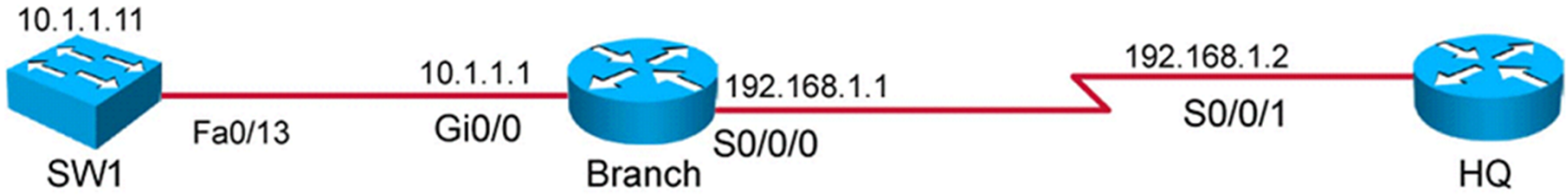
Using the **show cdp neighbors detail** Command




```
Branch#show cdp neighbors detail
-------------------------
Device ID: HQ
Entry address(es):
  IP address: 192.168.1.2
Platform: Cisco CISCO2901/K9,  Capabilities: Router Switch IGMP
Interface: Serial0/0/0,  Port ID (outgoing port): Serial0/0/1
Holdtime: 132 sec
Version:  Cisco IOS Software, C2900 Software (C2900-UNIVERSALK9-M),
Version 15.2(4)M1, RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2012 by Cisco Systems, Inc.
Compiled Tue 20-Mar-12 18:57 by prod_rel_team
<output omitted>
```

- Displays detailed information about neighboring devices

Summary

- The router startup sequence begins with POST, then the Cisco IOS image is found and loaded. Finally, the configuration file is loaded, if it exists.
- If a router starts without a configuration, the Cisco IOS Software executes a question-driven configuration dialog, which can be skipped.
- The main function of a router is to relay packets from one network device to another.
- Interface characteristics, such as the IP address and description, are configured using interface configuration mode.
- When you have completed router interface configuration, you can verify it by using the **show ip interface brief** and **show interfaces** commands

Summary (Cont.)

- Cisco Discovery Protocol is an information-gathering tool used by network administrators to obtain information about directly connected devices.
- Cisco Discovery Protocol exchanges hardware and software device information with its directly connected Cisco Discovery Protocol neighbors.
- The **show cdp neighbors** command displays information about the Cisco Discovery Protocol neighbors of a router.
- The **show cdp neighbors detail** command displays detailed Cisco Discovery Protocol information on a Cisco device.

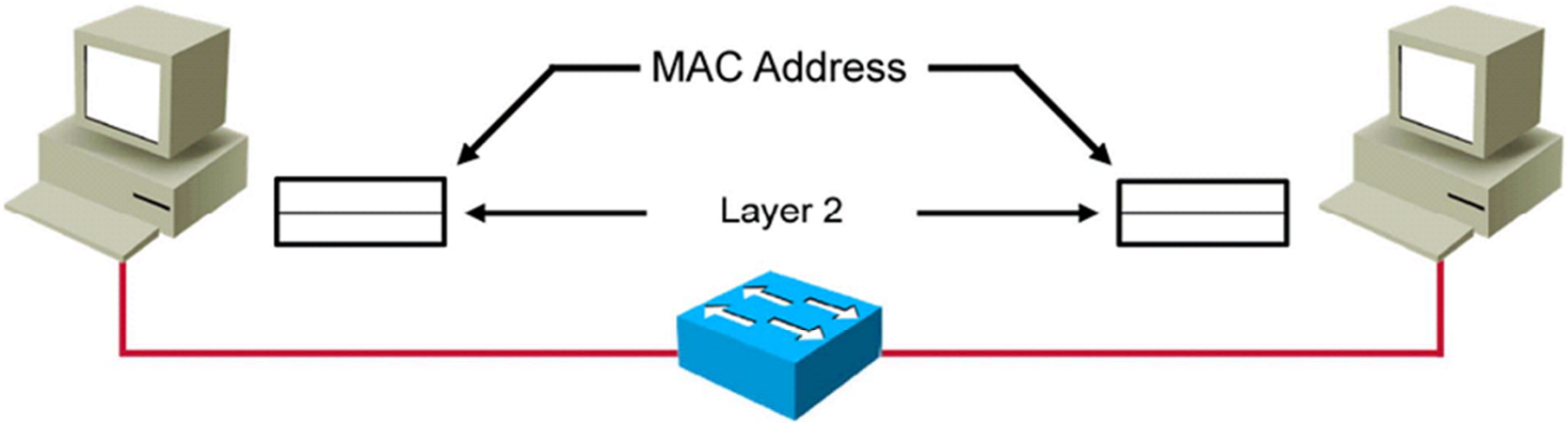
Exploring the Packet Delivery Process

Establishing Internet Connectivity

Layer 2 Addressing

Layer 2 characteristics:

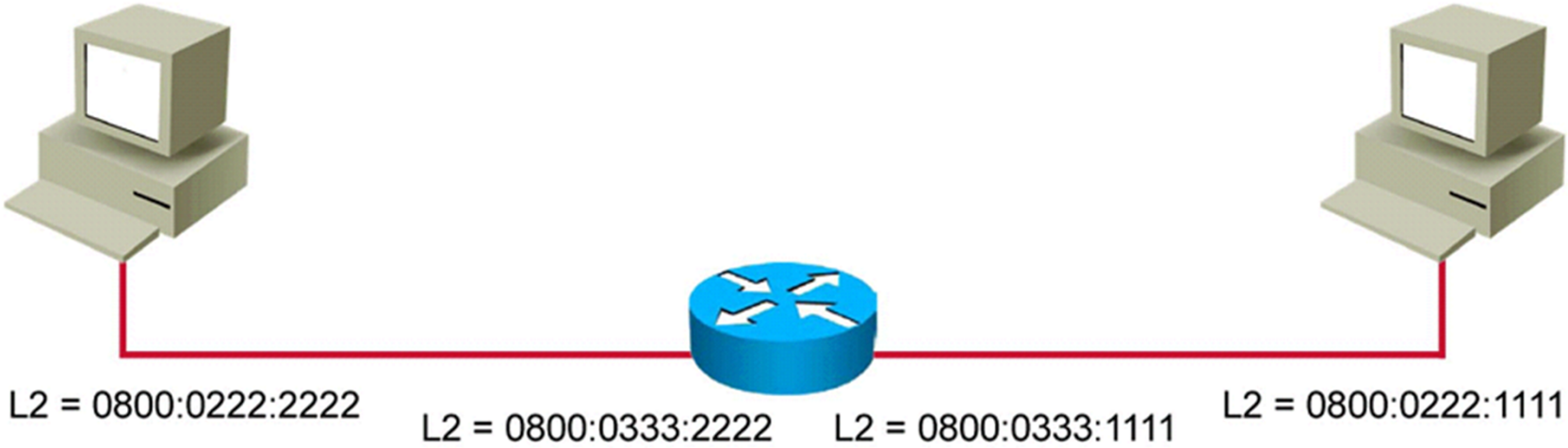
- Ethernet uses MAC addresses.
- Identifies end devices in the LAN.
- Enables the packet to be carried by the local media across each segment.



Layer 2 Addressing (Cont.)

Layer 2 addressing:

- The router has two interfaces directly connected to two PCs.
- Each PC and each router interface has its own unique MAC address.

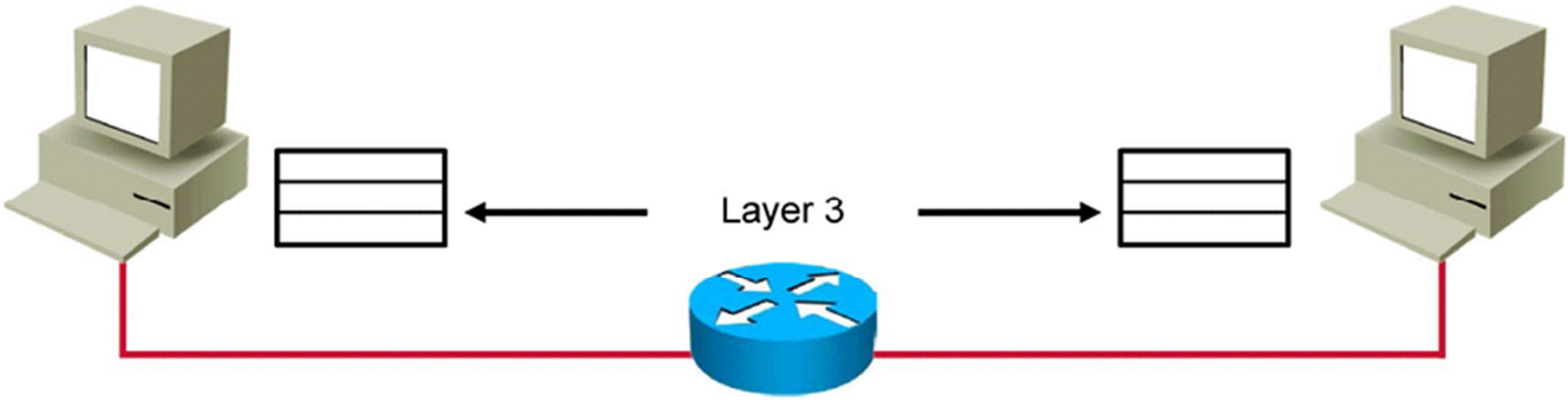


L2 = Layer 2

Layer 3 Addressing

Layer 3 devices and functions:

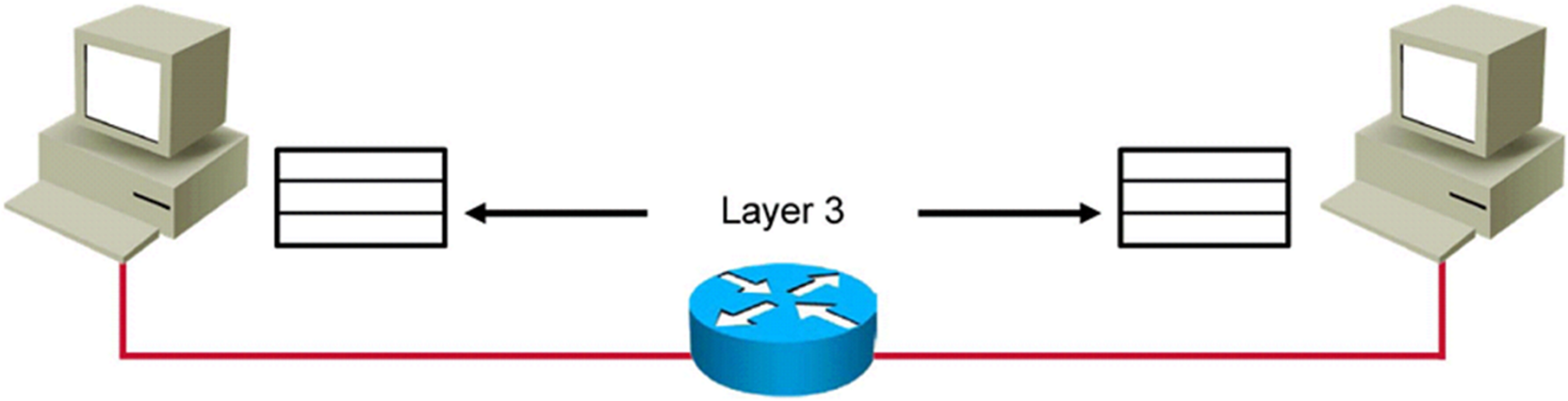
- The network layer provides connectivity and path selection between two host systems.
- In the host, this is the path between the data link layer and the upper layers.
- In the router, it is the actual path across the network.



Layer 3 Addressing (Cont.)

Layer 3 addressing:

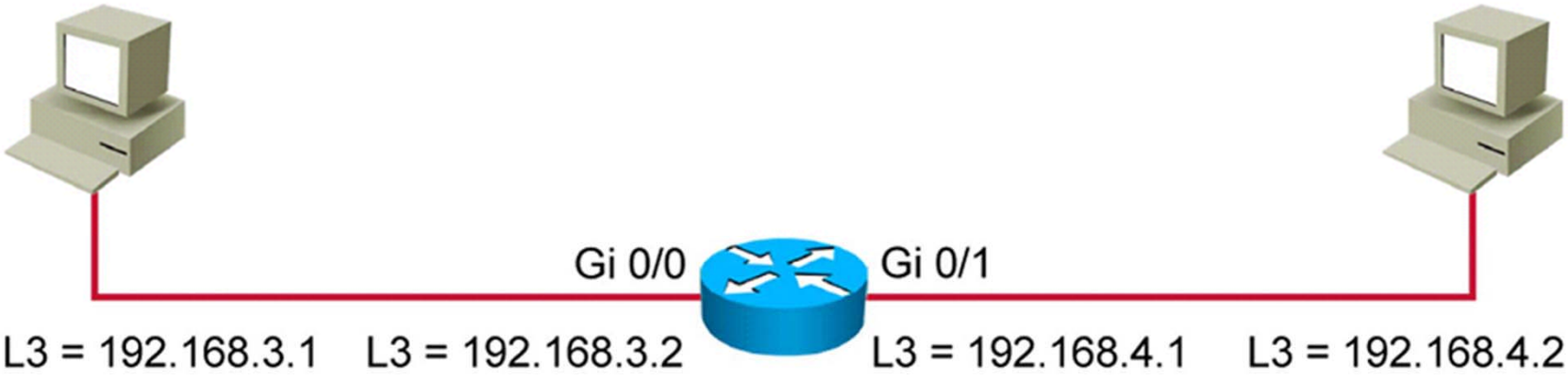
- Layer 3 addresses must include identifiers that enable intermediary network devices to locate hosts on different networks.
- TCP/IP protocol stack uses IP.



