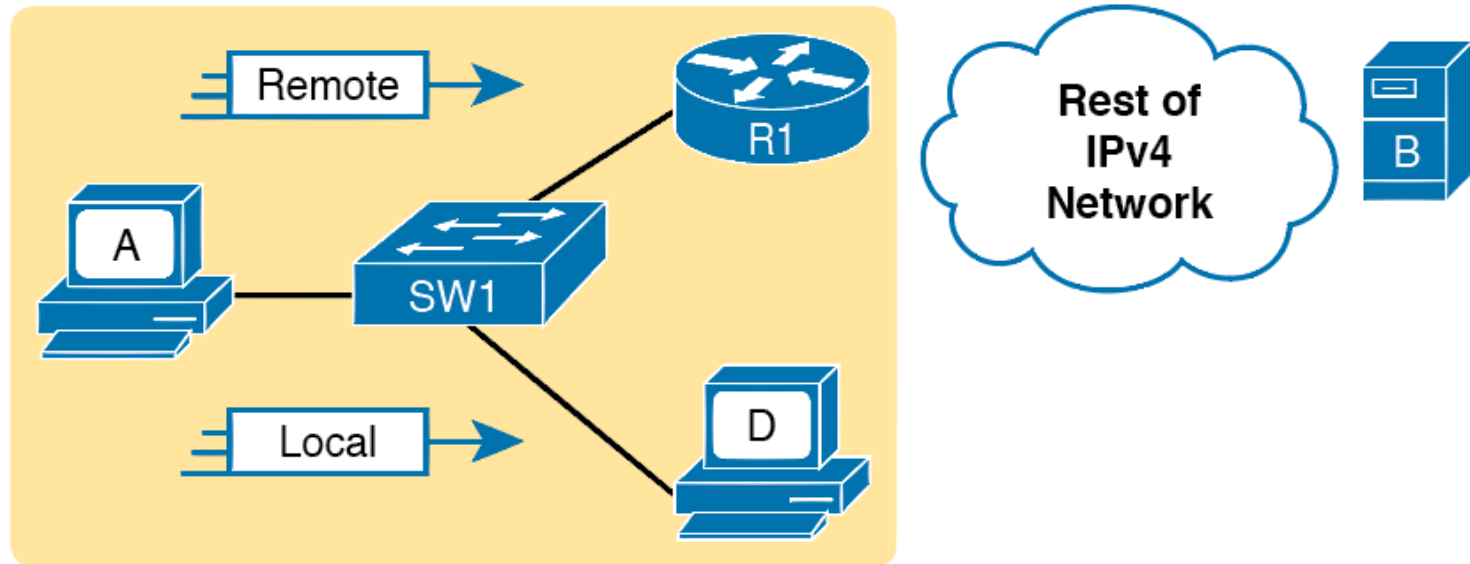# CCNA 200-301, Volume I

Chapter 18

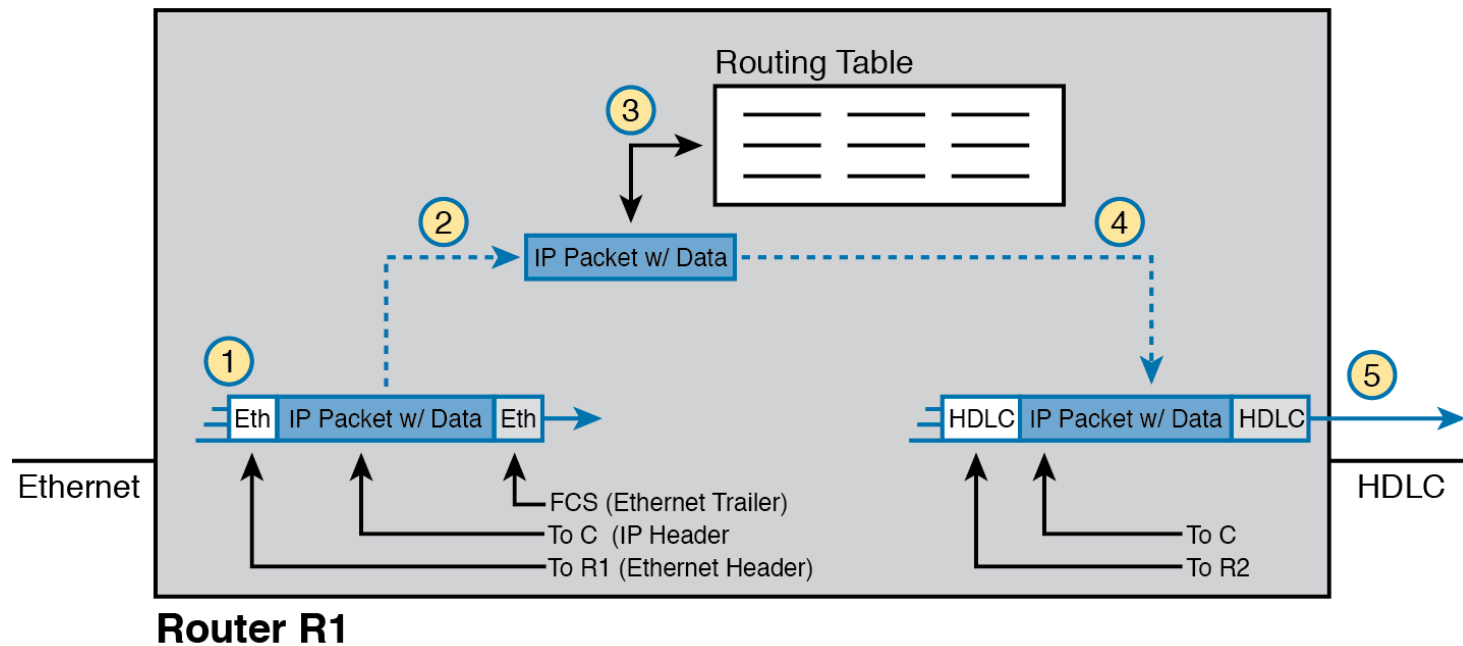**Configuring IPv4 Addresses and Static Routes**

