

NETWORKING ESSENTIALS

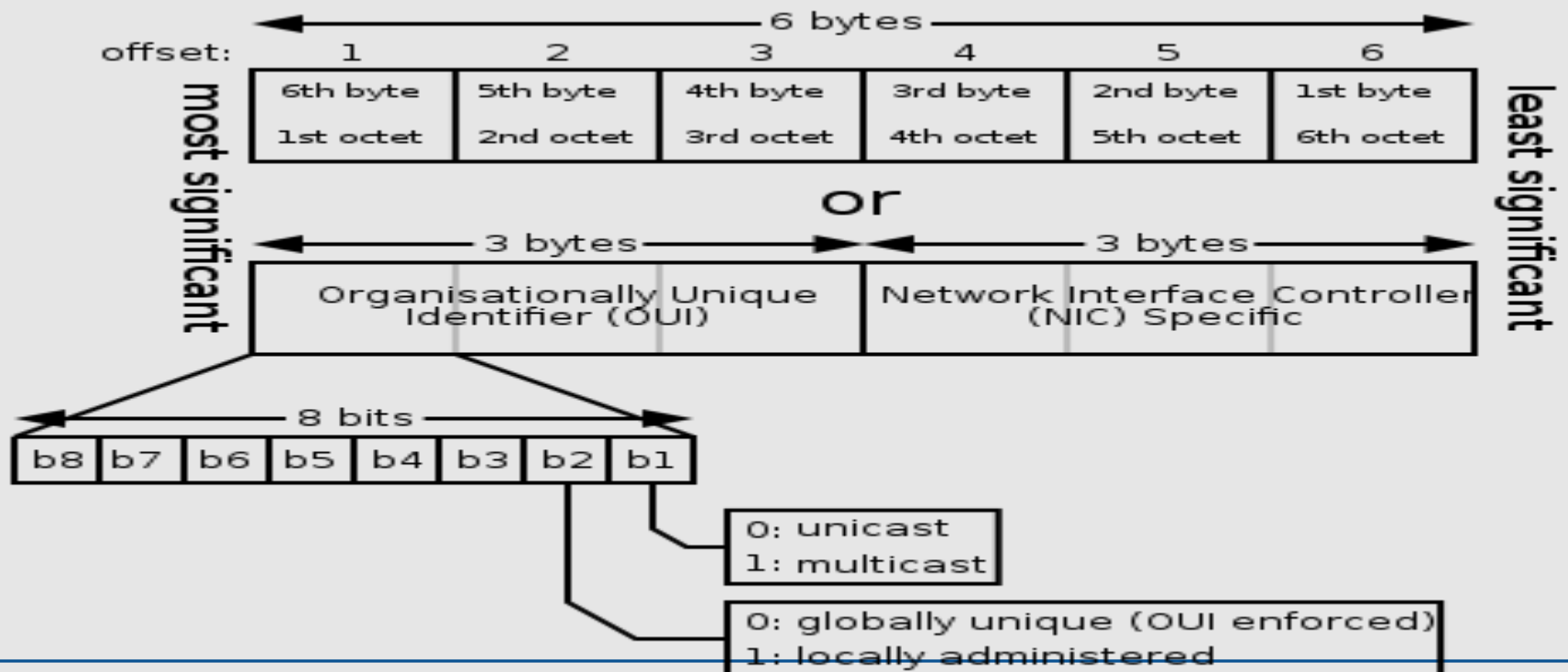
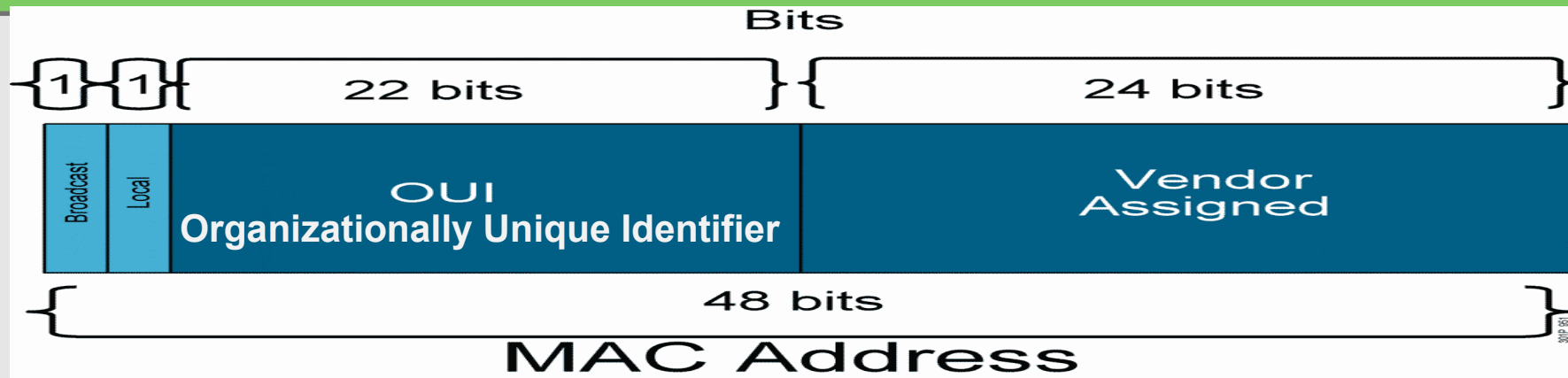
Chapter 3.