Layer 3 Addressing (Cont.)

- Layer 3 addresses are assigned to hosts and network devices that provide Layer 3 functions.
- Network devices maintain a routing table.

Routing Table	
192.168.3.0/24	Interface Gi0/0
192.168.4.0/24	Interface Gi0/1

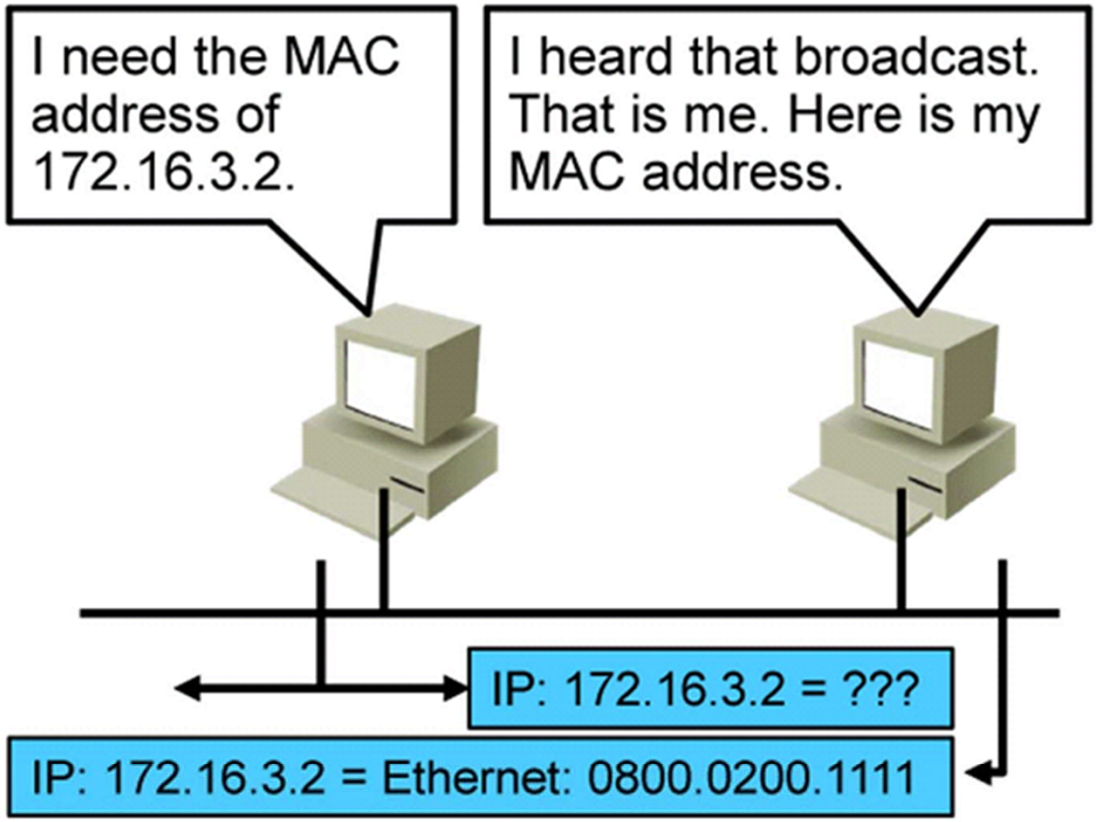


L3 = Layer 3

Address Resolution Protocol

ARP provides two basic functions:

- Resolving IP addresses to MAC addresses
- Maintaining a cache of mappings



Map IP ⟶ Ethernet

Local ARP

Address Resolution Protocol (Cont.)

The ARP table keeps a record of recent bindings of IP addresses to MAC addresses.

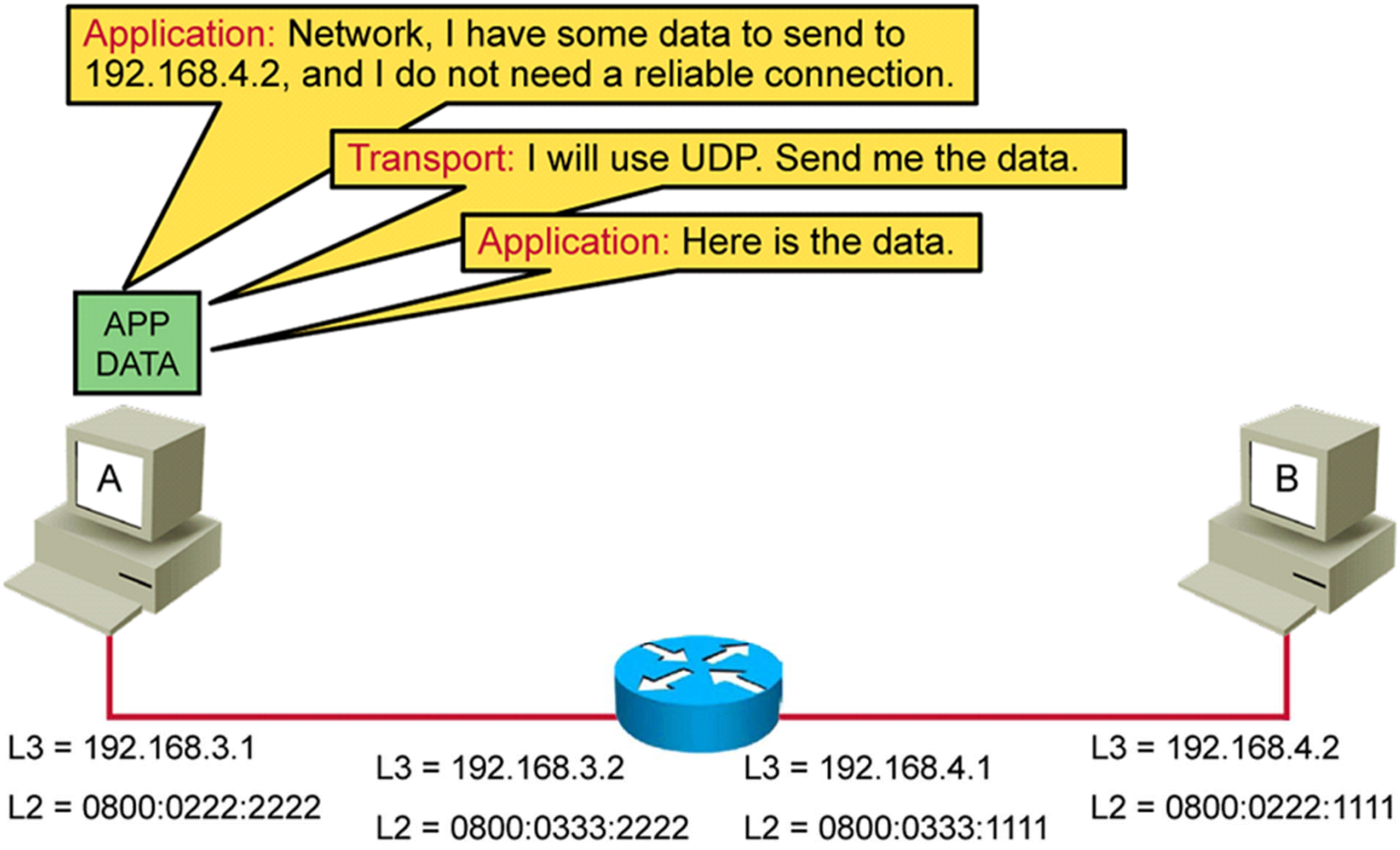
On the PC:

```
C:\Windows\system32>arp -a
Interface: 192.168.250.11 --- 0xb
  Internet Address      Physical Address      Type
  192.168.250.1         00-1b-0c-5d-91-0f     dynamic
  192.168.250.12        00-0c-29-13-cc-bf     dynamic
```

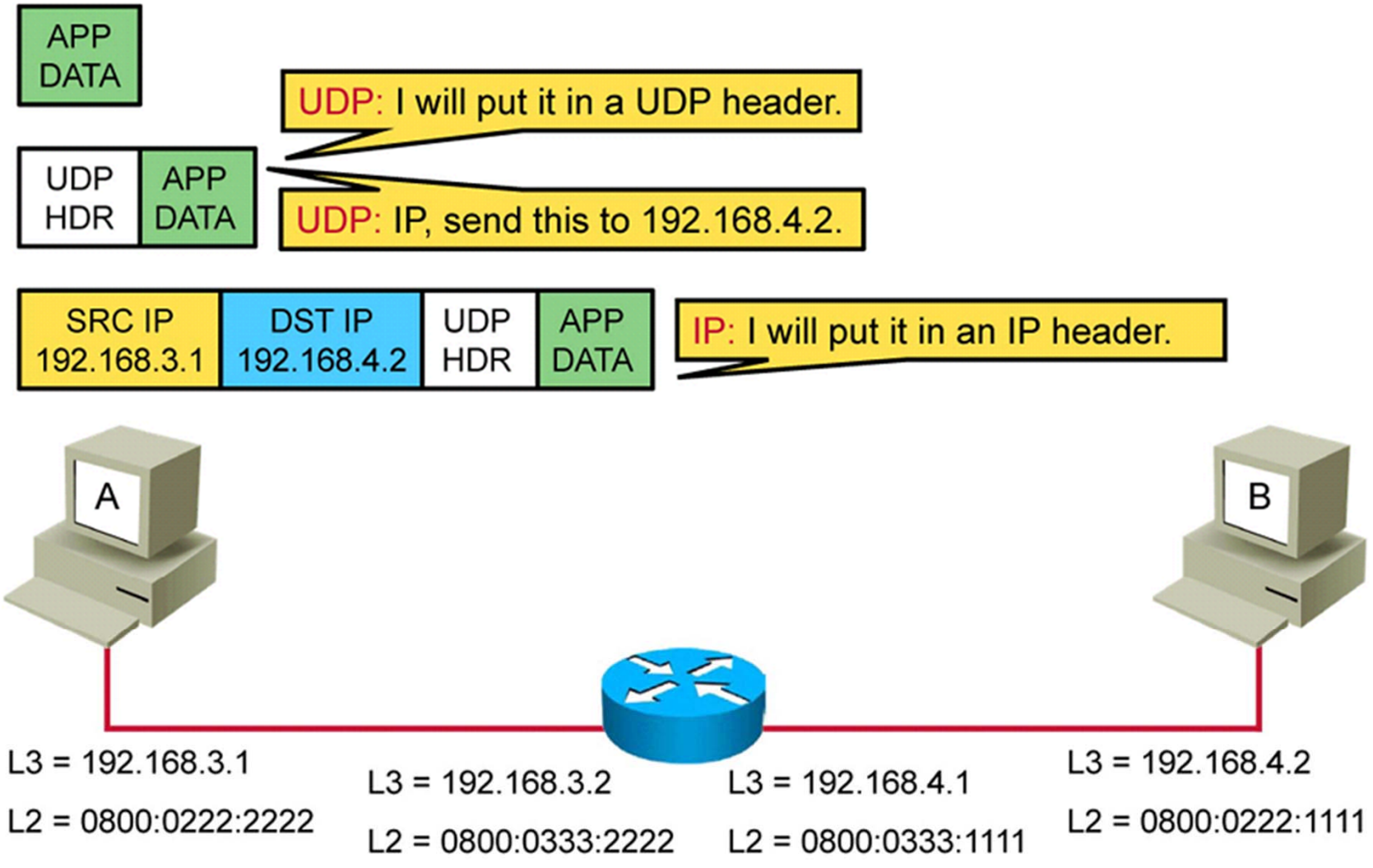
On the router:

```
Branch#show ip arp
Protocol  Address          Age (min)  Hardware Addr   Type   Interface
Internet  10.1.1.100             5   000c.2993.6a84  ARPA
GigabitEthernet0/0
Internet  10.1.1.101             4   000c.2913.ccc9  ARPA
GigabitEthernet0/0
```