Objectives

- IP Routing
- Configuring Connected Routes
- Configuring Static Routes
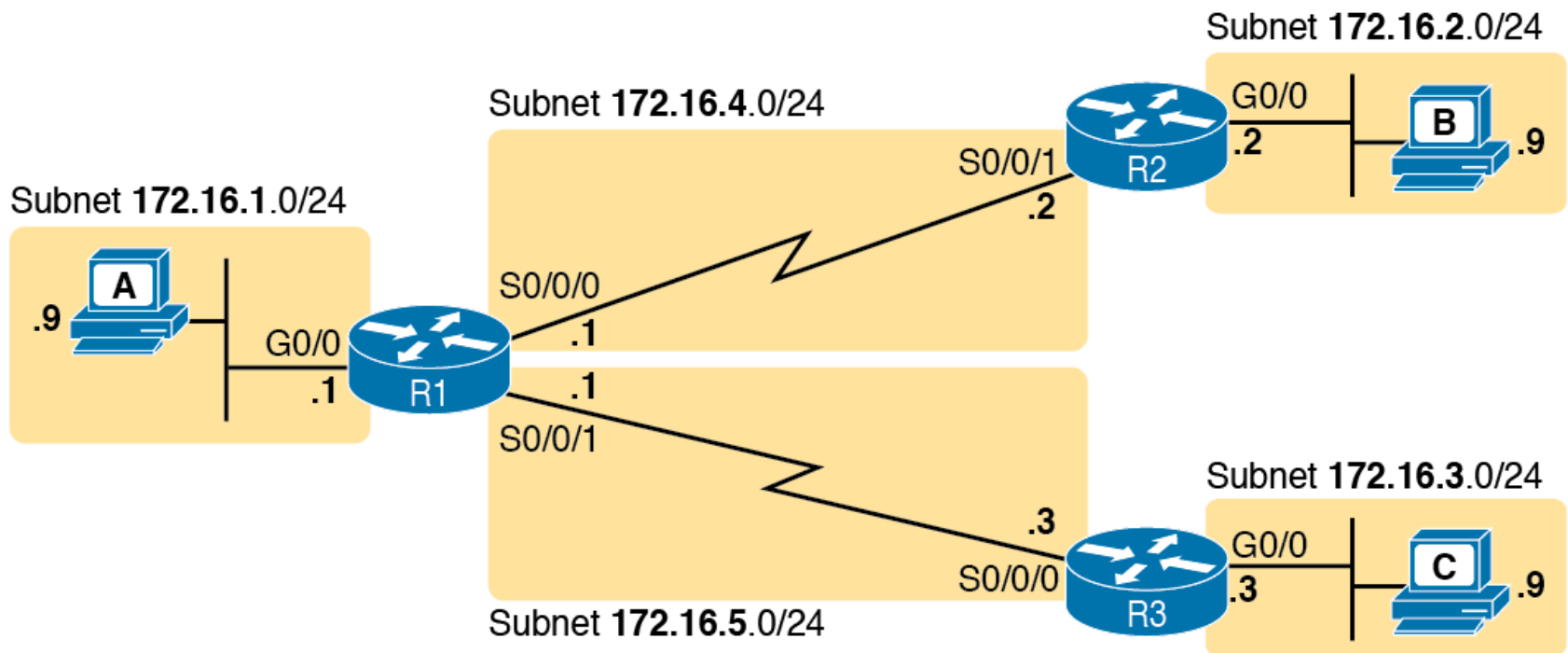- IP Forwarding with the Longest Prefix Match
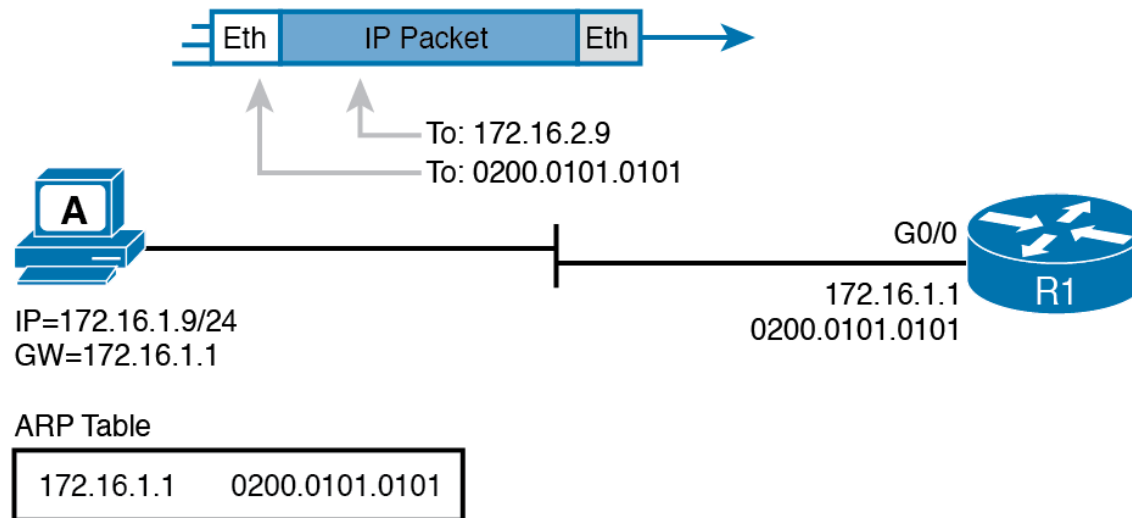
Host Routing Logic Summary