LAN Switching

Contents

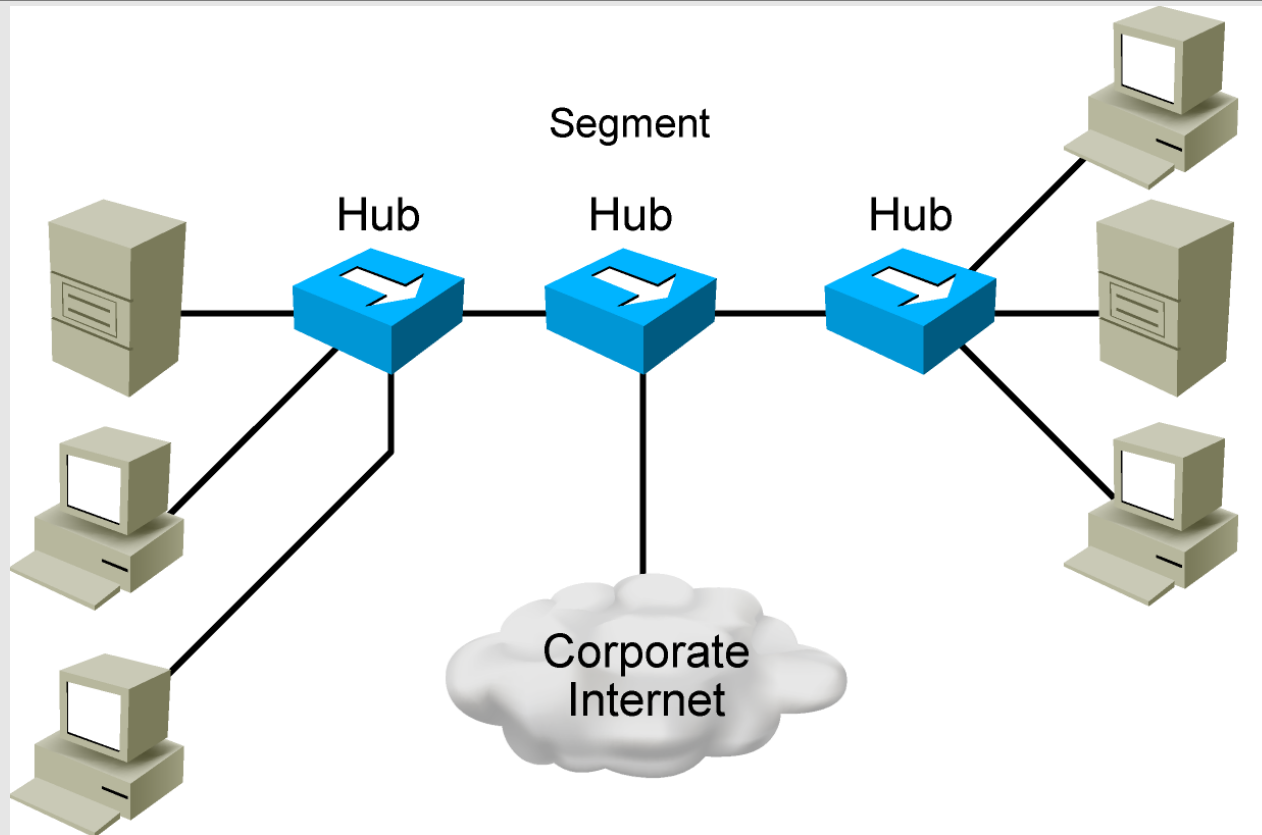
- I. Understanding the challenges with Switched LAN Technology
- II. Exploring the packet Delivery Process 1 (layer 1)
- III. Exploring the packet Delivery Process 2 (layer 2)
- IV. Exploring the packet Delivery Process 3 (layer 3)

MAC Address Components



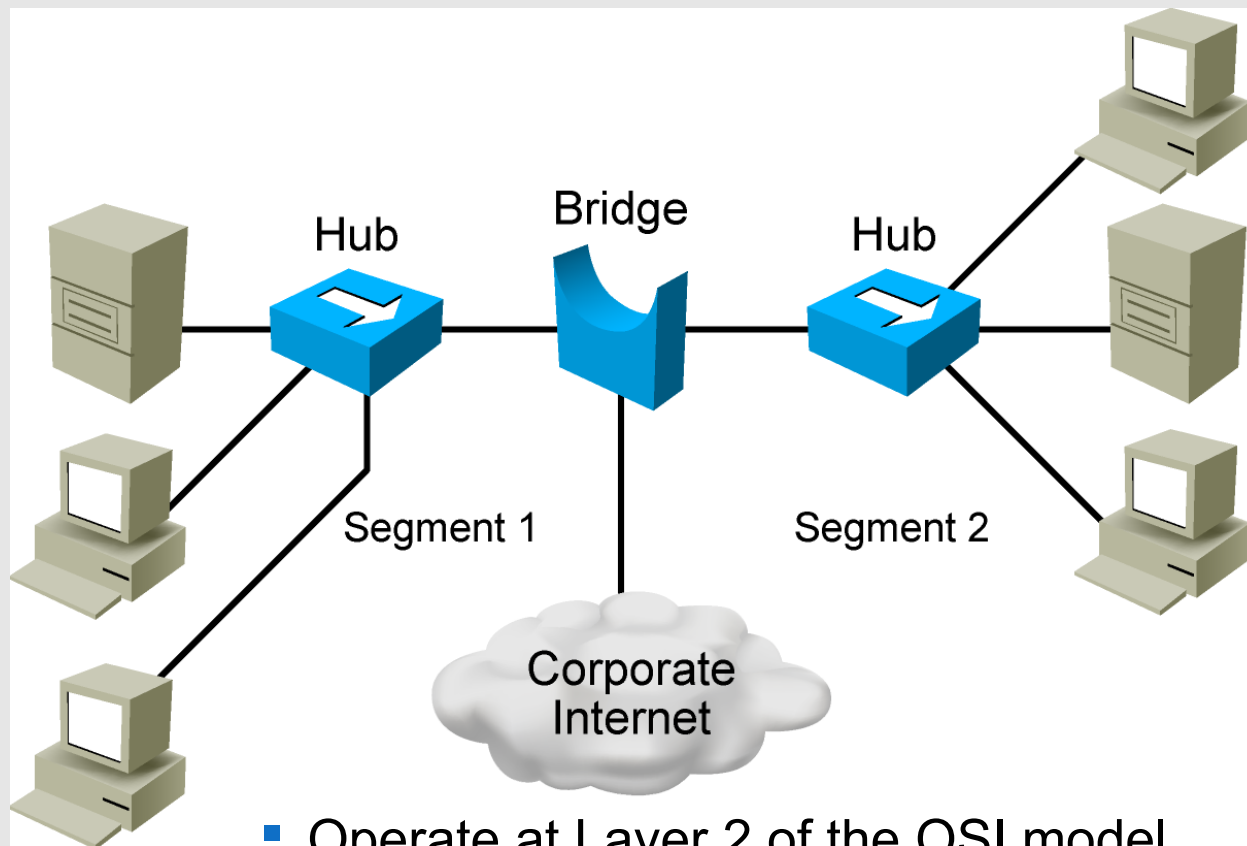
II. Understanding the challenges with Switched LAN Technology