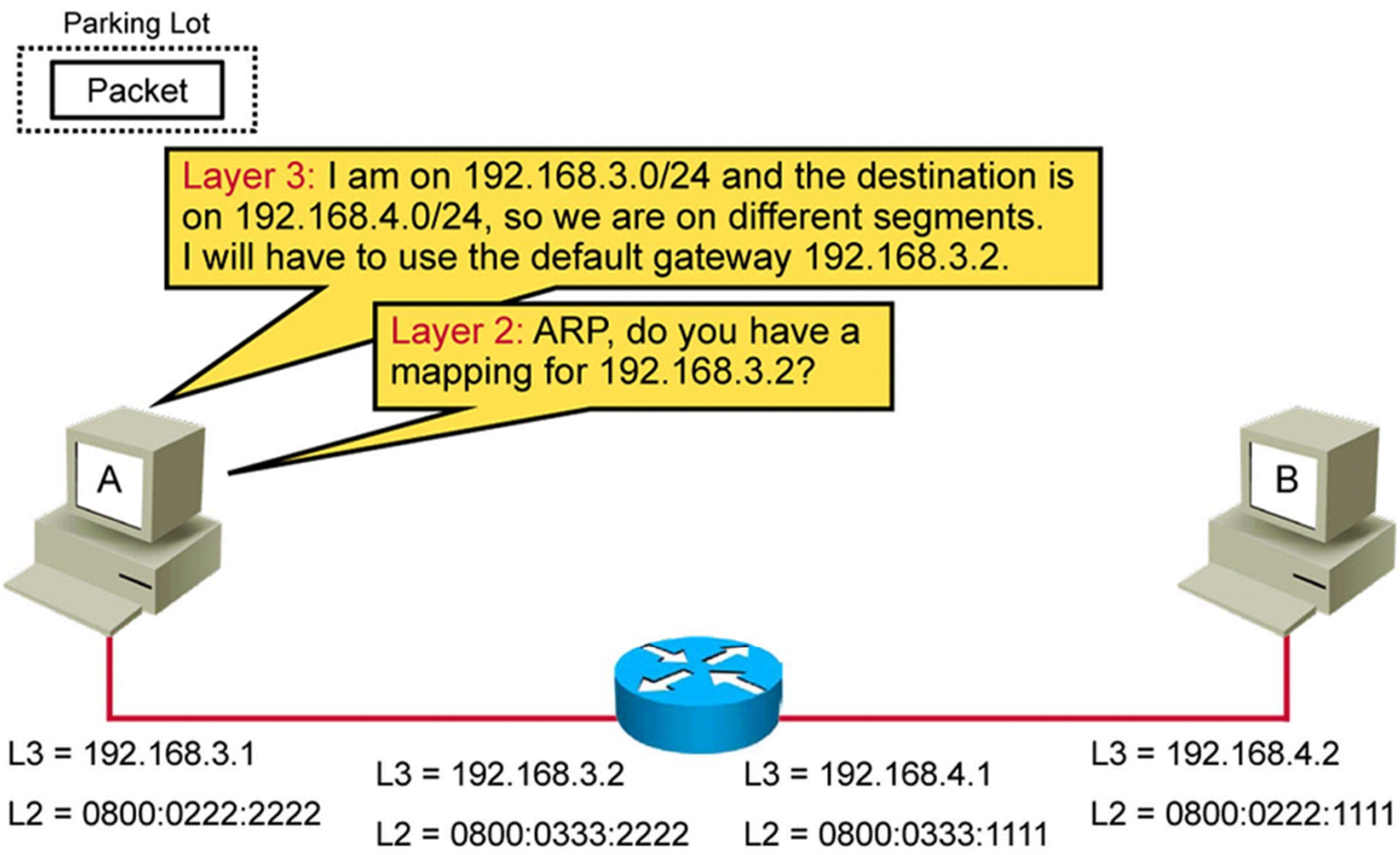
Host-to-Host Packet Delivery (Step 1 of 16)



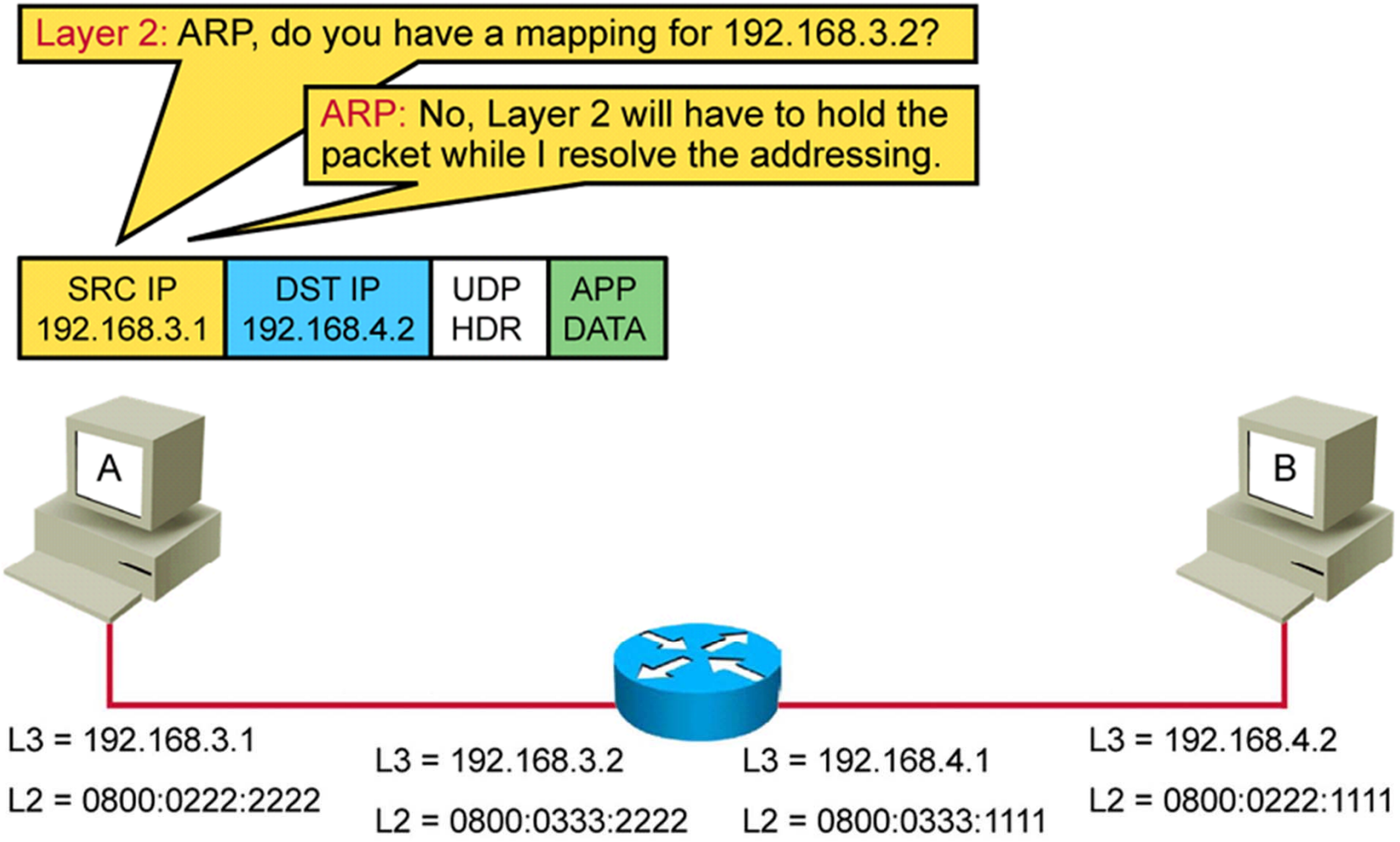
Host-to-Host Packet Delivery (Step 2 of 16)



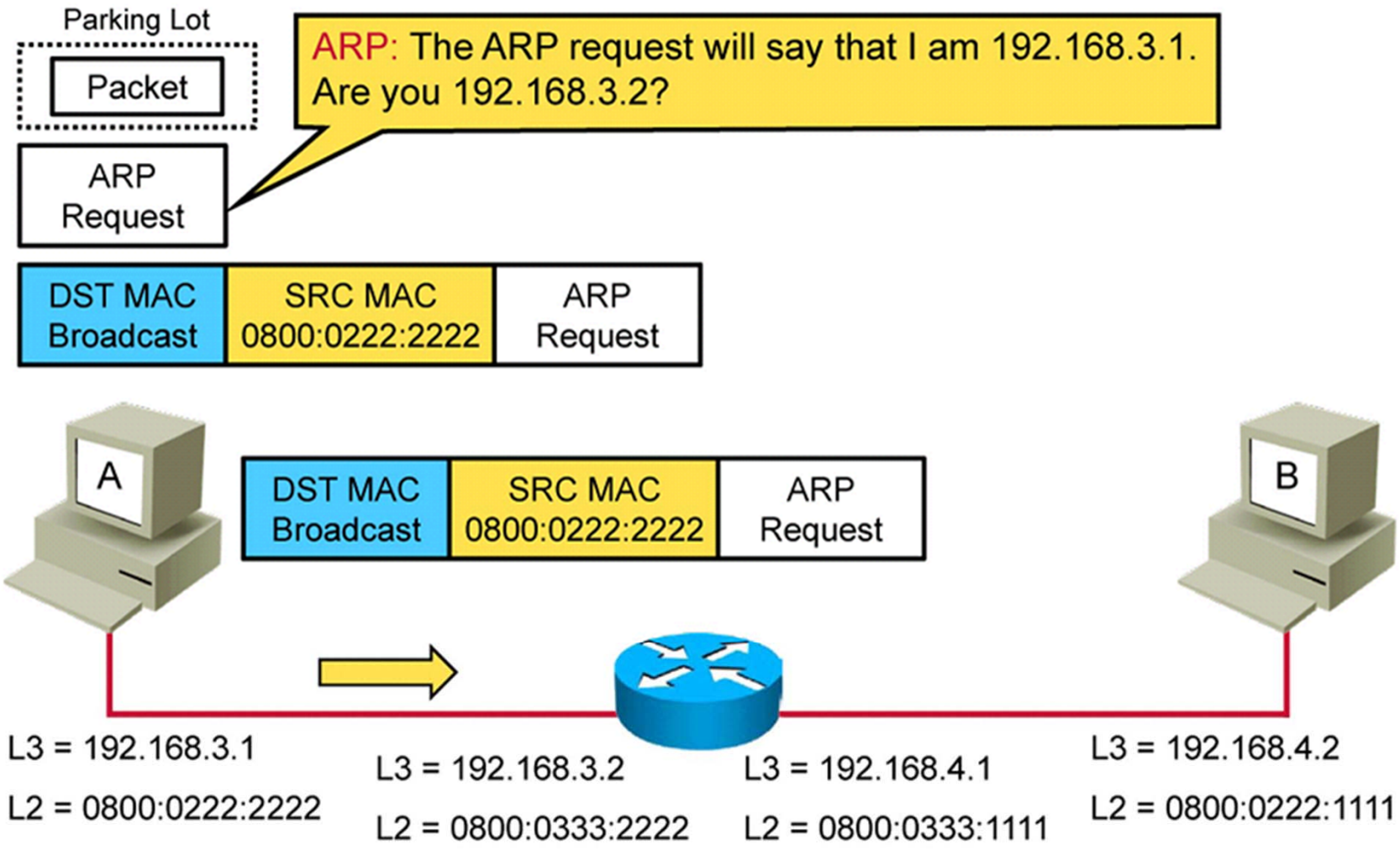
Host-to-Host Packet Delivery (Step 3 of 16)



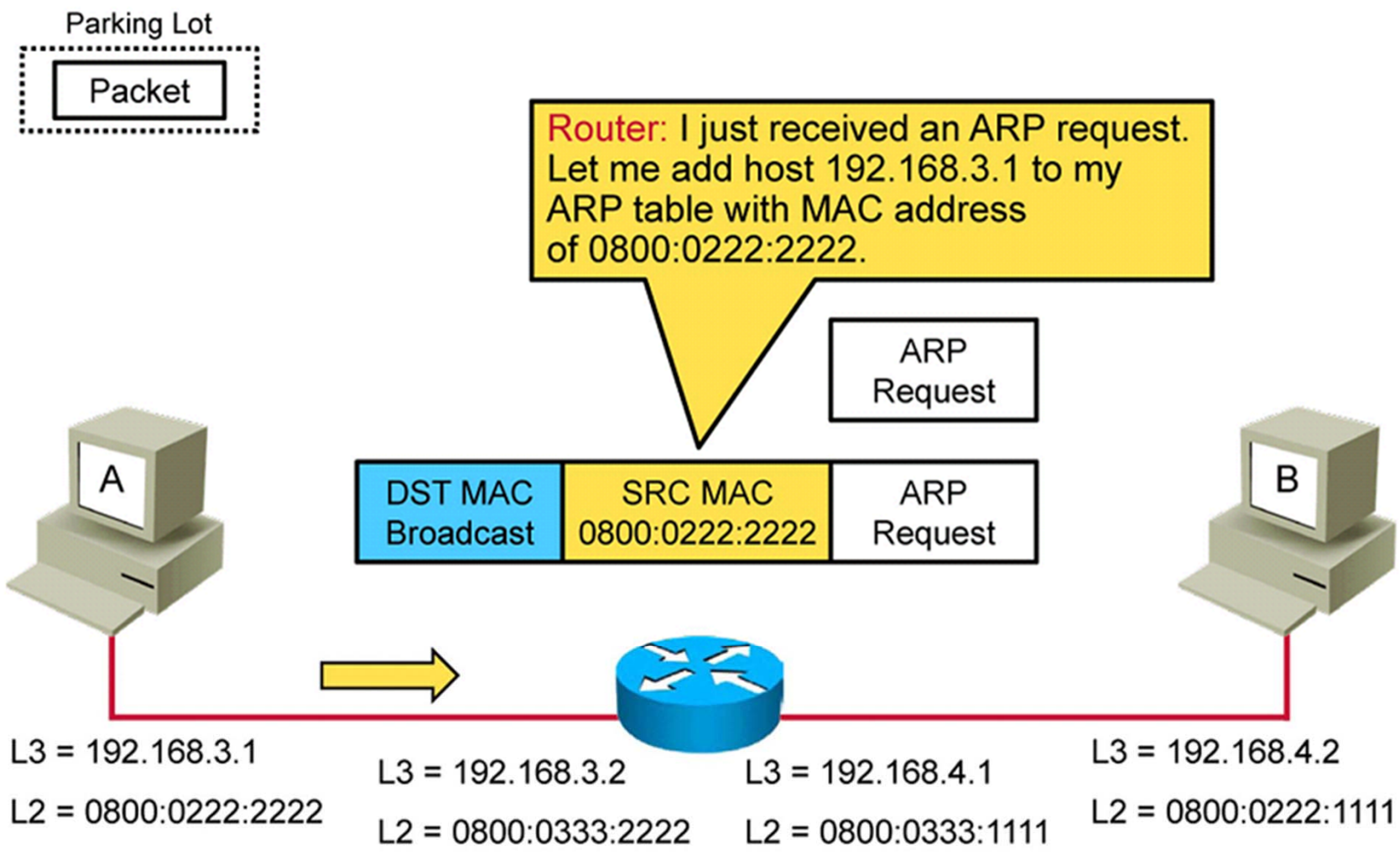
Host-to-Host Packet Delivery (Step 4 of 16)