Router Routing Logic Summary

Router R1

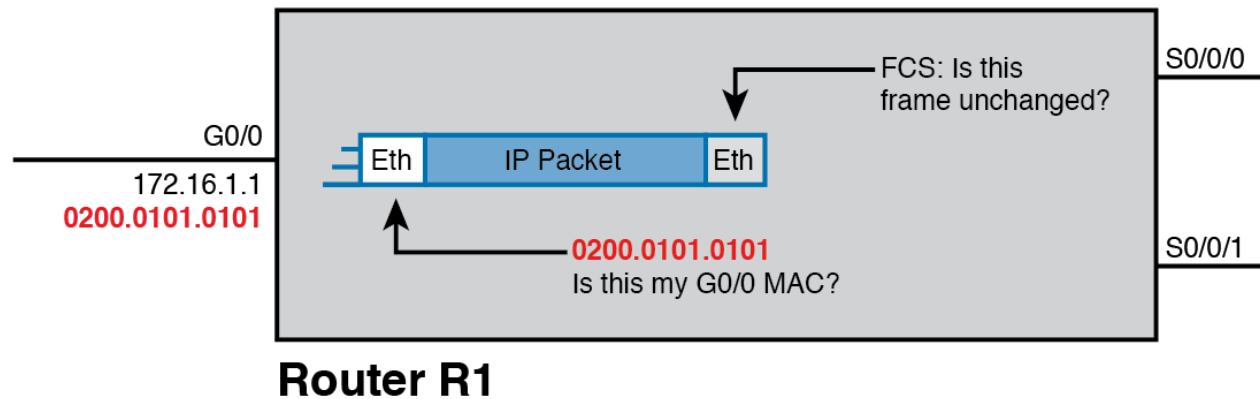# IPv4 Network Used to Show Five-Step Routing Example