Network Congestion



- High-performance PCs
- More networked data
- Bandwidth-intensive applications

Bridges



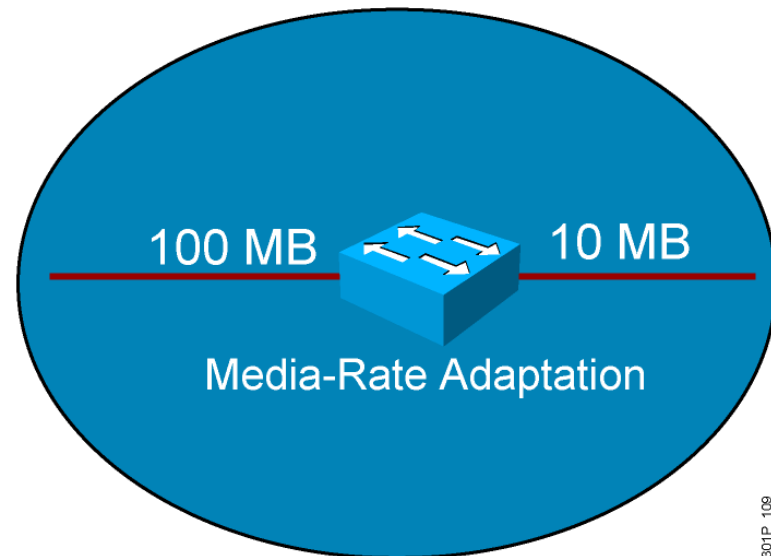
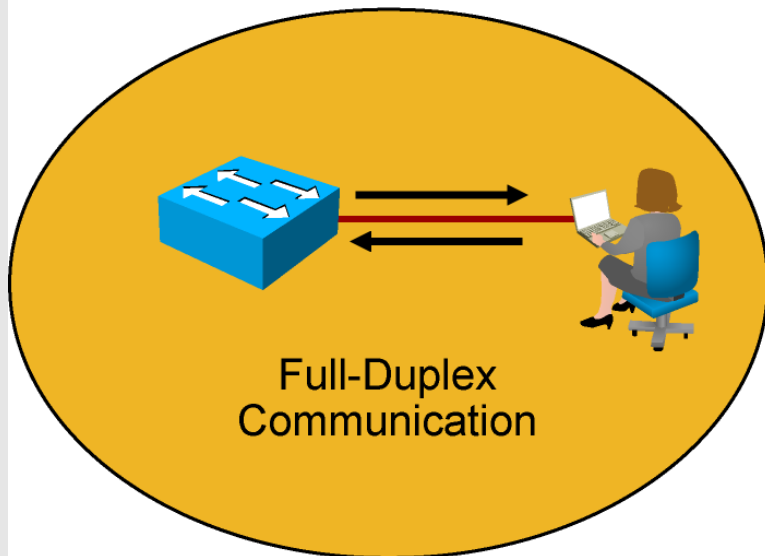
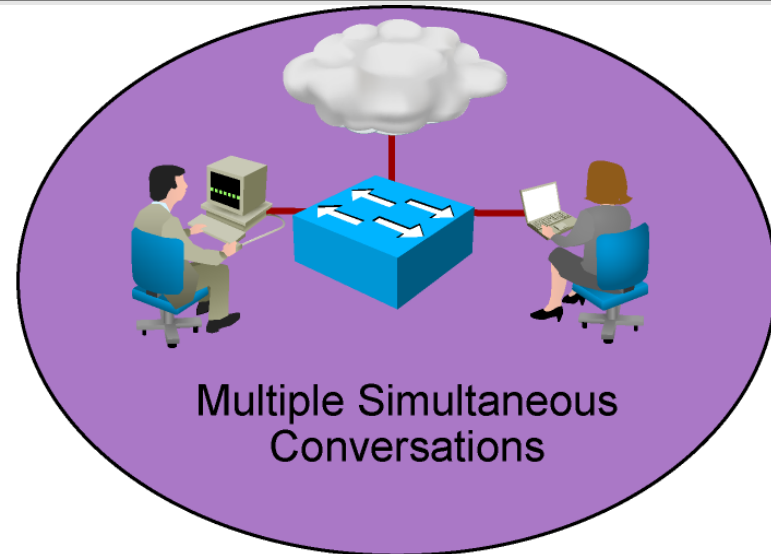
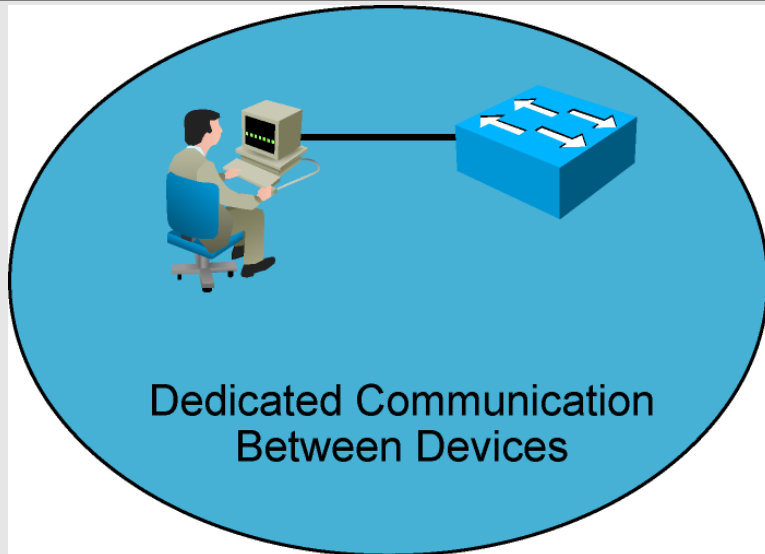
- Operate at Layer 2 of the OSI model
- Forward, filter, or flood frames
- Have few ports
- Are slow

LAN Switch

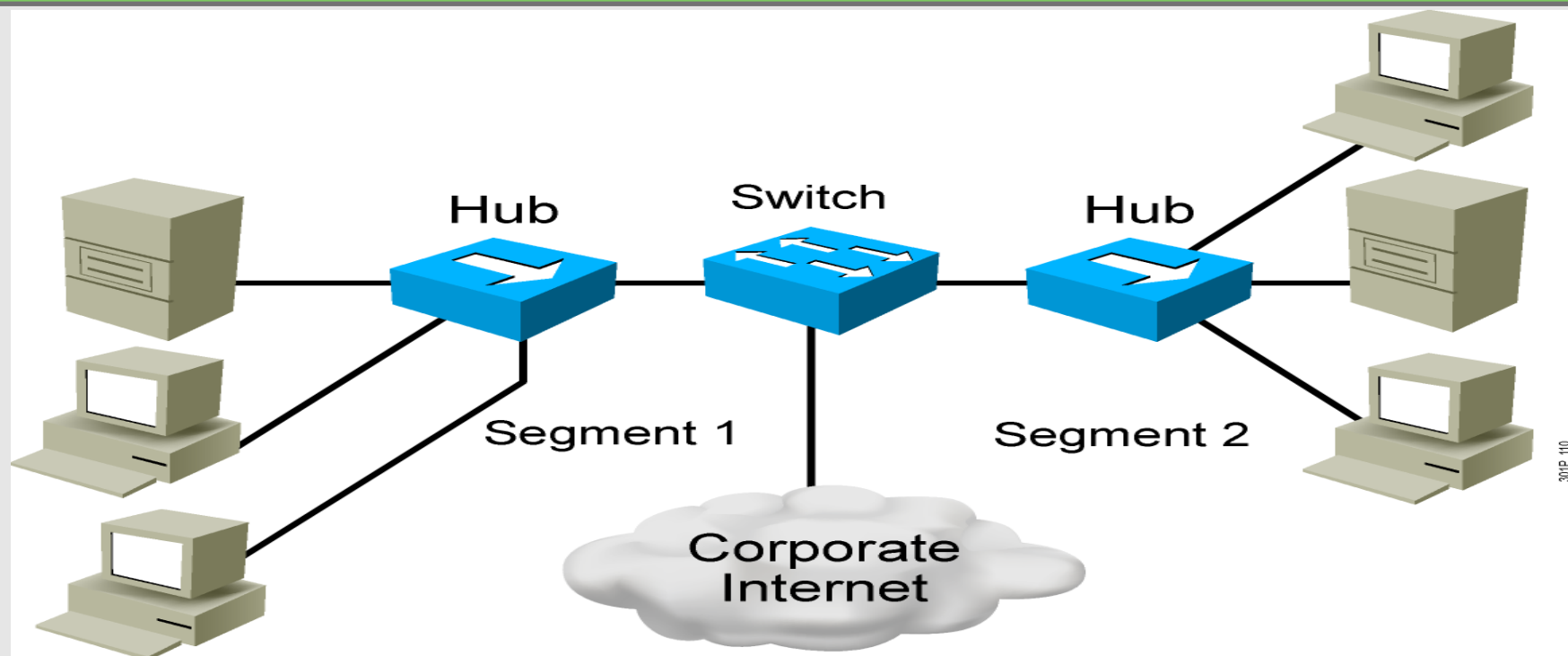
- High port density
- Large frame buffers
- Mixture of port speeds
- Fast internal switching
- Switching modes:
 - Cut-through
 - Store-and-forward
 - Fragment-free