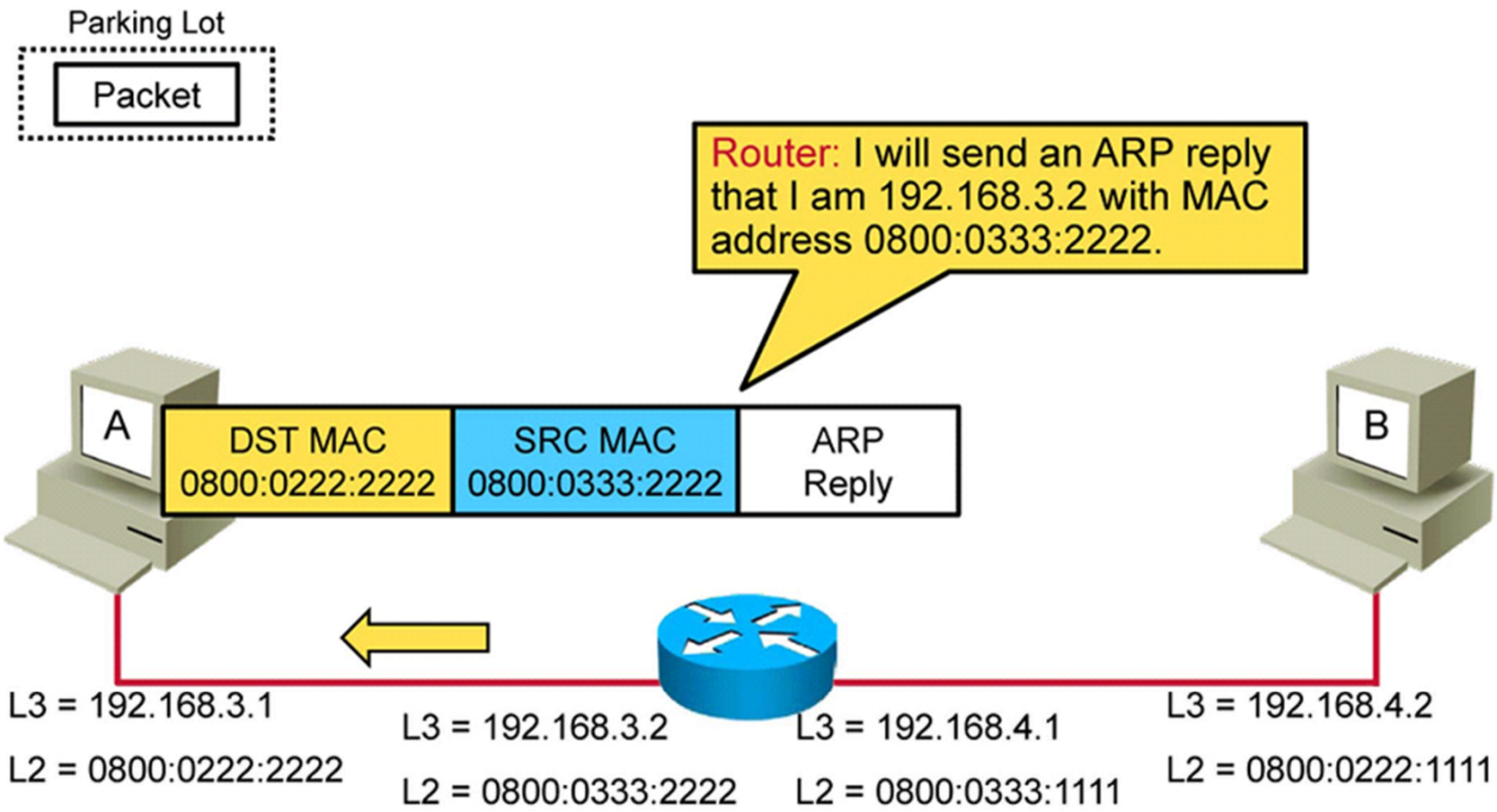
Host-to-Host Packet Delivery (Step 5 of 16)



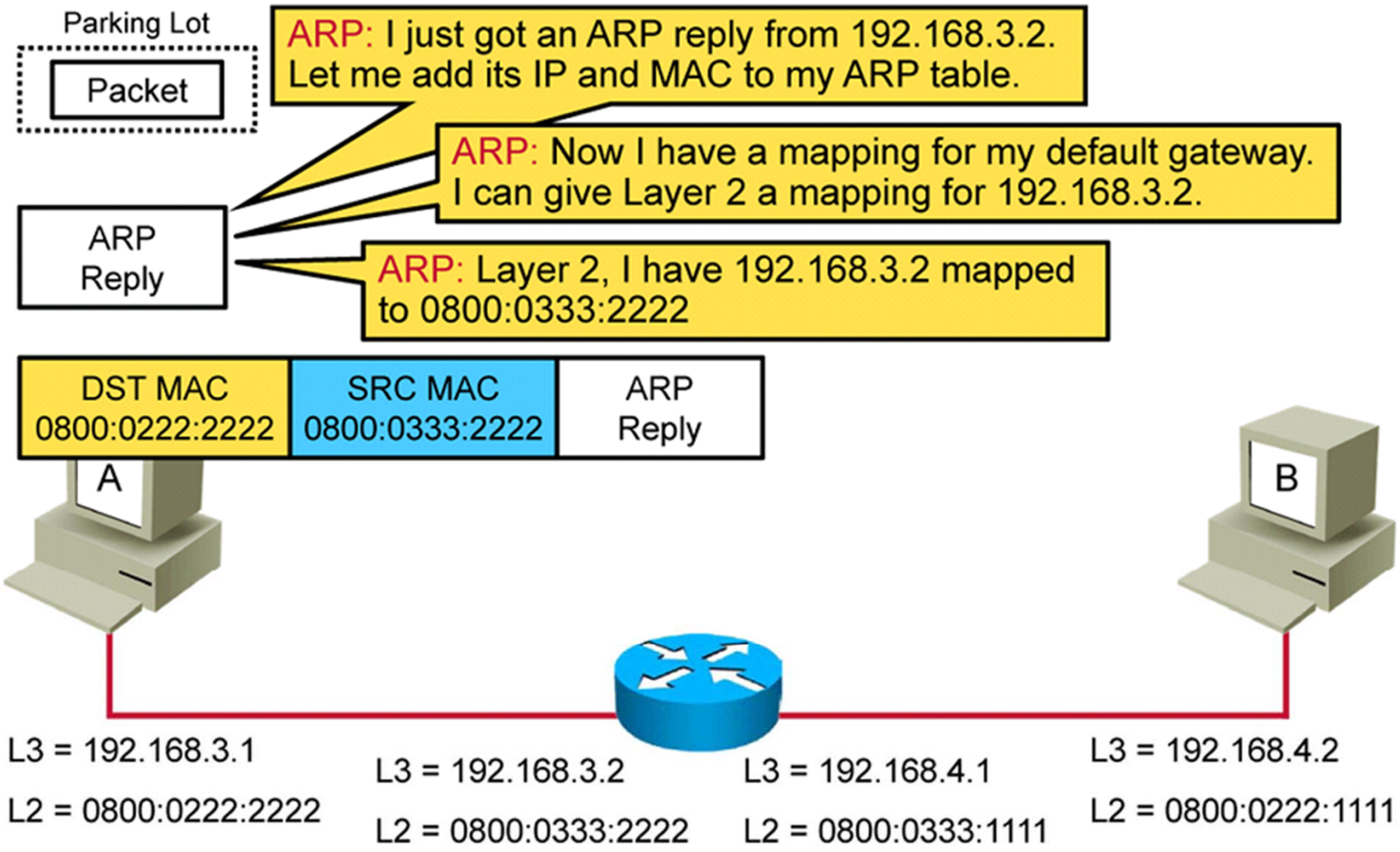
Host-to-Host Packet Delivery (Step 6 of 16)



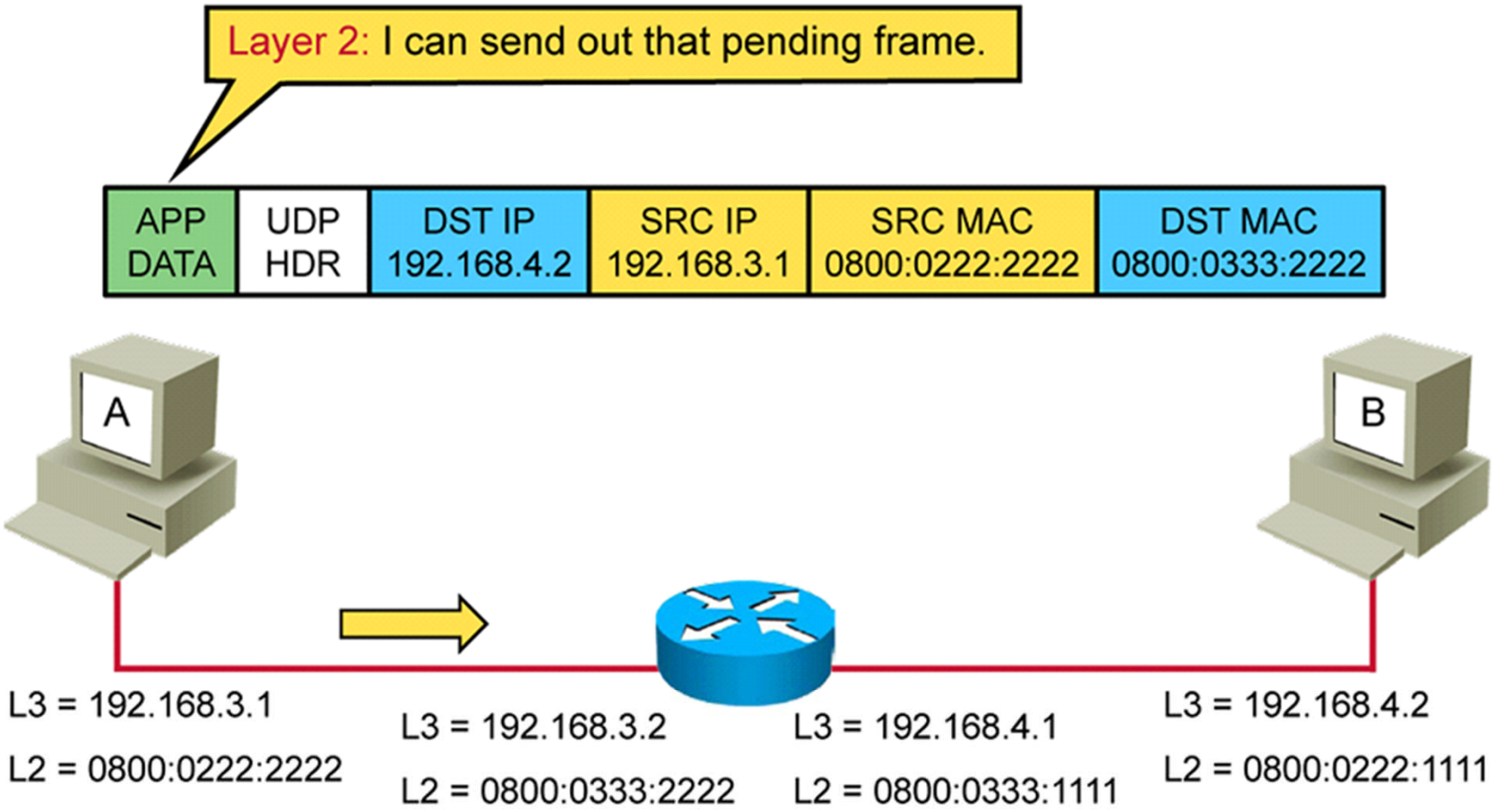
Host-to-Host Packet Delivery (Step 7 of 16)



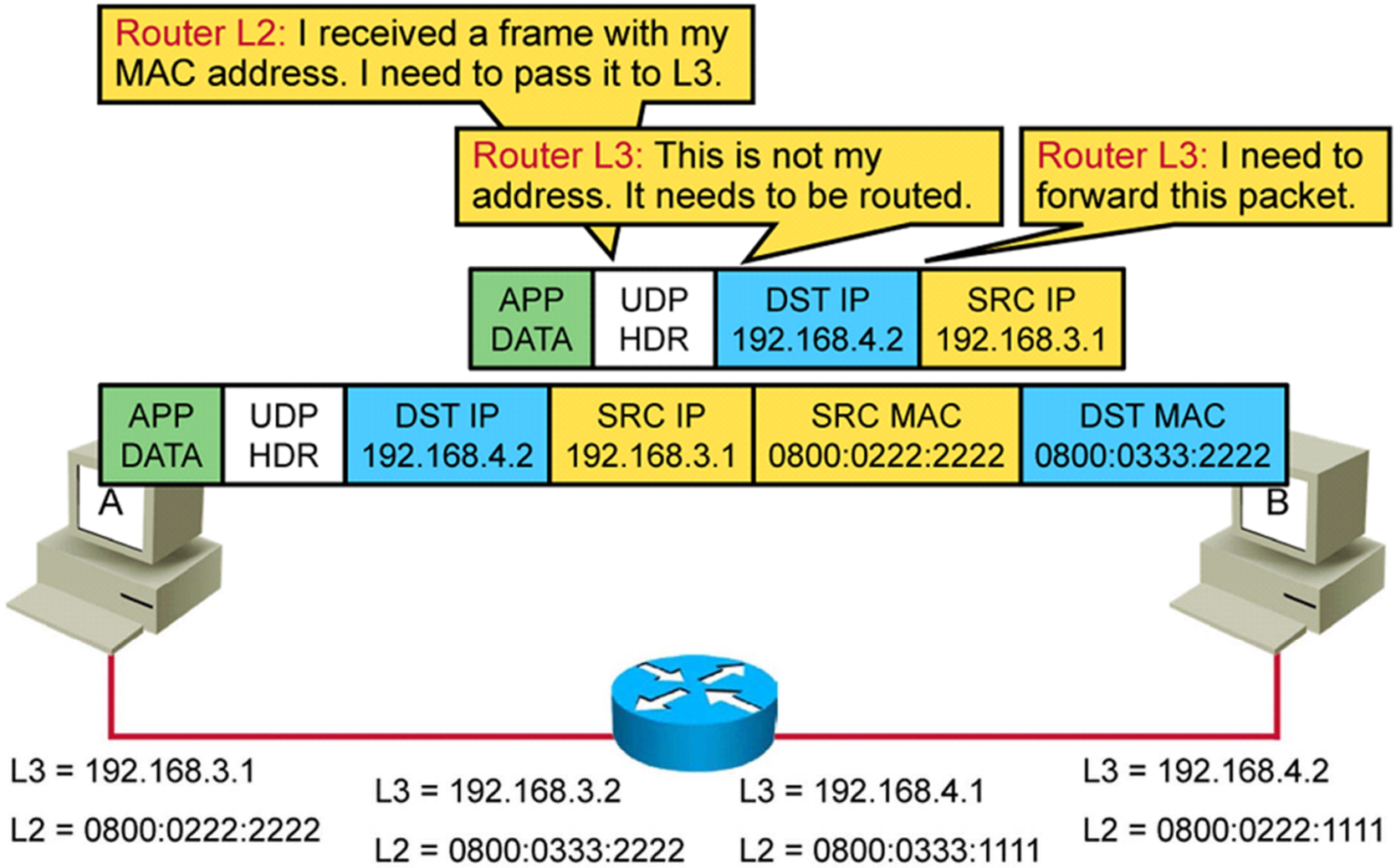
Host-to-Host Packet Delivery (Step 8 of 16)