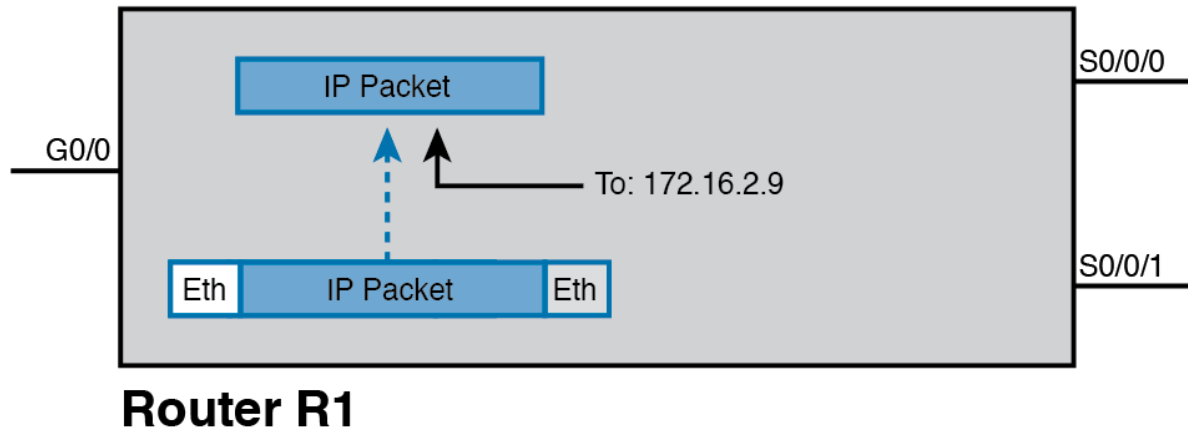# Host A Sends Packet to Host B

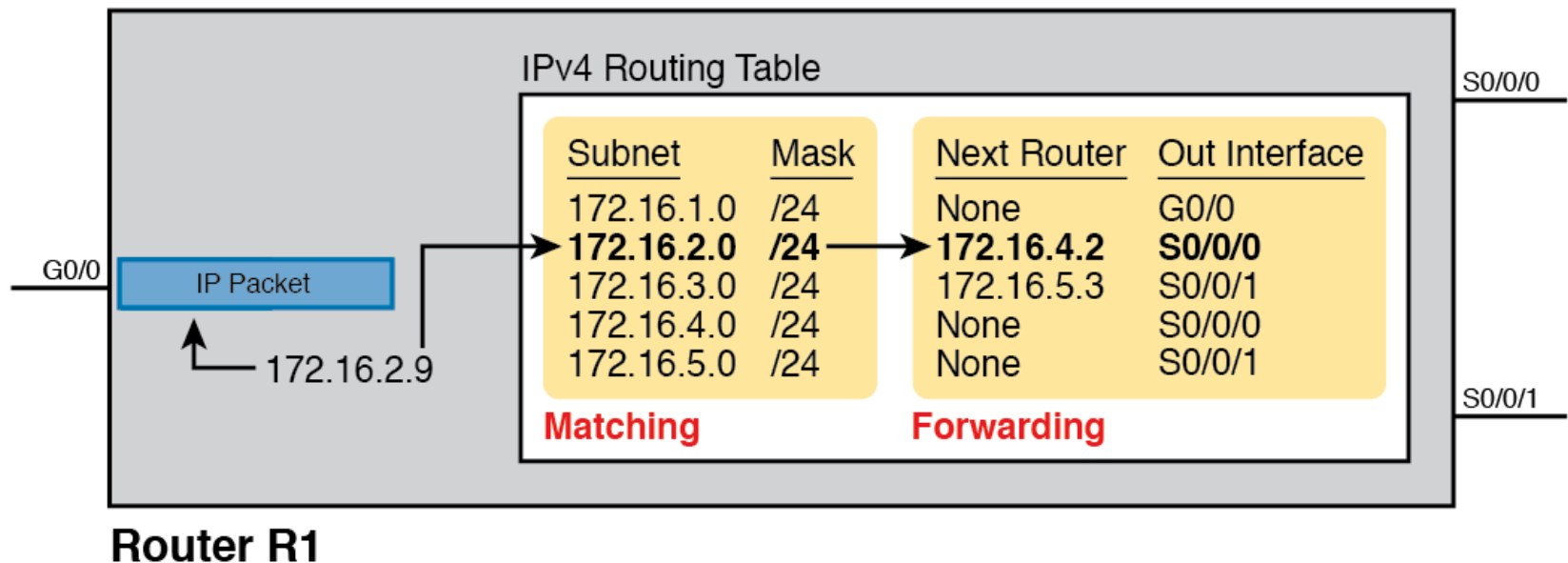# Routing Step 1, on Router R1: Checking FCS and Destination MAC
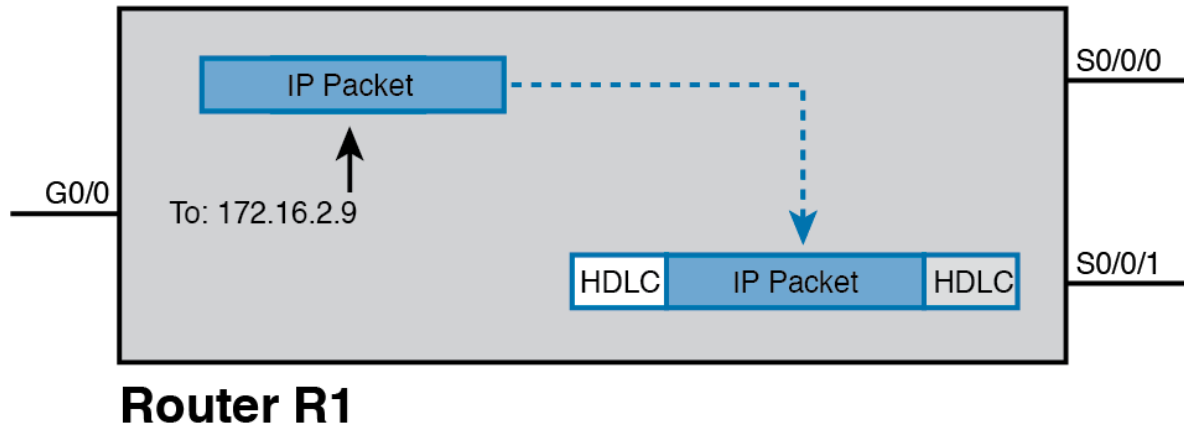
Routing Step 2 on Router R1: De-encapsulating the Packet