LAN Switch Features

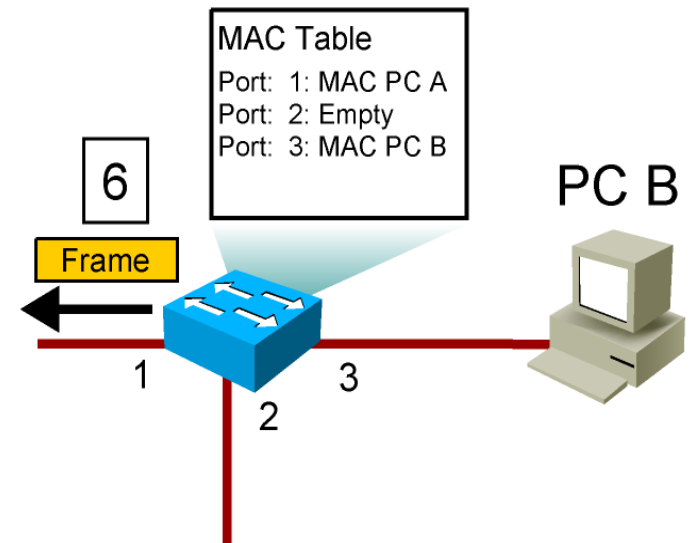
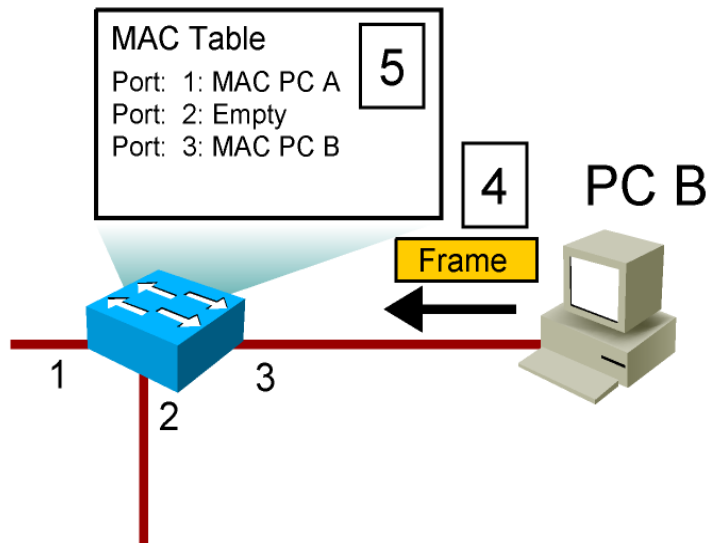
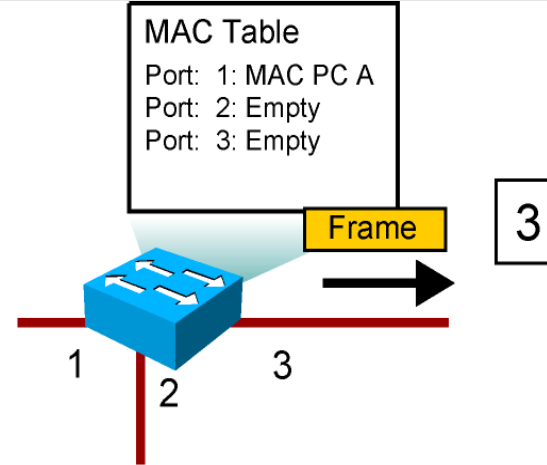
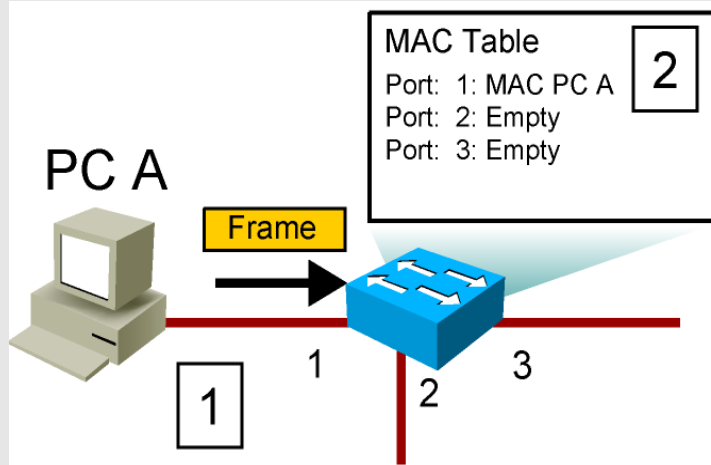