Host-to-Host Packet Delivery (Step 9 of 16)

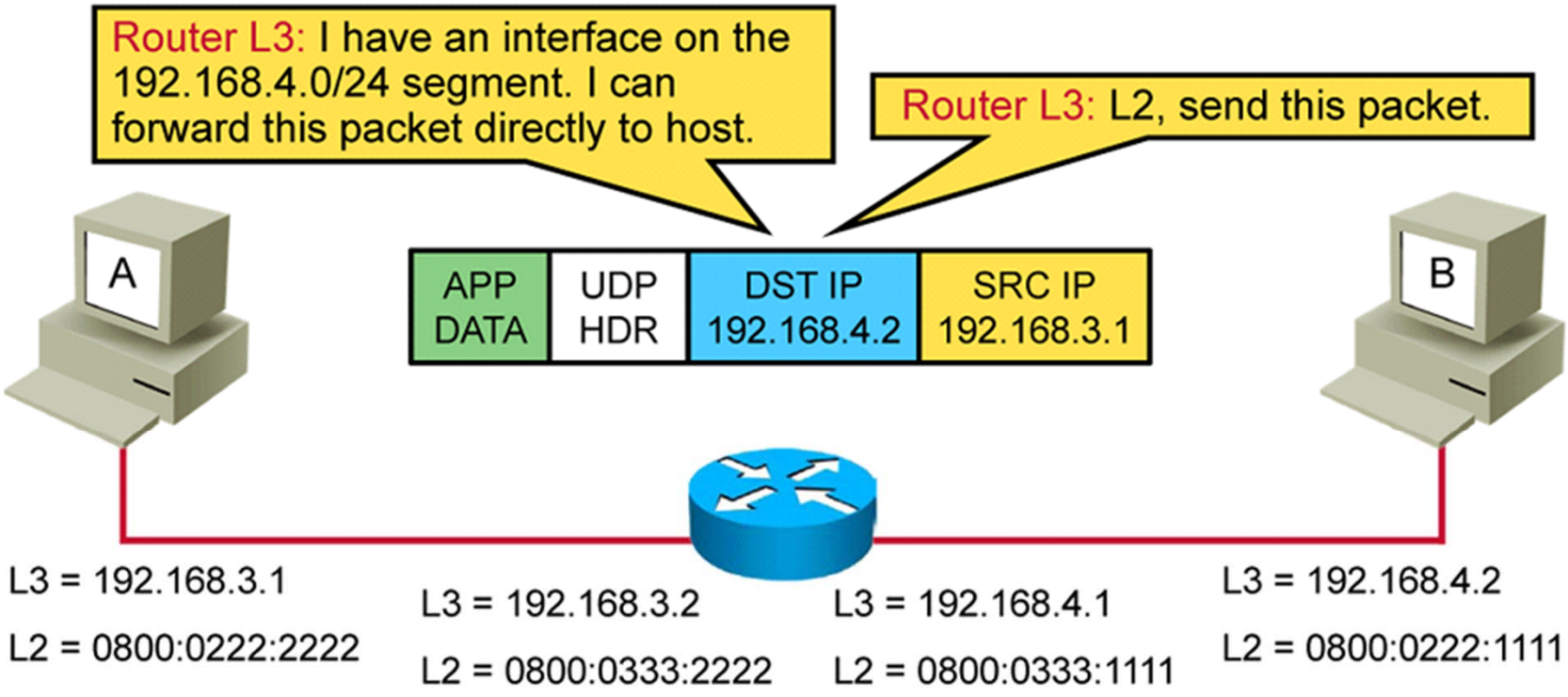


Host-to-Host Packet Delivery (Step 10 of 16)

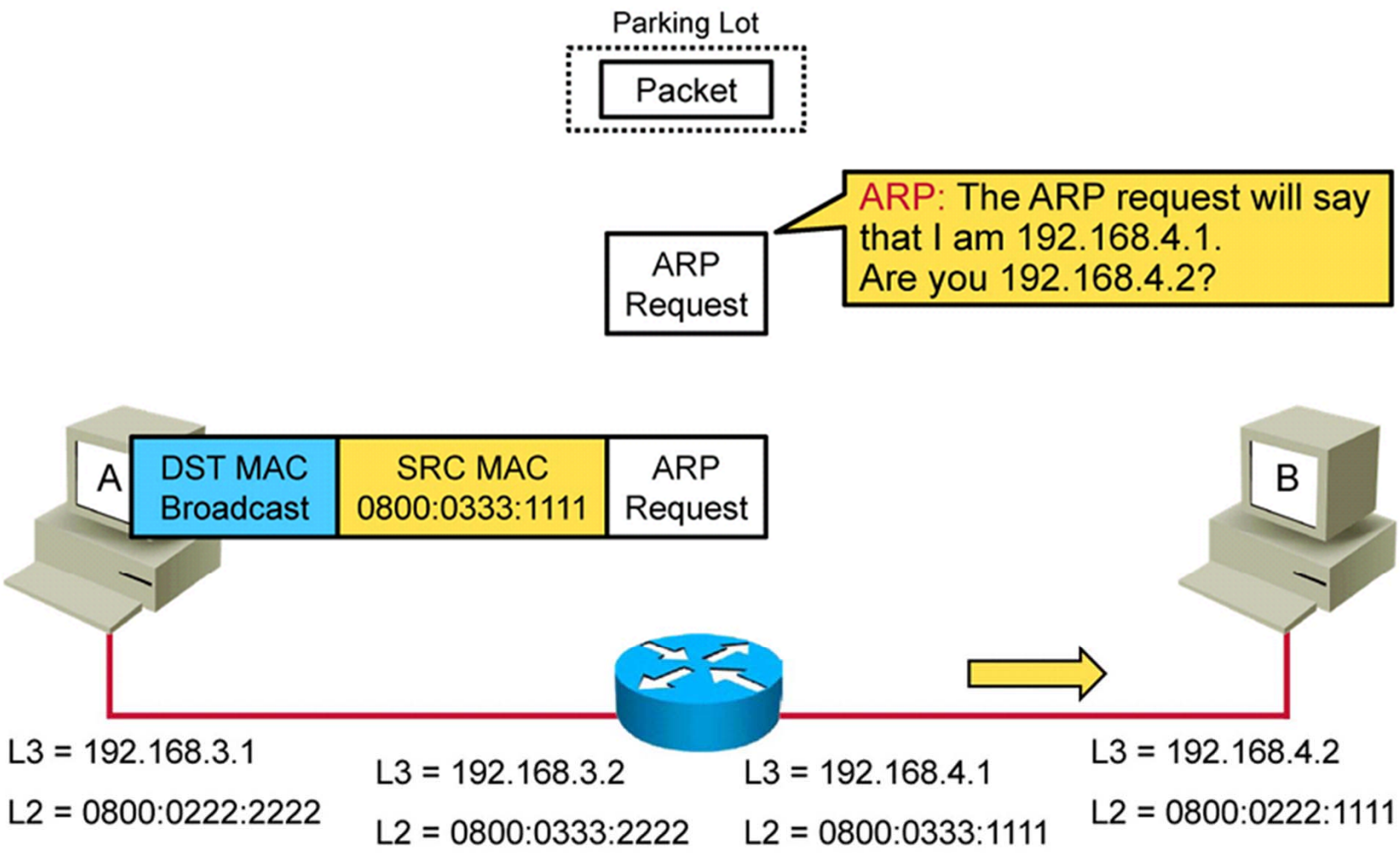


Host-to-Host Packet Delivery (Step 11 of 16)

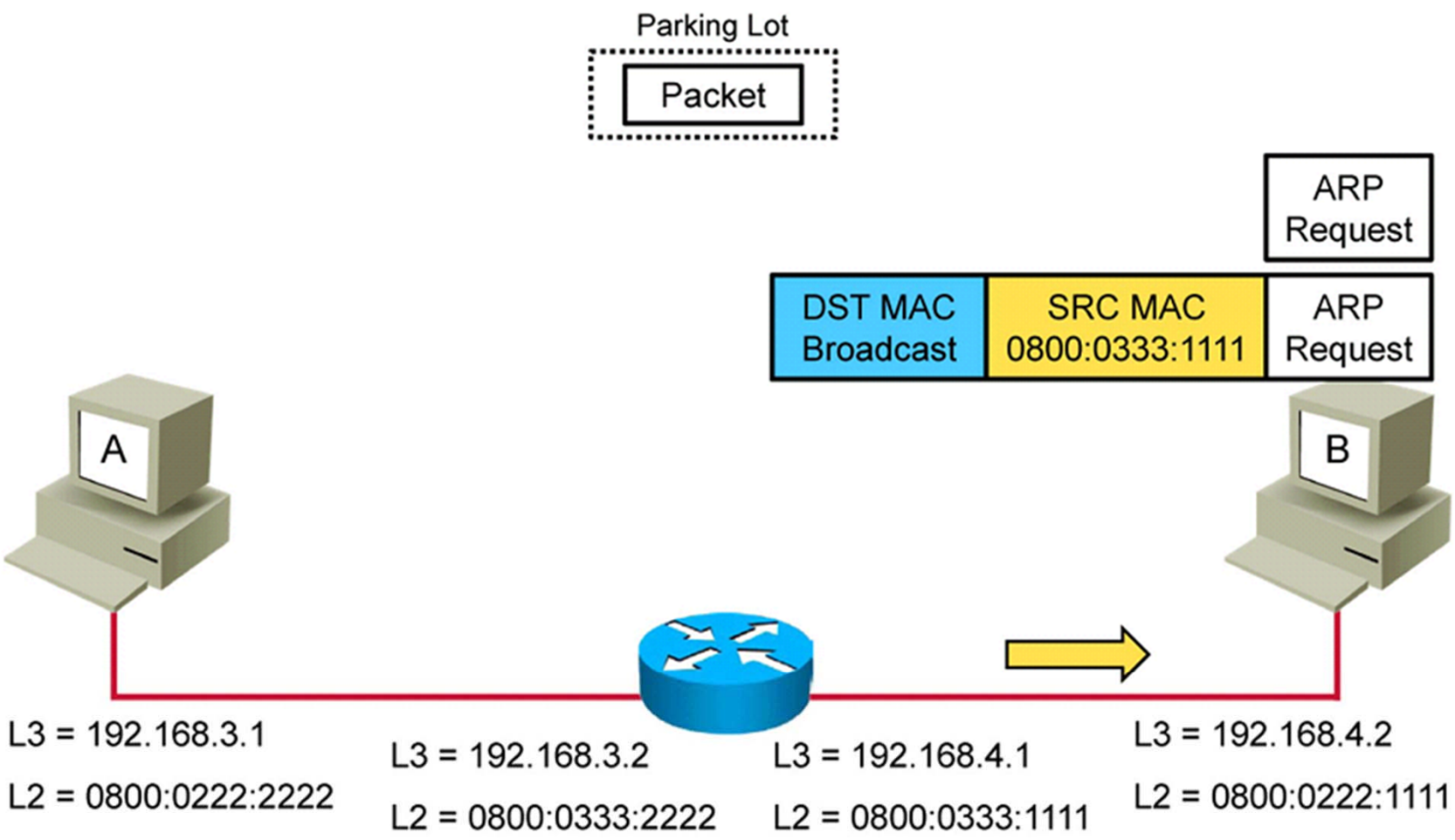
Destination	Next Hop	Interface
192.168.3.0/24	Connected	Gi 0/0
192.168.4.0/24	Connected	Gi 0/1