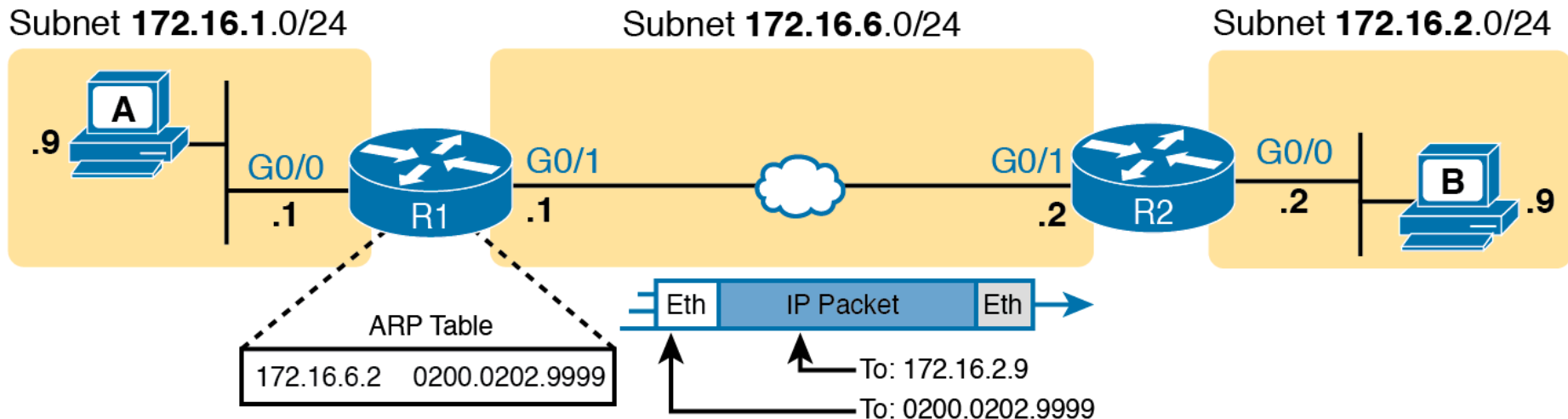**Router R1**

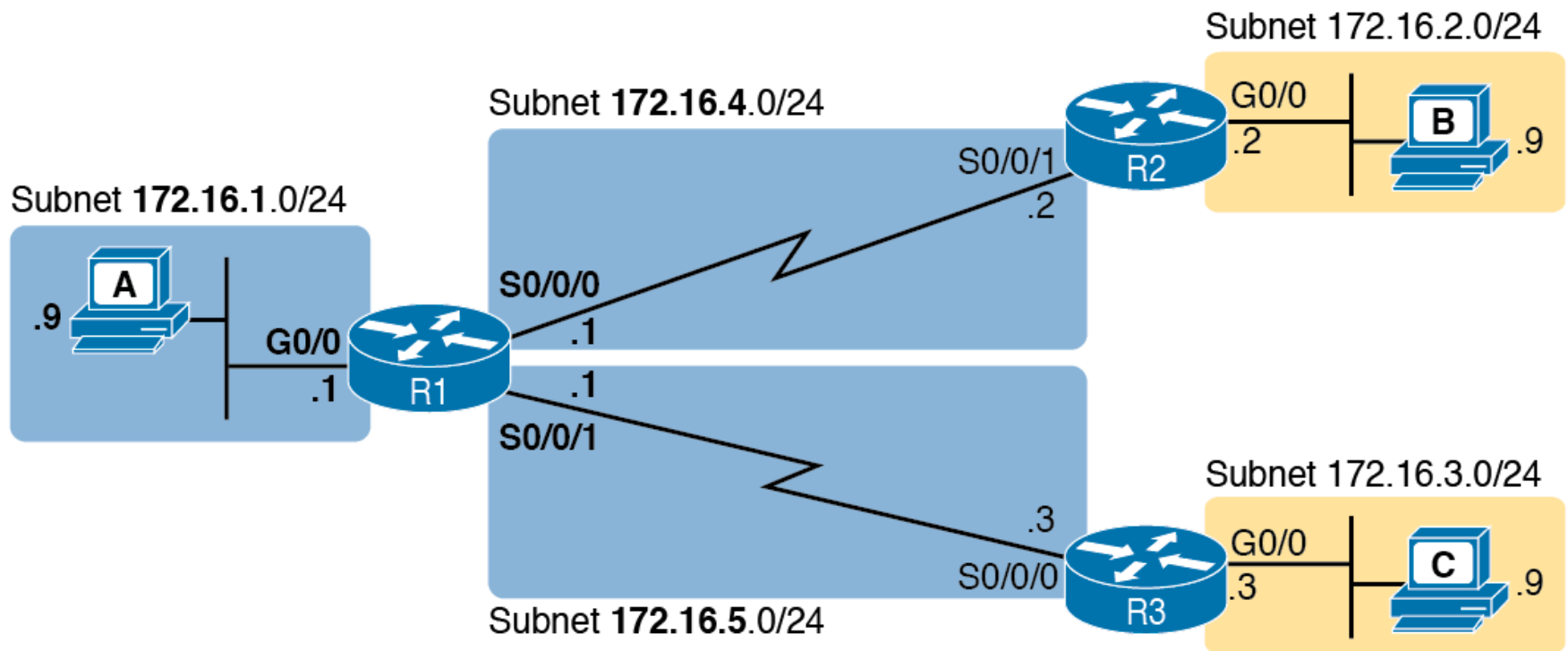# Routing Step 3 on Router R1: Matching the Routing Table

Routing Step 4 on Router R1: Encapsulating the Packet

Router R1

Routing Step 4 on Router R1 with a LAN Outgoing Interface

Sample Network to Show Connected Routes

Connected and Local Routes on Router R1

```
! Excerpt from show running-config follows...
!
interface GigabitEthernet0/0
 ip address 172.16.1.1 255.255.255.0
!
interface Serial0/0/0
 ip address 172.16.4.1 255.255.255.0
!
interface GigabitEthernet0/1/0
 ip address 172.16.5.1 255.255.255.0


R1# show ip route
Codes: L - local, C - connected, S - static, 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
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       a - application route
       + - replicated route, % - next hop override, p - overrides from PfR


Gateway of last resort is not set

      172.16.0.0/16 is variably subnetted, 6 subnets, 2 masks
C        172.16.1.0/24 is directly connected, GigabitEthernet0/0
L        172.16.1.1/32 is directly connected, GigabitEthernet0/0
C        172.16.4.0/24 is directly connected, Serial0/0/0
L        172.16.4.1/32 is directly connected, Serial0/0/0
C        172.16.5.0/24 is directly connected, GigabitEthernet0/1/0
L        172.16.5.1/32 is directly connected, GigabitEthernet0/1/0
```

