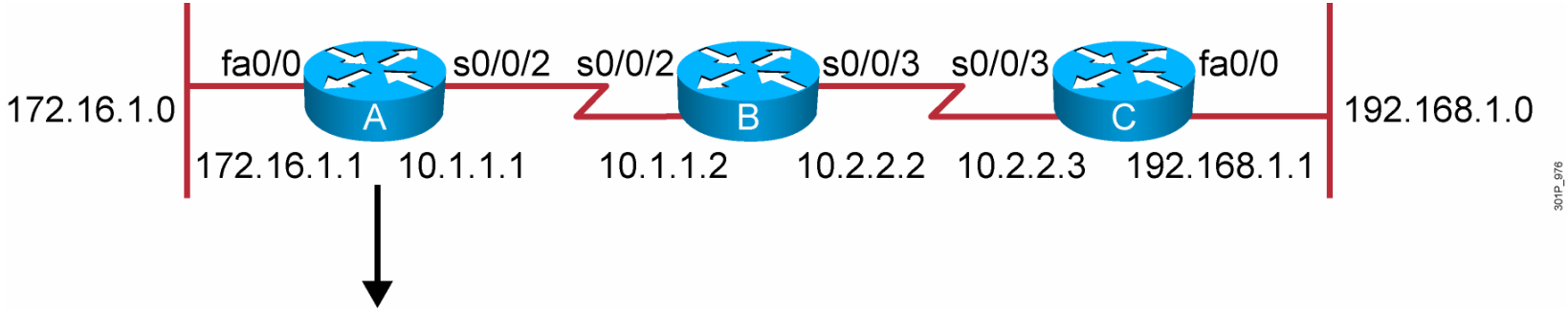
```
RouterX(config-router)# network network-number
```

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

RIP Configuration Example



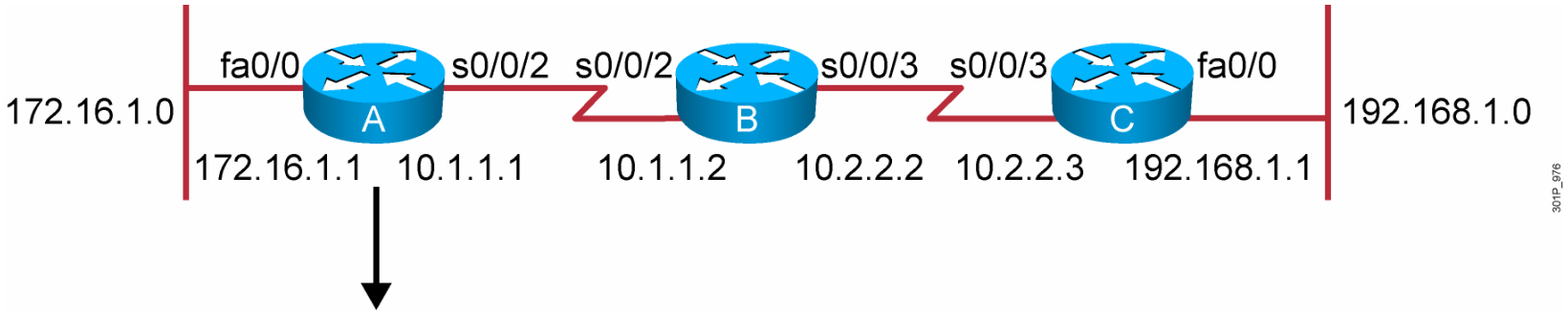
Verifying the RIP Configuration




```
Routing Protocol is "rip"
  Sending updates every 30 seconds, next due in 6 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Redistributing: rip
  Default version control: send version 2, receive version 2
    Interface              Send  Recv  Triggered RIP  Key-chain
    FastEthernet0/0        2     2
    Serial0/0/2            2     2
  Automatic network summarization is in effect
  Maximum path: 4
  Routing for Networks:
    10.0.0.0
    172.16.0.0
  Routing Information Sources:
    Gateway         Distance      Last Update
    10.1.1.2              120      00:00:25
  Distance: (default is 120)

RouterA#
```

Displaying the IP Routing Table

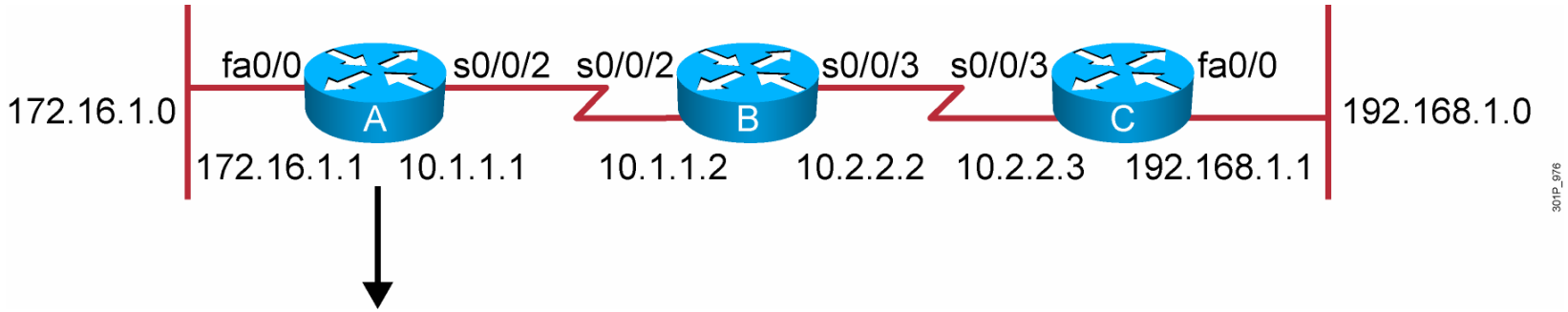



```
RouterA# show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, 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, fastethernet0/0
     10.0.0.0/24 is subnetted, 2 subnets
R       10.2.2.0 [120/1] via 10.1.1.2, 00:00:07, Serial0/0/2
C       10.1.1.0 is directly connected, Serial0/0/2
R    192.168.1.0/24 [120/2] via 10.1.1.2, 00:00:07, Serial0/0/2
```

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 Serial0/0/2
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 FastEthernet0/0 (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 Serial0/0/2 (10.1.1.1)
00:06:34:      network 172.16.0.0, metric 1
```

Summary

- Routing is the process by which items get from one location to another.
- Dynamic routing protocols determine how updates are conveyed, what knowledge is conveyed, when to convey knowledge, and how to locate recipients of the updates.
- A routing protocol that has a lower administrative value is more trustworthy than a protocol that has a higher administrative value.
- There are three classes of routing protocols: distance vector, link-state, and balanced hybrid.
- The **ip classless** command can be used to prevent a router from dropping a packet that is destined for an unknown subnetwork of a directly attached network if a default route is configured.

Summary (Cont.)

- RIP is a distance vector routing protocol that uses hop count as the matrix for route selection and broadcasts updates every 30 seconds.
- RIPv1 uses classful routing protocol; RIPv2 uses classless routing protocol. RIPv2 supports VLSM, manual route summarization, and authentication; RIPv1 does not support these activities.
- To enable a dynamic routing protocol, first a routing protocol is selected, then IP network numbers are assigned without values being specified (except OSPF).
- The **router** command starts the routing process. The **network** command allows the routing process to determine which interfaces will participate in sending and receiving the routing updates.

Summary (Cont.)

- The **router RIP** command selects RIP as the routing protocol. The **network** command identifies a participating attached network.
- The **show ip** command displays information about routing protocols and the routing table.
- The **debug ip rip** command displays information on RIP routing transactions.