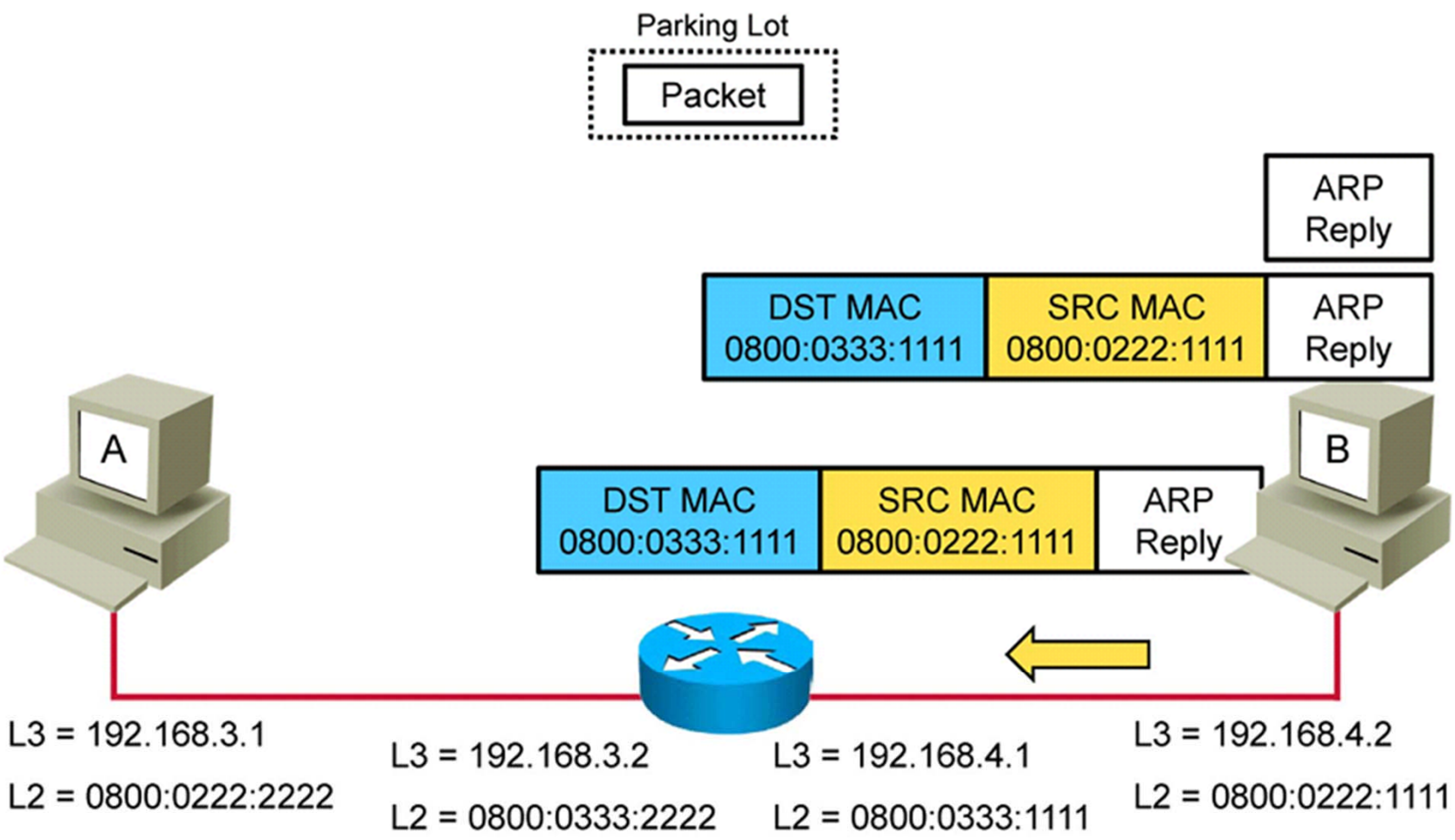
Host-to-Host Packet Delivery (Step 12 of 16)



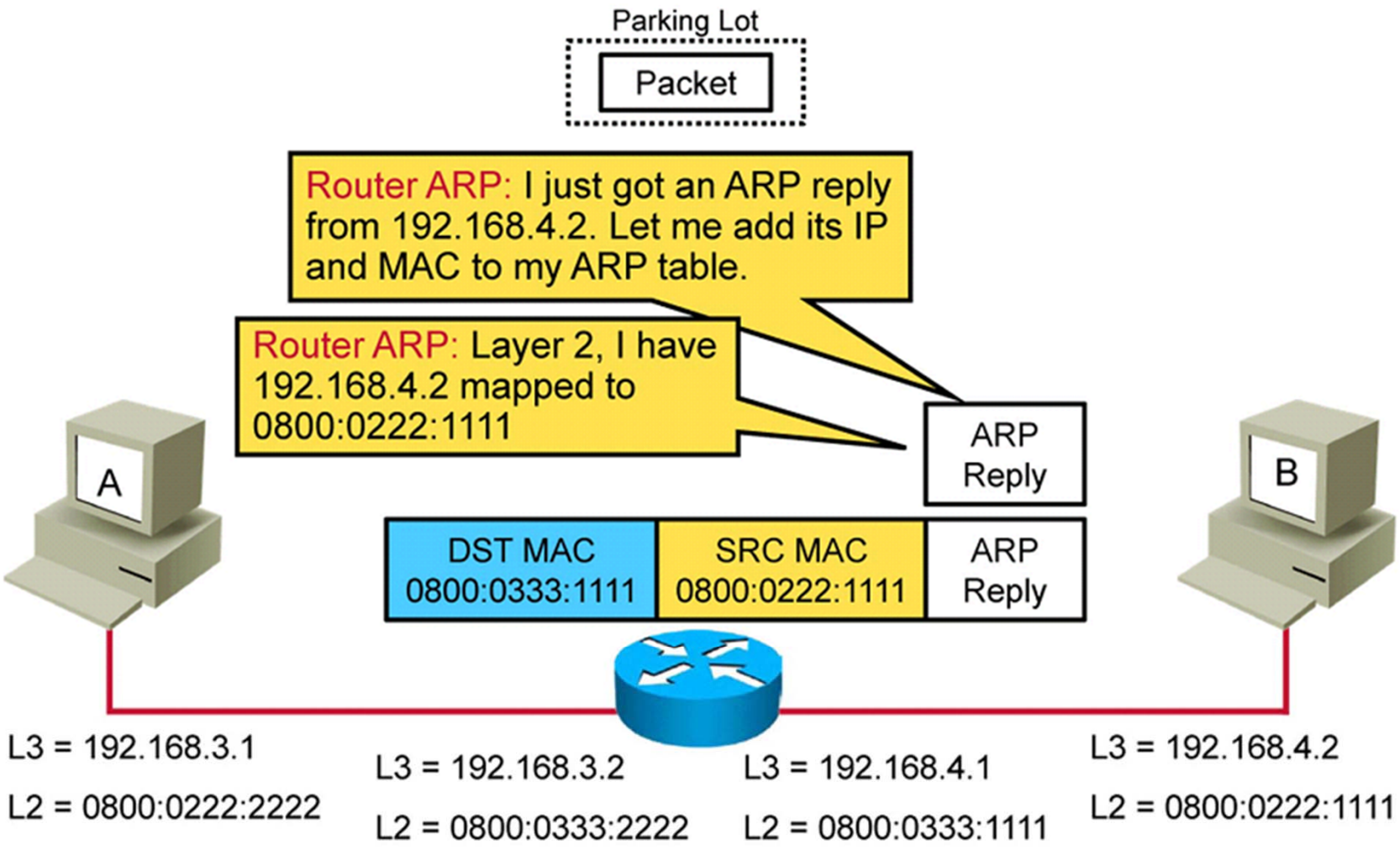
Host-to-Host Packet Delivery (Step 13 of 16)



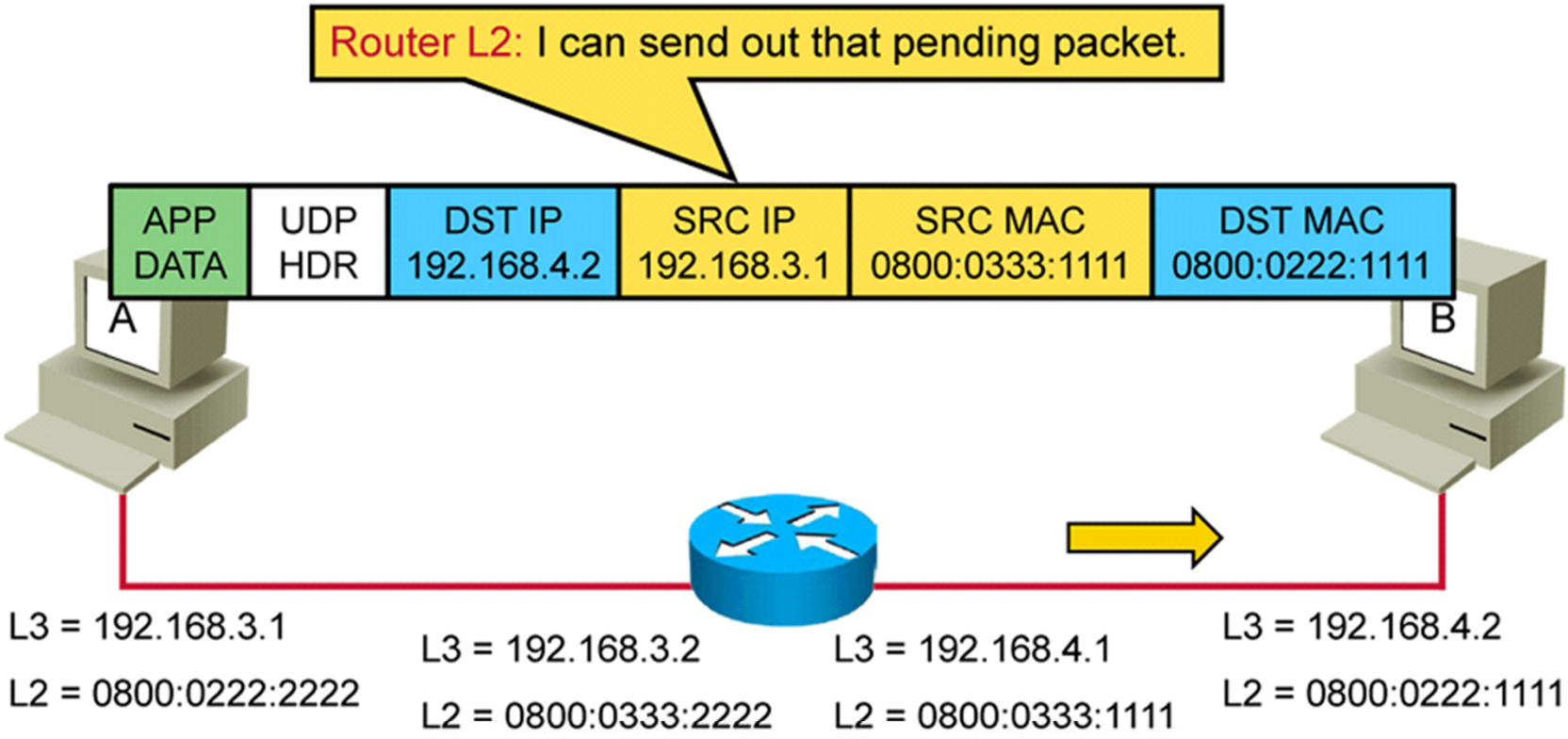
Host-to-Host Packet Delivery (Step 14 of 16)



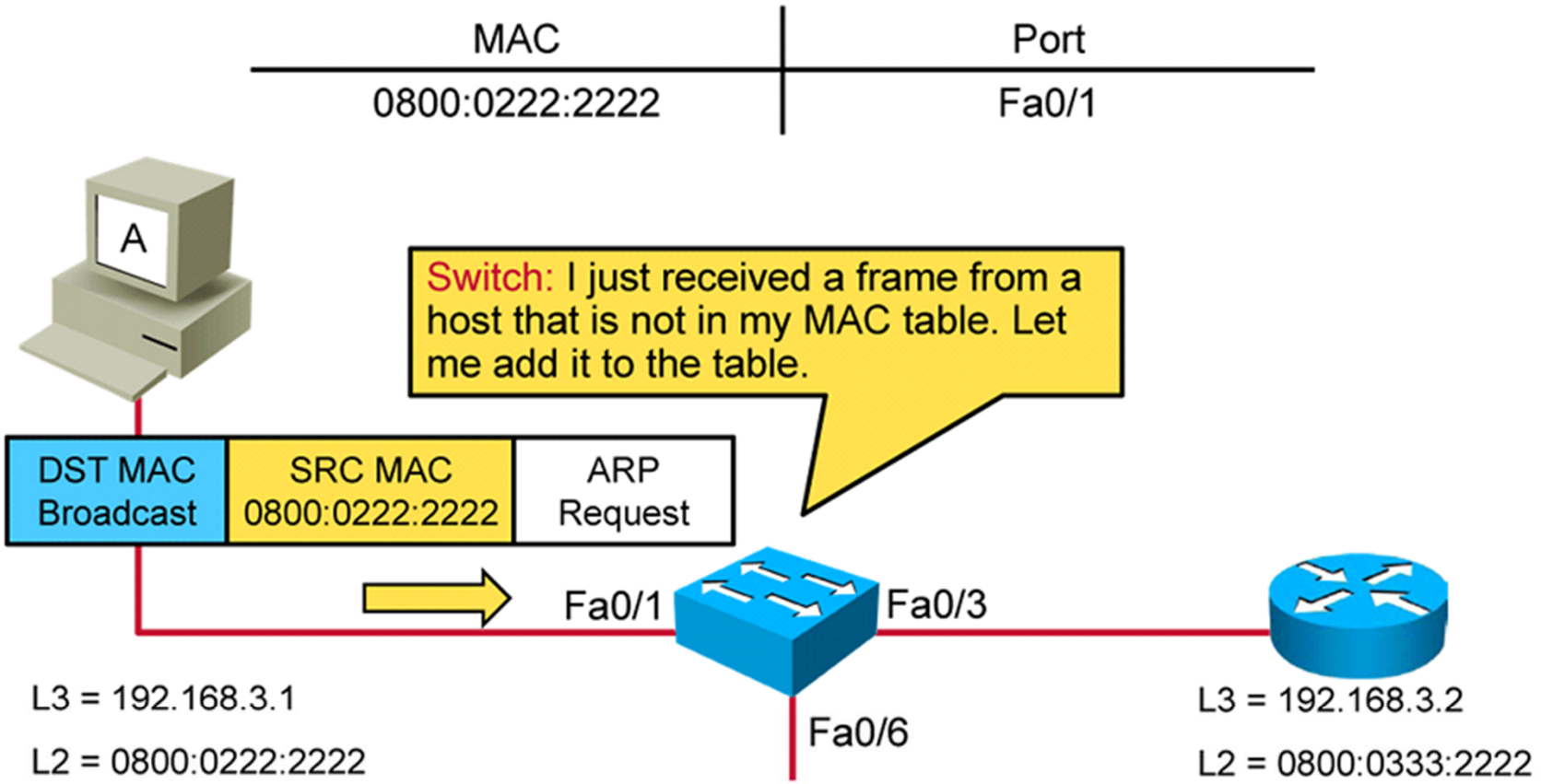
Host-to-Host Packet Delivery (Step 15 of 16)