Displaying a Router's IP ARP Table

```
R2# show ip arp
Protocol   Address        Age (min)  Hardware Addr   Type   Interface
Internet   172.16.1.1          -     0200.2222.2222  ARPA   GigabitEthernet0/0
Internet   172.16.1.9         35     0200.3333.3333  ARPA   GigabitEthernet0/0
```

Static Route Configuration Concept
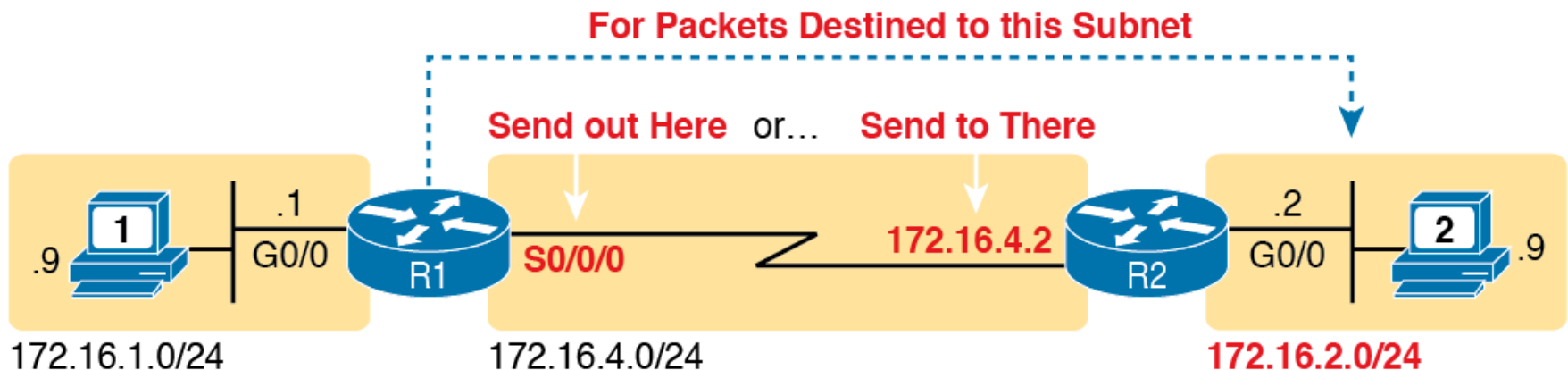
Sample Network Used in Static Route Configuration Examples
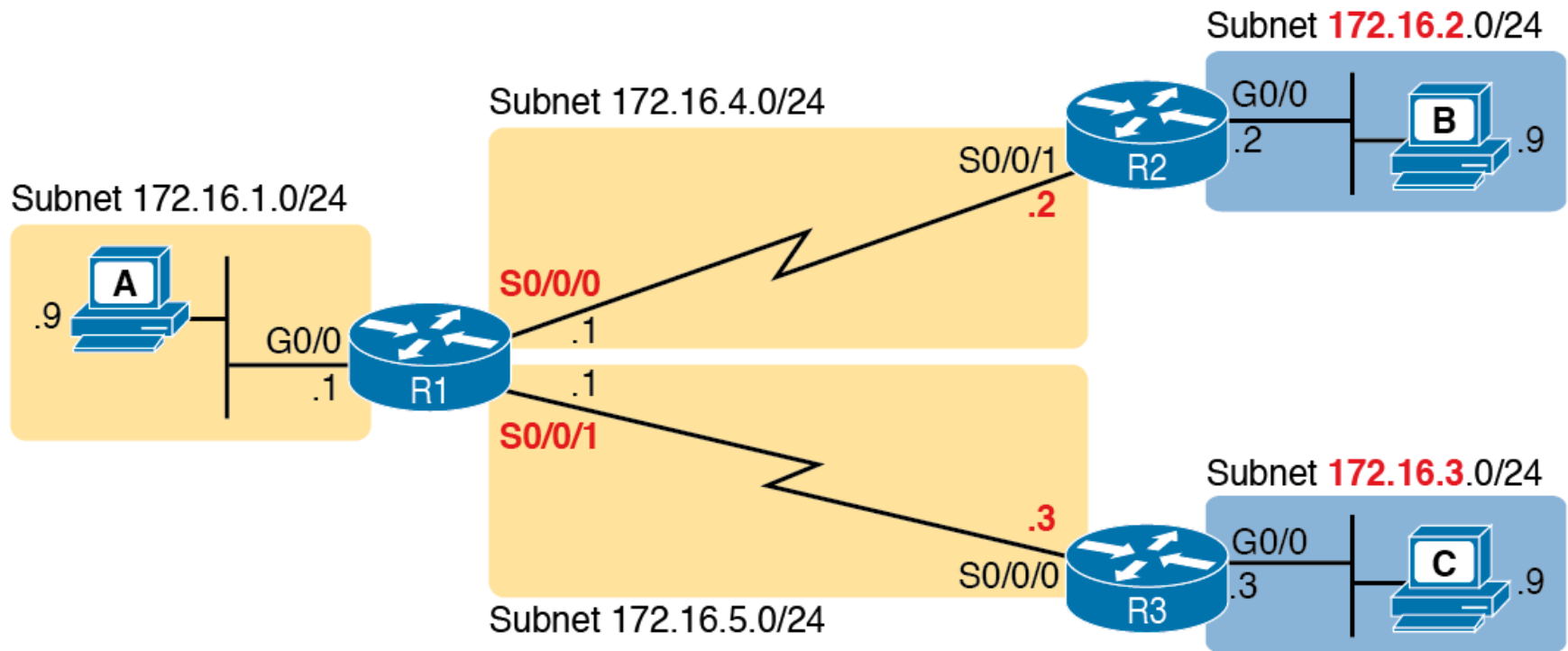
Static Routes Added to R1

```
R1# show ip route static

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
! lines omitted for brevity

Gateway of last resort is not set

        172.16.0.0/16 is variably subnetted, 8 subnets, 2 masks
S          172.16.2.0/24 is directly connected, Serial0/0/0
S          172.16.3.0/24 [1/0] via 172.16.5.3
```