Switches Supersede Bridges

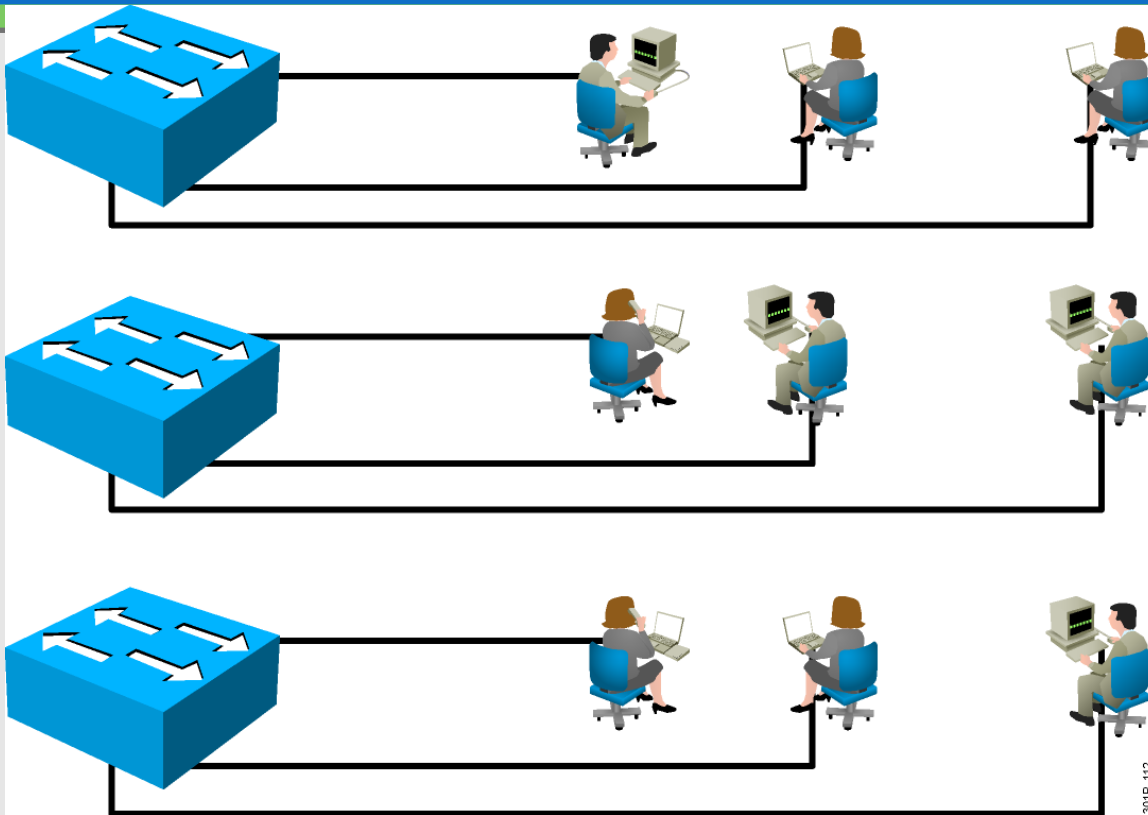


- Operate at Layer 2 of the OSI model
- Forward, filter, or flood frames
- Have many ports
- Are fast

Switching Frames



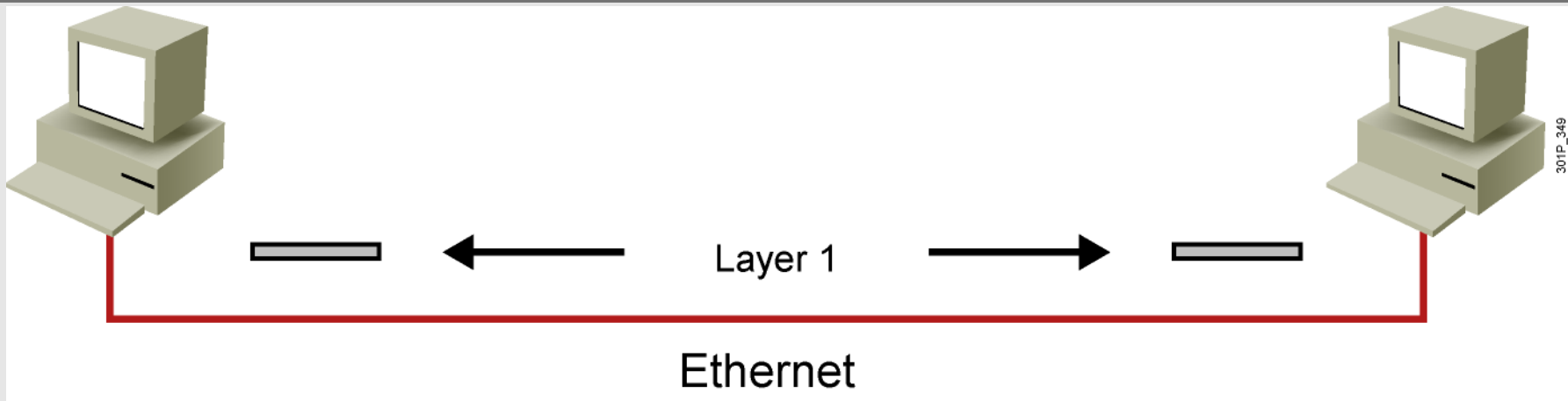
LANs Today



- Users grouped by physical location
- More switches added to networks
- Switches connected by high-speed links

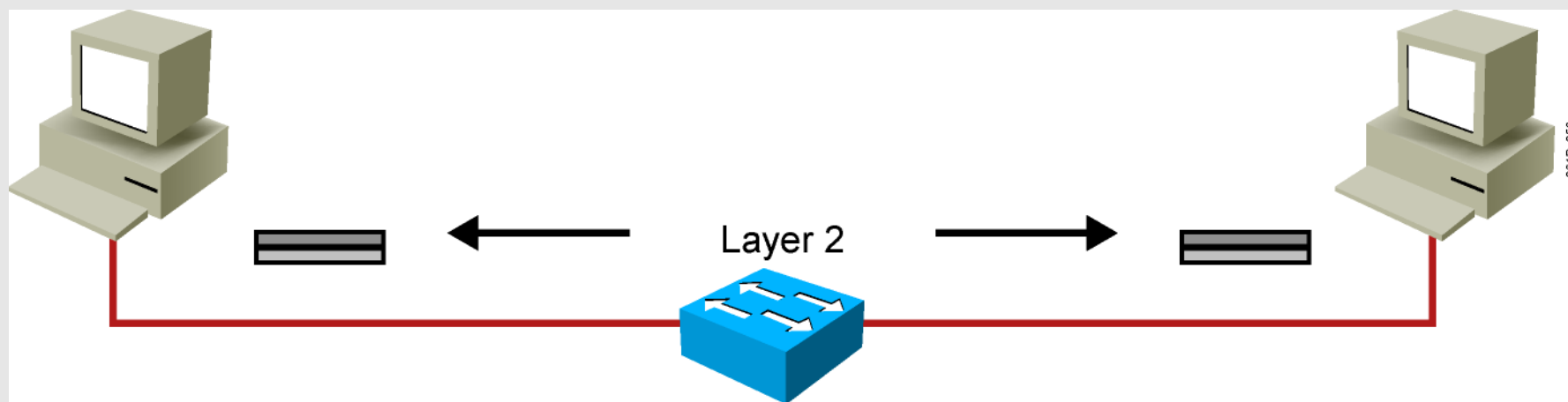
III. Exploring the packet Delivery Process 1 (layer 1)

Layer 1 Devices



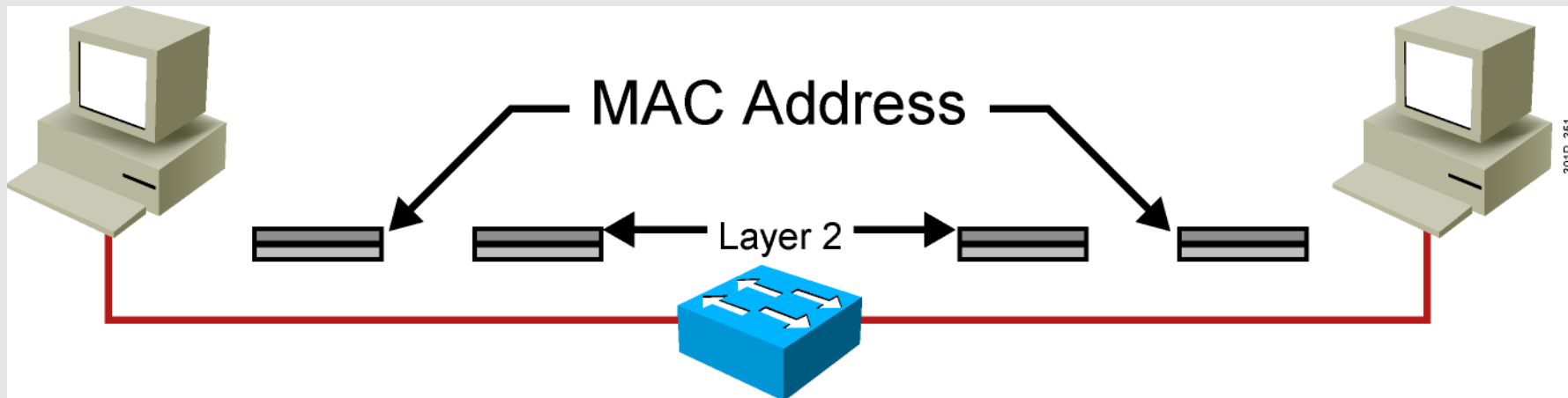
- Layer 1 provides the physical media and its encoding.
- Examples:
 - Ethernet
 - Serial
 - Repeater
 - Physical interface of the NIC