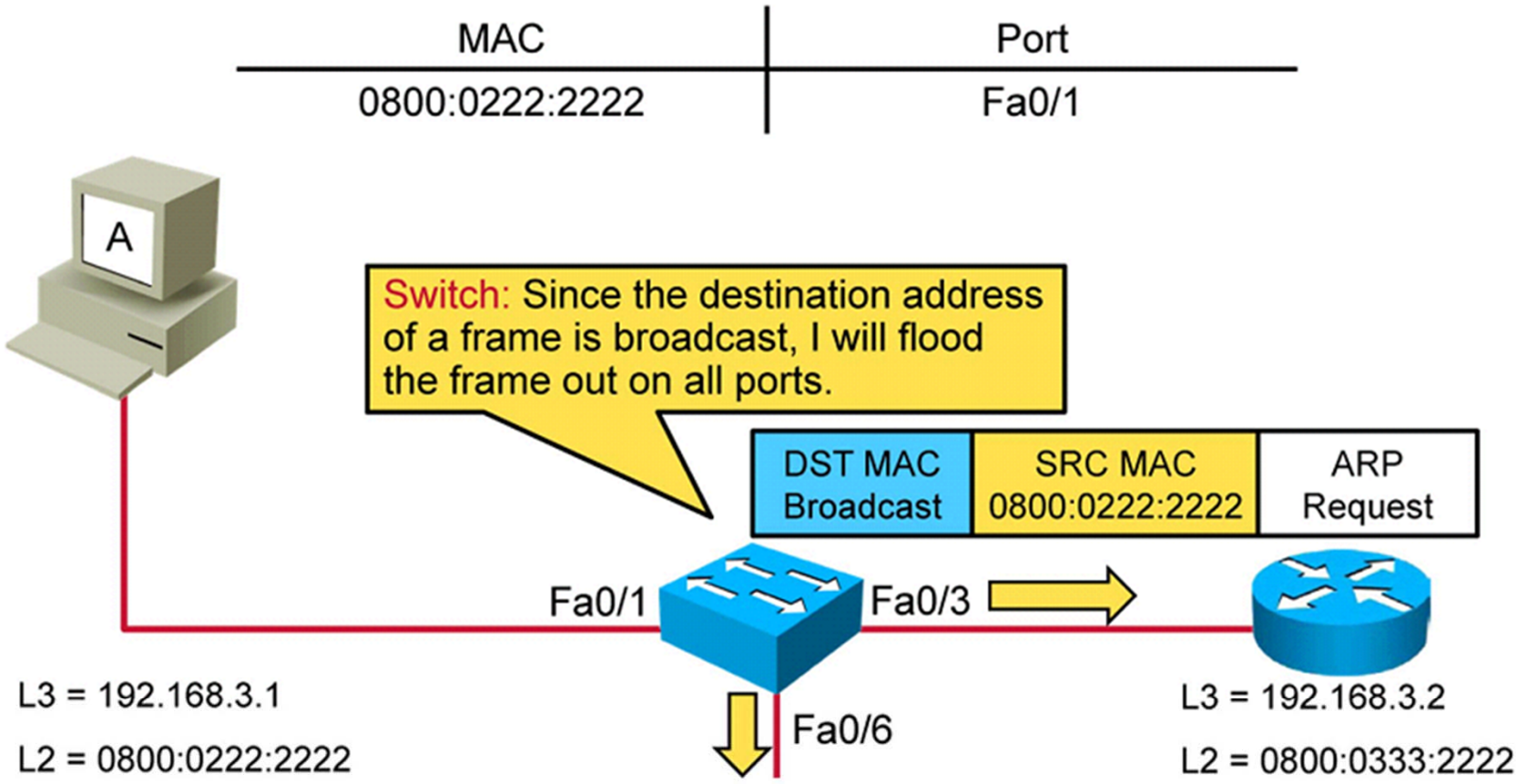
Host-to-Host Packet Delivery (Step 16 of 16)



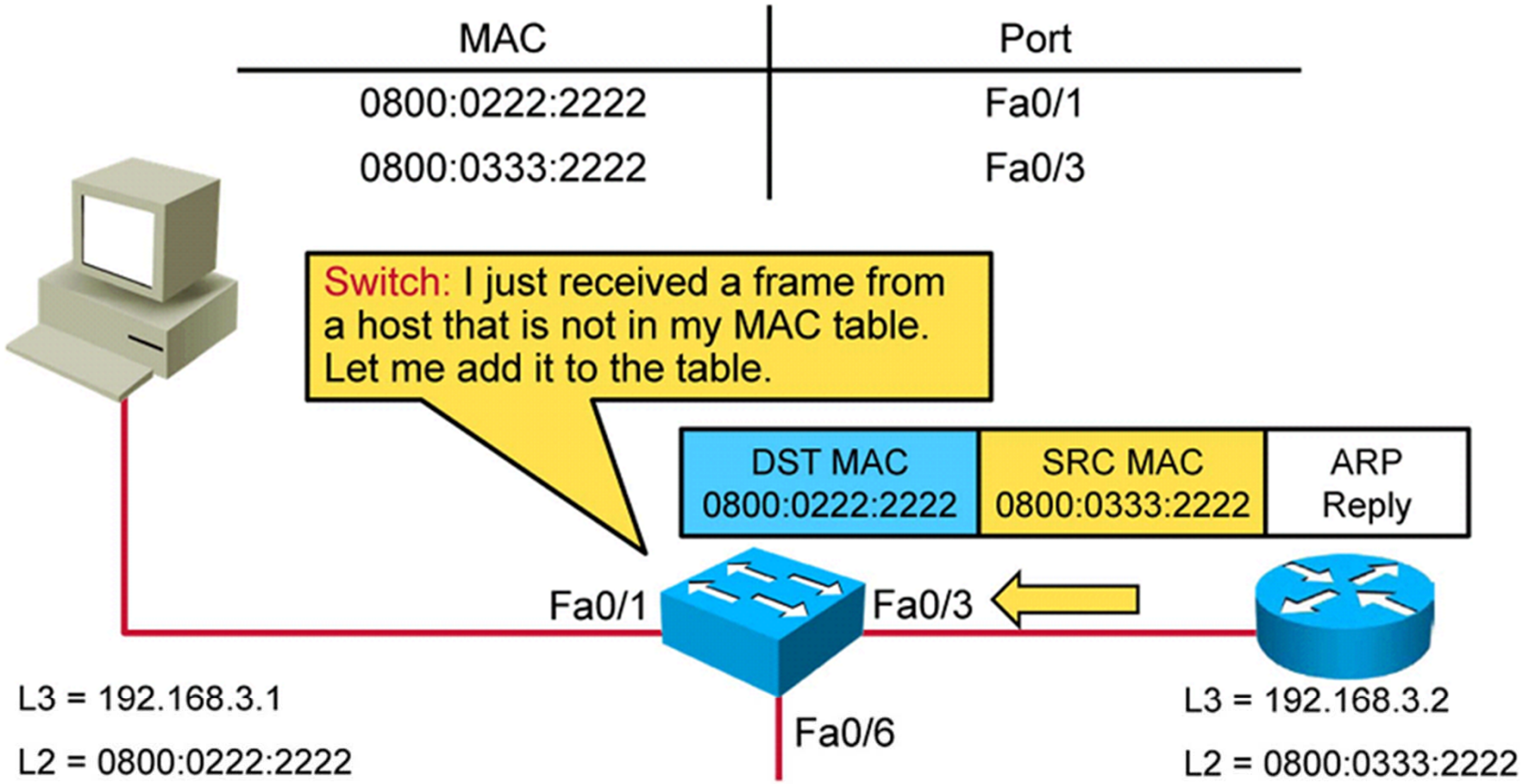
Role of a Switch in Packet Delivery (Step 1 of 4)



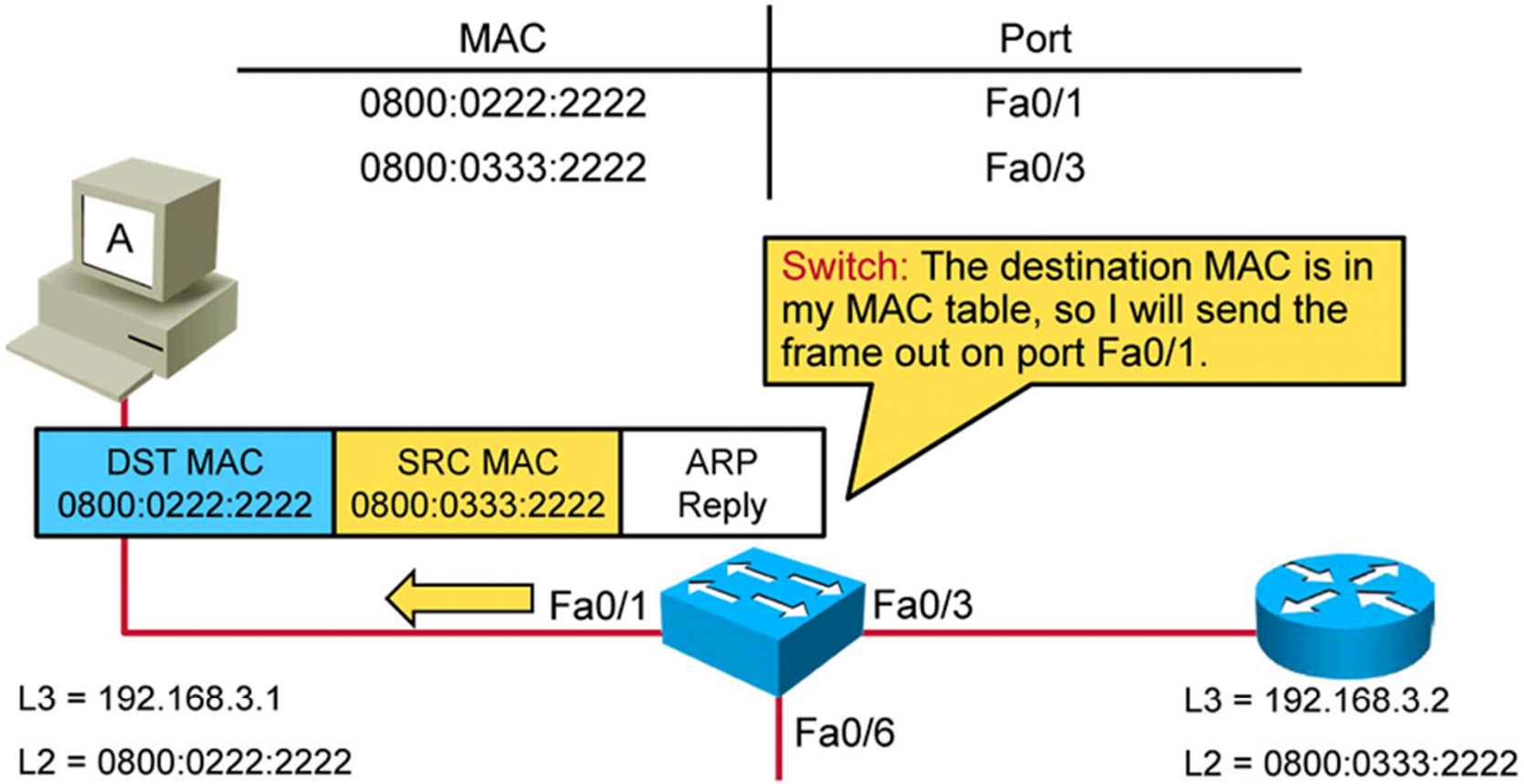
Role of a Switch in Packet Delivery (Step 2 of 4)



Role of a Switch in Packet Delivery (Step 3 of 4)



Role of a Switch in Packet Delivery (Step 4 of 4)



Summary

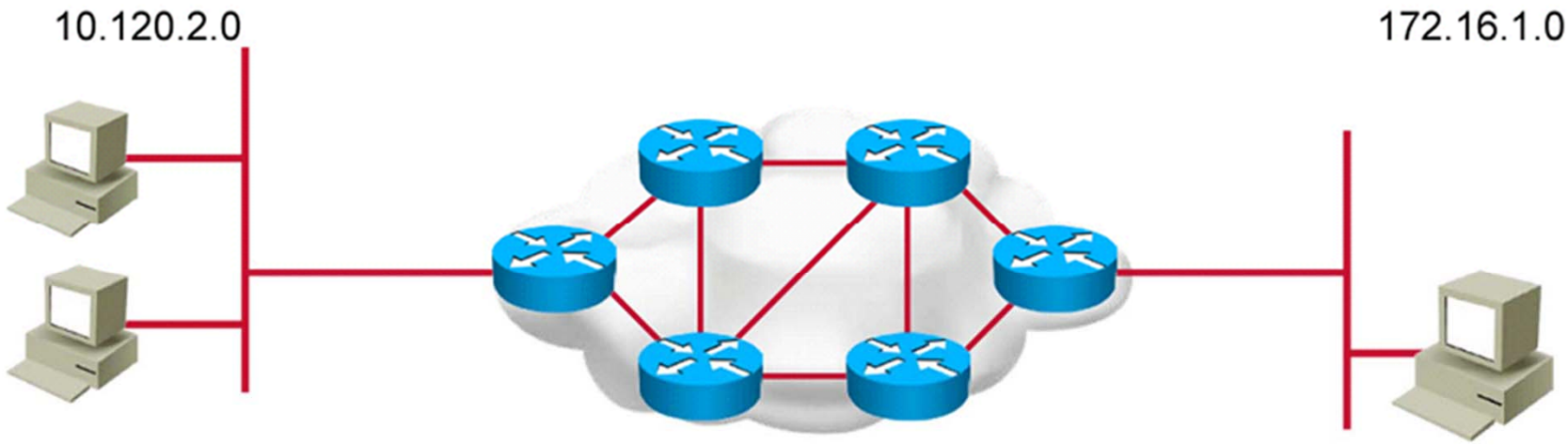
- If hosts are not in the same network, the frame is sent to the default gateway.
- Frames sent to the default gateway have the local host source MAC address and the default gateway destination MAC address.
- A router changes the Layer 2 address as needed, but it does not change the Layer 3 address.
- The switch does not change the frame in any way, it just forwards the frame out on the proper port according to the MAC address table.