Static Host Routes

ip route 10.1.1.0 255.255.255.0 10.2.2.2
ip route 10.1.1.9 255.255.255.255 10.9.9.9

Using a Floating Static Route to Key Subnet 172.16.2.0/24
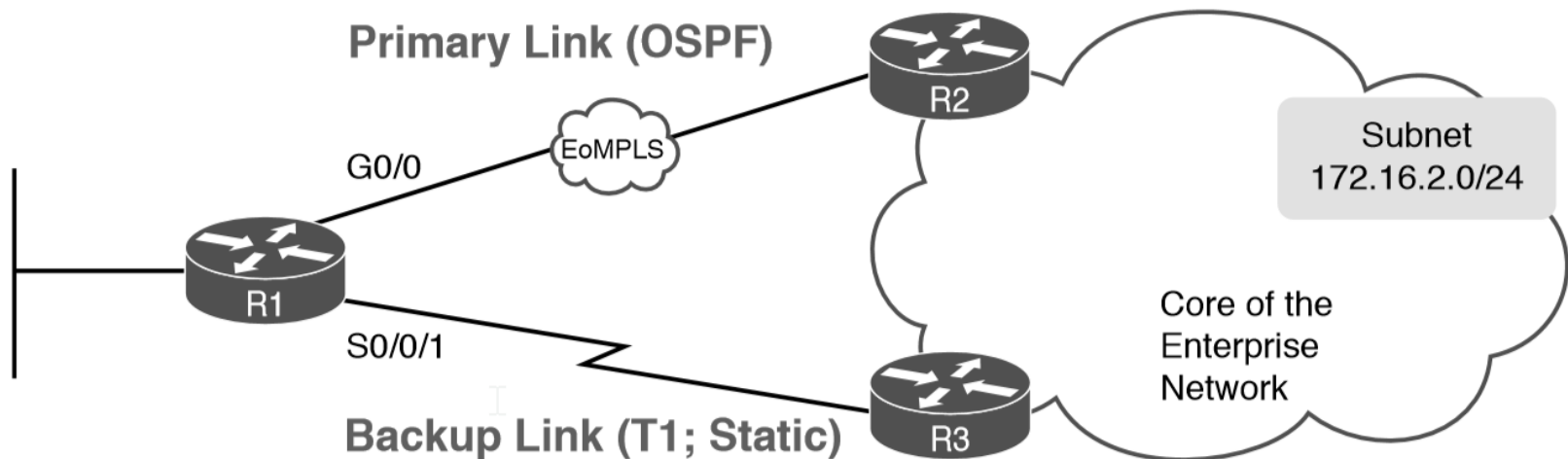
Displaying the Administrative Distance of the Static Route

```
R1# show ip route static
! Legend omitted for brevity
        172.16.0.0/16 is variably subnetted, 6 subnets, 2 masks
S           172.16.2.0/24 is directly connected, Serial0/0/1


R1# show ip route 172.16.2.0
Routing entry for 172.16.2.0/24
  Known via "static", distance 130, metric 0 (connected)
  Routing Descriptor Blocks:
  * directly connected, via Serial0/0/1
        Route metric is 0, traffic share count is 1
```