Layer 2 Devices



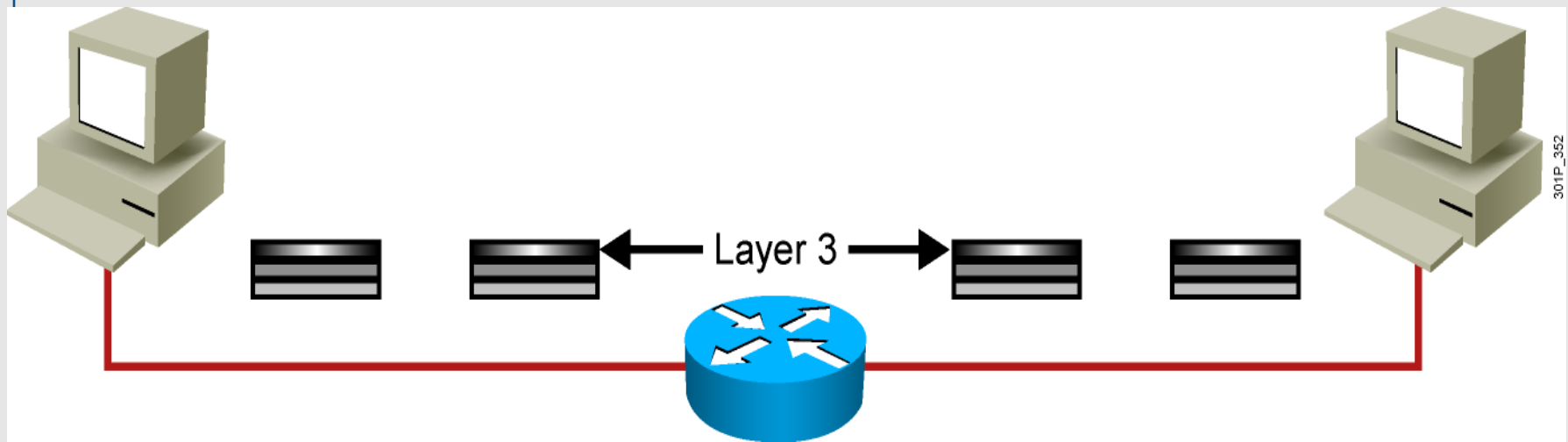
- Layer 2 devices provide an interface with the physical media.
- Examples:
 - NIC
 - Bridge
 - Switch

Layer 2 Addressing



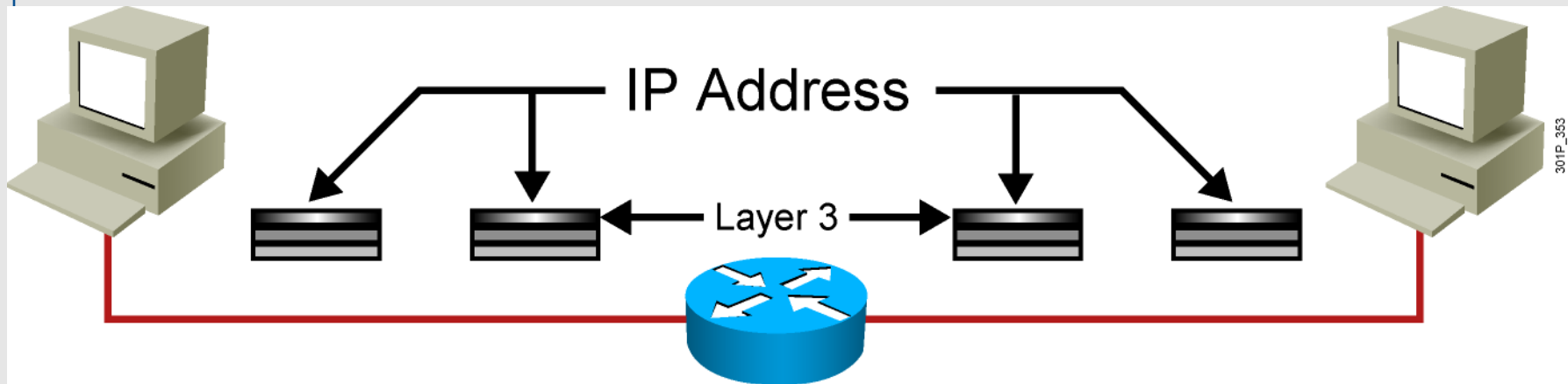
- MAC address
- Assigned to end devices

Layer 3 Devices and Their Function



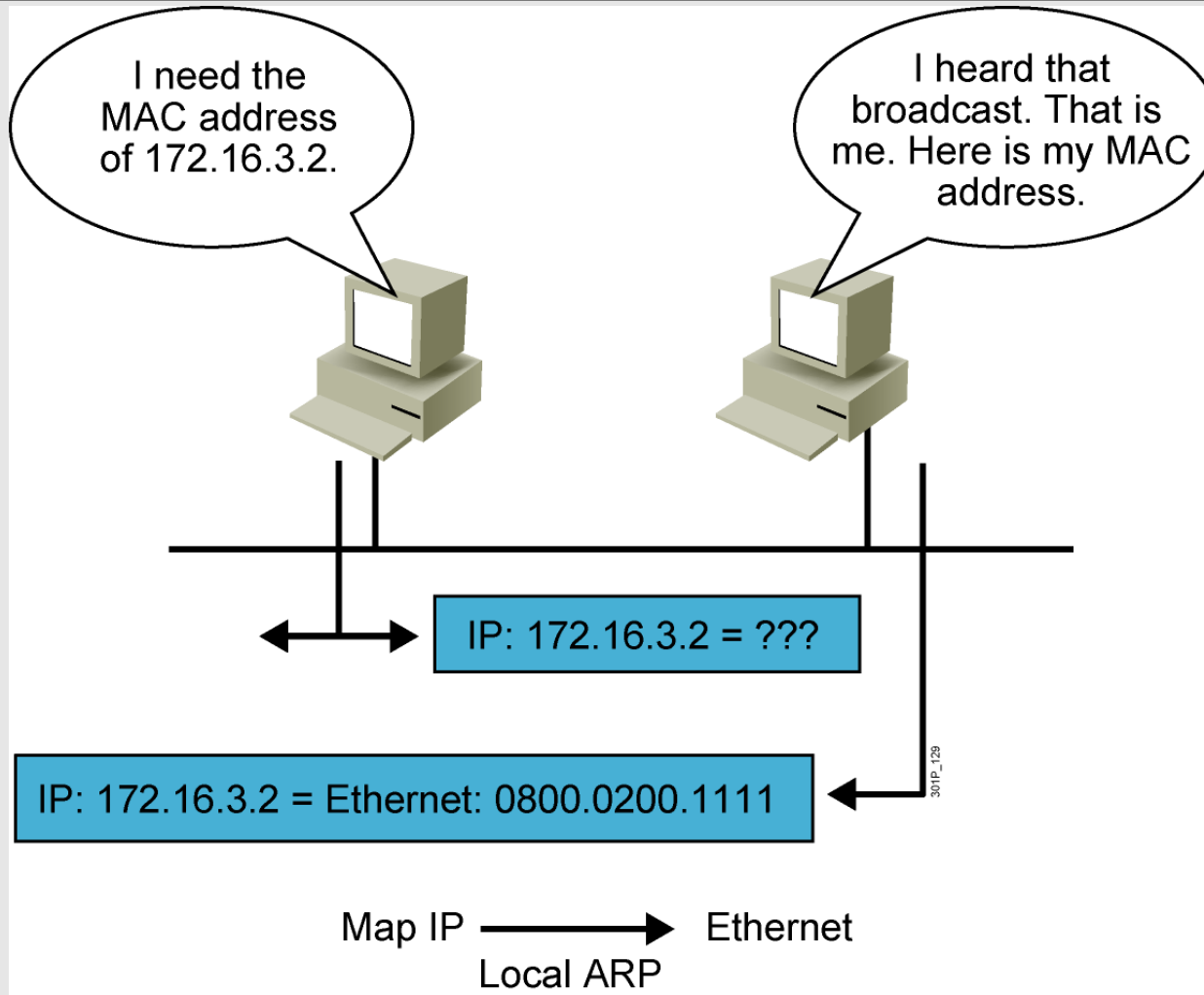
- The network layer provides connectivity and path selection between two host systems.
- In the host, this is the path between the data link layer and the upper layers of the Network Operating System(NOS).
- In the router, it is the actual path across the network.