Enabling Static Routing

Establishing Internet Connectivity

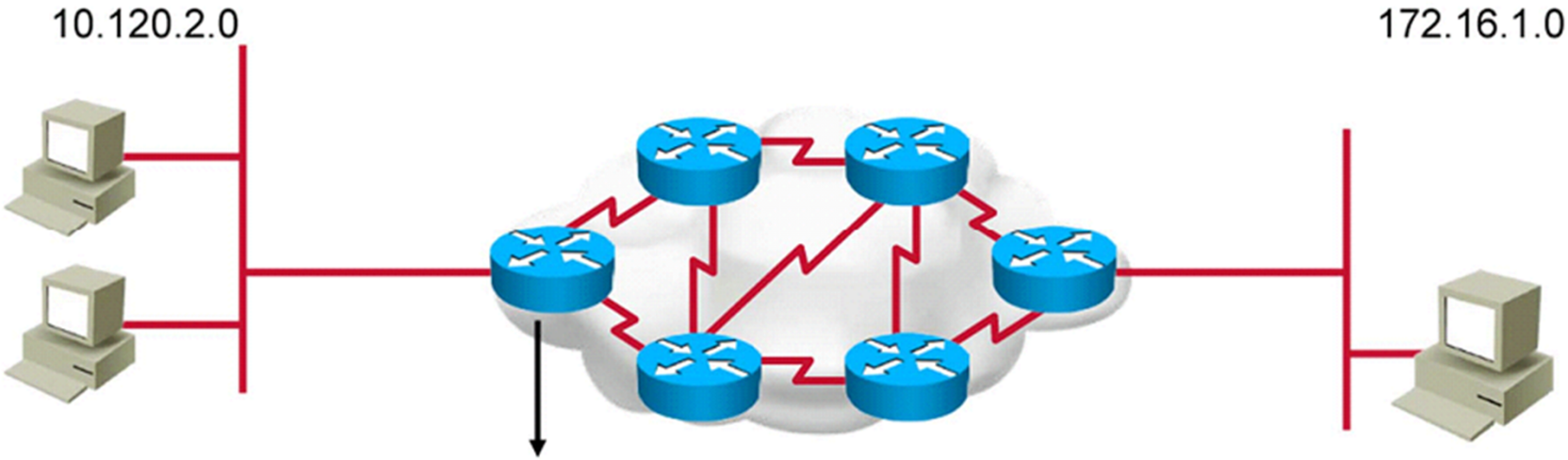
Routing Operations

- Path identification and selection:
  - Discovers possible routes to the intended destination
  - Selects the best route
  - Maintains and verifies the routing information
- Packet forwarding:
  - Router identifies the destination address



Routing Operations (Cont.)

- A router must learn about destinations that are not directly connected to it.
- The routing table is used to determine the best path to the destination.



Network Protocol	Destination Network	Exit Interface	Next Hop
Connected	10.120.2.0	fa0/0	
Learned	172.16.1.0	s0/0/0	172.20.1.2

Static and Dynamic Routing Comparison

Static routes:

- A network administrator manually enters static routes into the router.
- A network topology change requires a manual update to the route.
- Routing behavior can be precisely controlled.

Dynamic routes:

- A network routing protocol automatically adjusts dynamic routes when the topology or traffic changes.
- Routers learn and maintain routes to the remote destinations by exchanging routing updates.
- Routers discover new networks by sharing routing table information.

When to Use Static Routing

Use static routes:

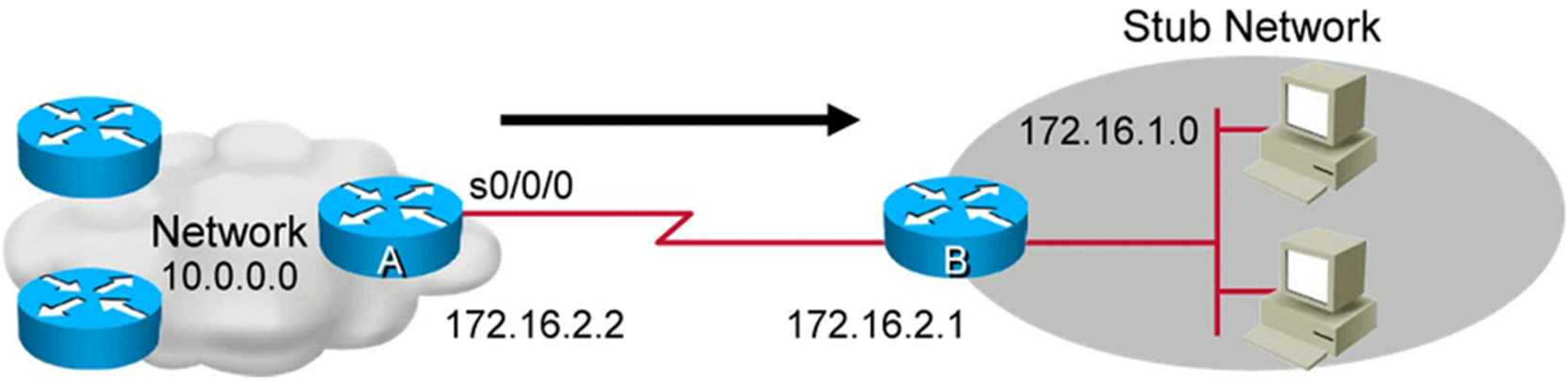
- In a small network that requires only simple routing
- In a hub-and-spoke network topology
- When you want to create a quick ad hoc route

Do *not* use static routes:

- In a large network
- When the network is expected to scale

Static Route Configuration

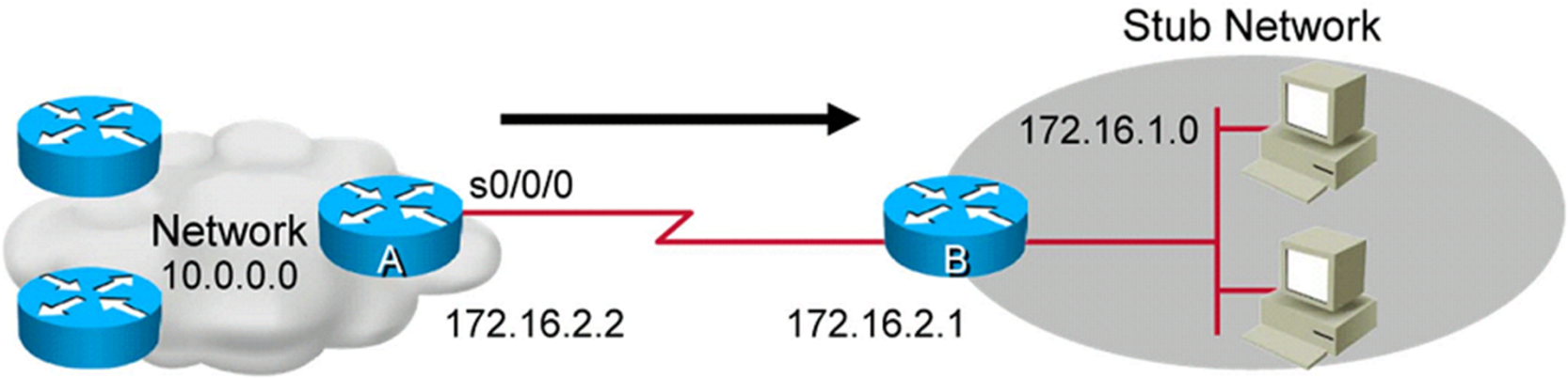
Configure unidirectional static routes to and from a stub network to allow communication to occur.



Static Route Configuration (Cont.)

Static route configuration steps:

- Define a path to an IP destination network (172.16.1.0 255.255.255.0).
- Use the IP address of the next-hop router (172.16.2.1).
- Or, use the outbound interface of the local router (serial 0/0/0).

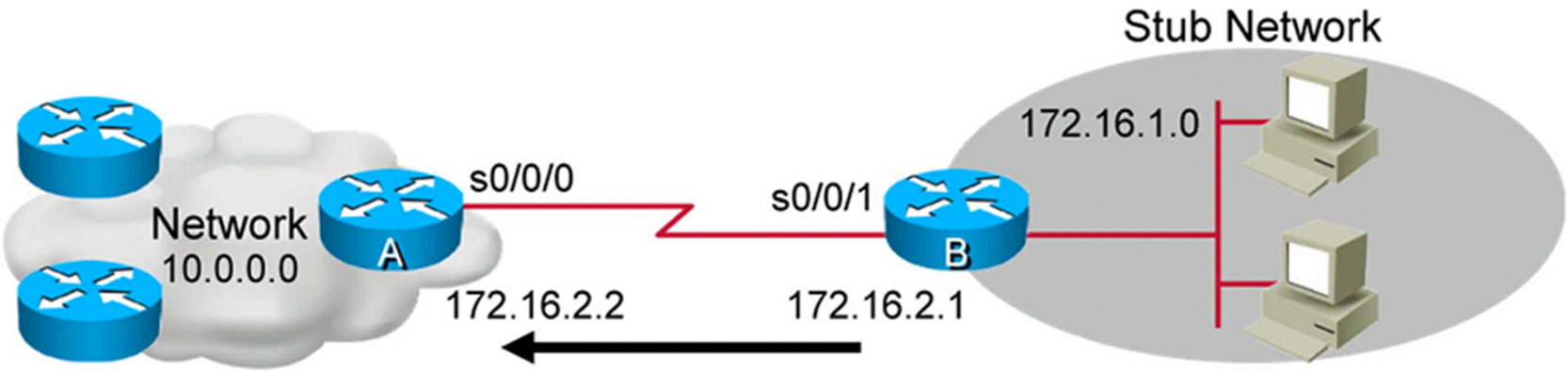


Static route pointing to next-hop IP.

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

Default Routes

This route allows the stub network to reach all known networks beyond Router A.



Default route pointing to next-hop IP.

```
RouterB(config)#ip route 0.0.0.0 0.0.0.0 172.16.2.2
```

Default route pointing to exit interface.

```
RouterB(config)#ip route 0.0.0.0 0.0.0.0 Serial0/0/1
```

Static Route Configuration Verification

```
RouterA#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

<output omitted>

Gateway of last resort is not set

   10.0.0.0/24 is subnetted, 1 subnets
C     10.0.0.0 is directly connected, FastEthernet0/0
   172.16.0.0/24 is subnetted, 2 subnets
S     172.16.1.0/24 [1/0] via 172.16.2.1
C     172.16.2.0/24 is directly connected, Serial0/0/0
L     172.16.2.2/32 is directly connected, Serial0/0/0
```

Static Route Configuration Verification (Cont.)

To verify static routes in the routing table, examine the routing table with the **show ip route** command:

- Includes network address and subnet mask as well as IP address of next-hop router or exit interface
- Denoted with the code "*S*" in the routing table

Routing tables must contain directly connected networks that are used to connect remote networks before static or dynamic routing can be used.

Verifying the Default Route Configuration

To verify the default route configuration, examine the routing table on RouterB:

```
RouterB#show ip route
Codes: L - local, C - connected, S - static,
R - RIP, M - mobile, B - BGP

<output omitted>

Gateway of last resort is 172.16.2.2 to network 0.0.0.0

     172.16.0.0/24 is subnetted, 2 subnets
C       172.16.1.0/24 is directly connected, FastEthernet0/0
C       172.16.2.0/24 is directly connected, Serial0/0/0
S*   0.0.0.0/0 [1/0] via 172.16.2.2
```

Summary

- Routing is the process by which items get from one location to another. Routers can forward packets over static routes or dynamic routes.
- Static routes are entered manually by a network administrator. Dynamic routes are learned by a routing protocol, and dynamic routes change automatically when circumstances in the network change.
- Unidirectional static routes must be configured to and from a stub network to allow communication 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” in the first position.

Managing Traffic Using ACLs

Establishing Internet Connectivity

Understanding ACLs

What is an ACL?

- An ACL is a Cisco IOS tool for traffic identification.
- An ACL is a list of permit and deny statements.
- An ACL identifies traffic based on the information within the IP packet.
- After traffic is identified, different actions can be taken.
- ACLs can be used on routers and switches.

ACL Operation

ACL tests:

- An ACL consists of a series of permit and deny statements.
- An ACL is consulted in top-down order.
- The first match executes the permit or deny action and stops further ACL matching.
- There is an implicit deny all statement at the end of each ACL.