Example Use of Static Default Routes at 1000 Low-Speed Remote Sites
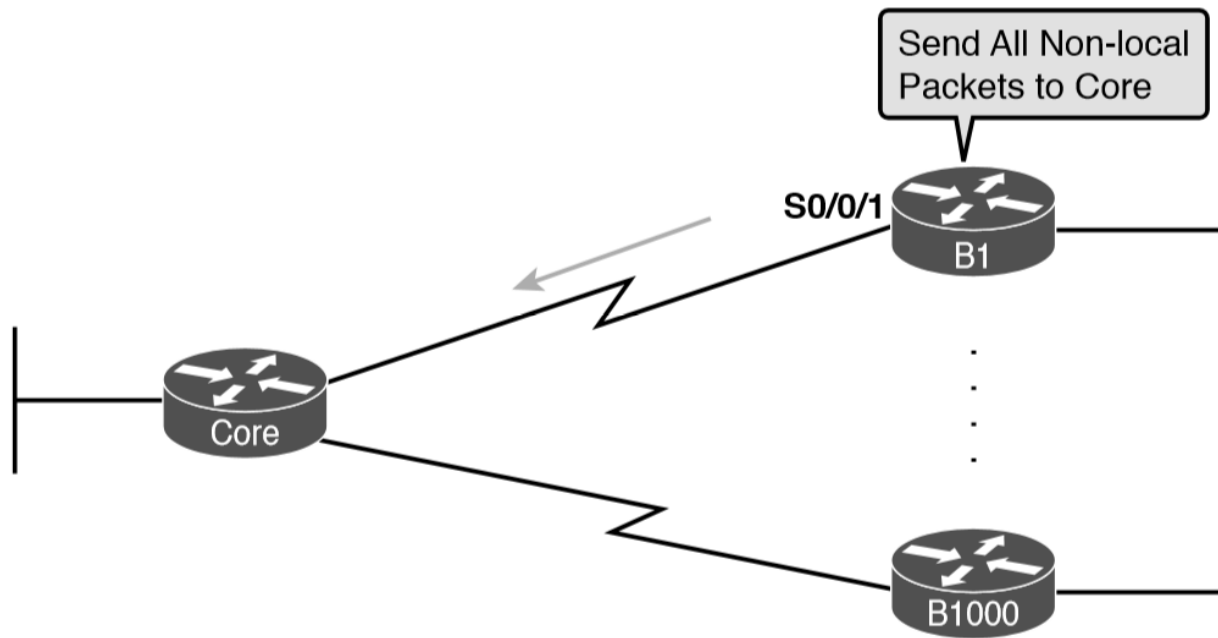
Adding a Static Default Route on R2

```
R2# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)# ip route 0.0.0.0 0.0.0.0 s0/0/1
R2(config)# ^Z
R2# show ip route
Codes: L - local, C - connected, S - static, 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
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override


Gateway of last resort is 0.0.0.0 to network 0.0.0.0


S*    0.0.0.0/0 is directly connected, Serial0/0/1
      172.16.0.0/16 is variably subnetted, 4 subnets, 2 masks
C        172.16.2.0/24 is directly connected, GigabitEthernet0/0
L        172.16.2.2/32 is directly connected, GigabitEthernet0/0
C        172.16.4.0/24 is directly connected, Serial0/0/1
L        172.16.4.2/32 is directly connected, Serial0/0/1
```

Permanently Adding Static Routes to the IP Routing Table

```
ip route 172.16.2.0 255.255.255.0 S0/0/0 permanent
ip route 172.16.3.0 255.255.255.0 172.16.5.3 permanent
```

show ip route Command with Overlapping Routes

```
R1# show ip route ospf
Codes: L - local, C - connected, S - static, 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
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is 172.16.25.129 to network 0.0.0.0

      172.16.0.0/16 is variably subnetted, 9 subnets, 5 masks
O        172.16.1.1/32 [110/50] via 172.16.25.2, 00:00:04, GigabitEthernet0/0/0
O        172.16.1.0/24 [110/100] via 172.16.25.129, 00:00:09, GigabitEthernet0/1/0
O        172.16.0.0/22 [110/65] via 172.16.24.2, 00:00:04, GigabitEthernet0/2/0
O        172.16.0.0/16 [110/65] via 172.16.24.129, 00:00:09, GigabitEthernet0/3/0
O        0.0.0.0/0 [110/129] via 172.16.25.129, 00:00:09, GigabitEthernet0/0/0
```

show ip route Command Output

Item	Idea	Value in the Figure	Description
1	Classful network	10.0.0.0/8	The routing table is organized by classful network. This line is the heading line for classful network 10.0.0.0; it lists the default mask for Class A networks (/8).
2	Number of subnets	13 subnets	The number of routes for subnets of the classful network known to this router, from all sources, including local routes—the /32 routes that match each router interface IP address.
3	Number of masks	5 masks	The number of different masks used in all routes known to this router inside this classful network.
4	Legend code	C, L, O	A short code that identifies the source of the routing information. *O* is for OSPF, *D* for EIGRP, *C* for Connected, *S* for static, and *L* for local. (See Example 16-8 for a sample of the legend.)
5	Prefix (Subnet ID)	10.2.2.0	The subnet number of this particular route.
6	Prefix length (Mask)	/30	The prefix mask used with this subnet.
7	Administrative distance	110	If a router learns routes for the listed subnet from more than one source of routing information, the router uses the source with the lowest administrative distance (AD).
8	Metric	128	The metric for this route.
9	Next-hop router	10.2.2.5	For packets matching this route, the IP address of the next router to which the packet should be forwarded.
10	Timer	14:31:52	For OSPF and EIGRP routes, this is the time since the route was first learned.
11	Outgoing interface	Serial0/0/1	For packets matching this route, the interface out which the packet should be forwarded.

```
           ①                                    ②          ③
   10.0.0.0/8 is variably subnetted, 13 subnets, 5 masks
C      10.1.3.0/26 is directly connected, GigabitEthernet0/1
L      10.1.3.3/32 is directly connected, GigabitEthernet0/1
O      10.1.4.64/26 [110/65] via 10.2.2.10, 14:31:52, Serial0/1/0
O      10.2.2.0/30 [110/128] via 10.2.2.5, 14:31:52, Serial0/0/1
④          ⑤          ⑥ ⑦ ⑧              ⑨          ⑩          ⑪
```