Layer 3 Addressing

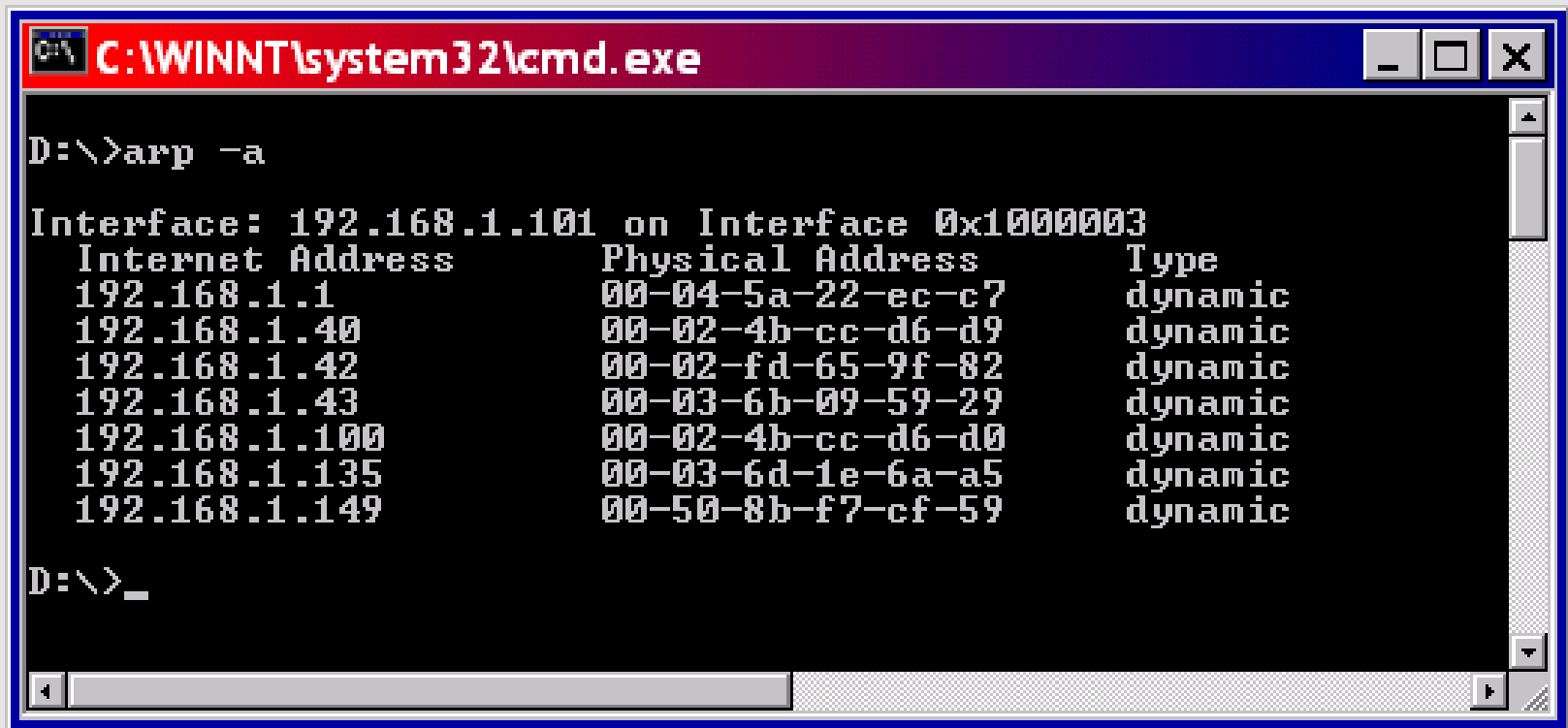


- Each NOS has its own Layer 3 address format.
- OSI uses an Network Service Access Point.
- TCP/IP uses IP.

ARP



ARP Table



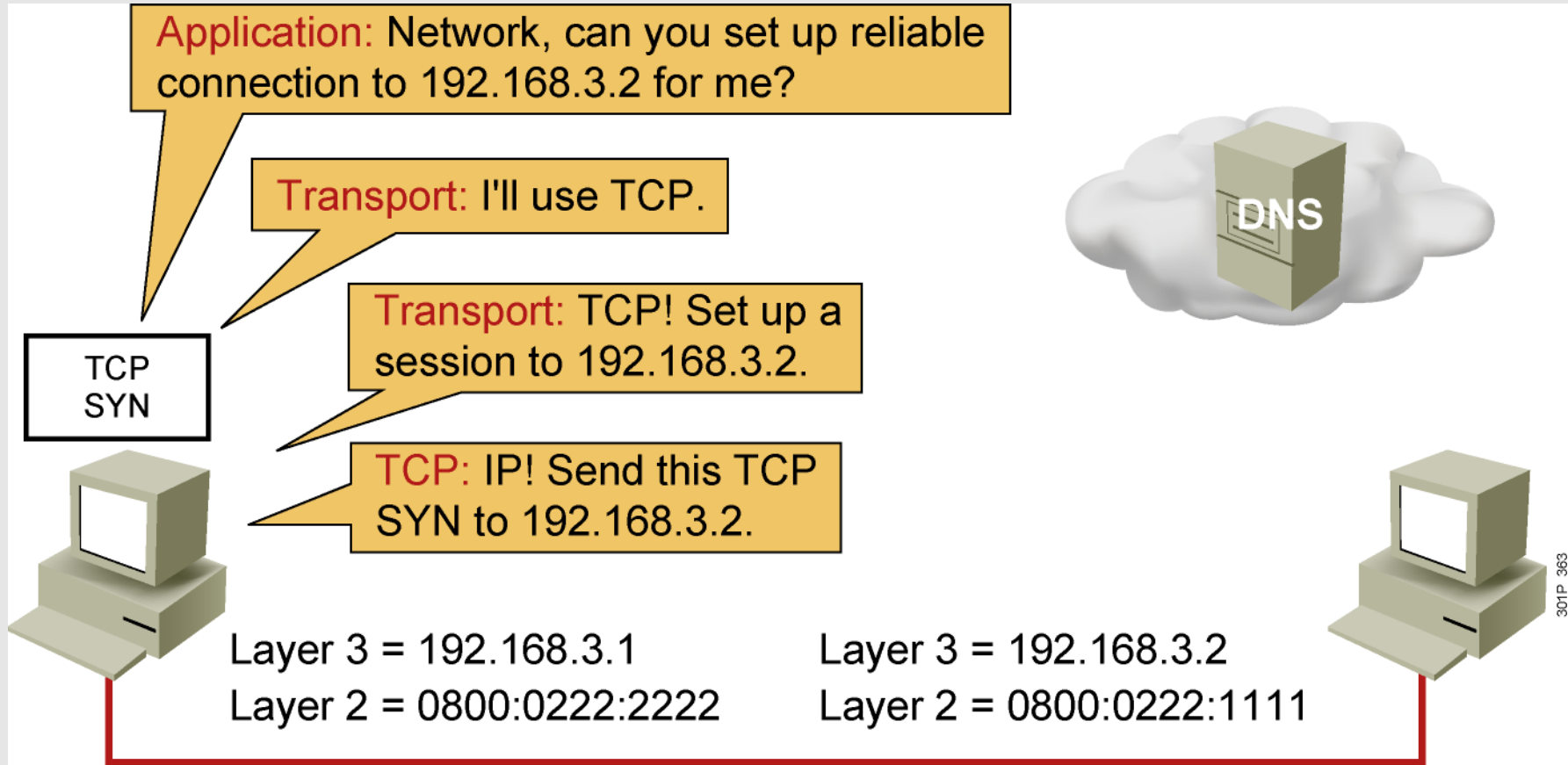
```

C:\WINNT\system32\cmd.exe
D:\>arp -a

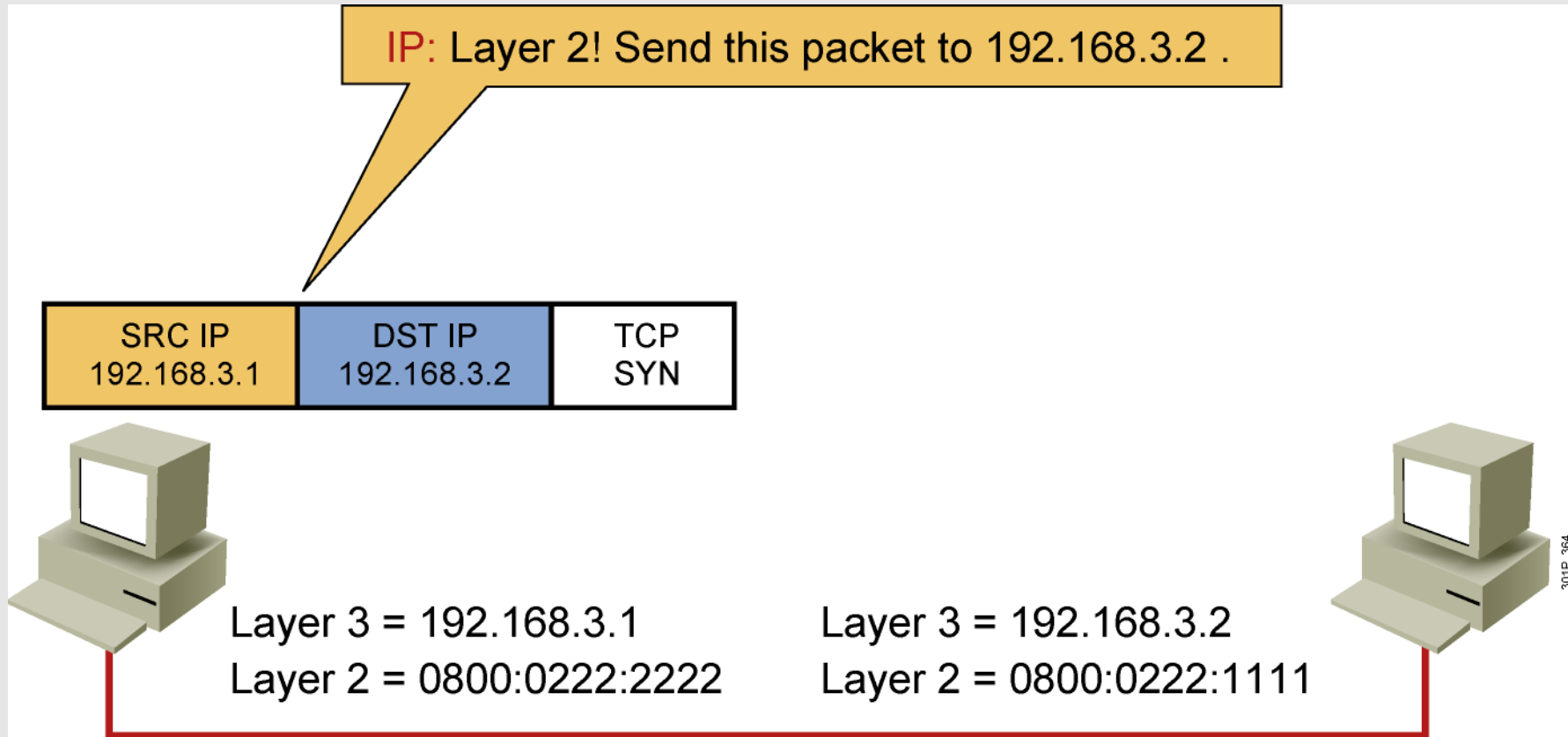
Interface: 192.168.1.101 on Interface 0x1000003
Internet Address      Physical Address      Type
192.168.1.1           00-04-5a-22-ec-c7     dynamic
192.168.1.40          00-02-4b-cc-d6-d9     dynamic
192.168.1.42          00-02-fd-65-9f-82     dynamic
192.168.1.43          00-03-6b-09-59-29     dynamic
192.168.1.100         00-02-4b-cc-d6-d0     dynamic
192.168.1.135         00-03-6d-1e-6a-a5     dynamic
192.168.1.149         00-50-8b-f7-cf-59     dynamic

D:\>_
  
```

Host-to-Host Packet Delivery (1 of 22)



Host-to-Host Packet Delivery (2 of 22)

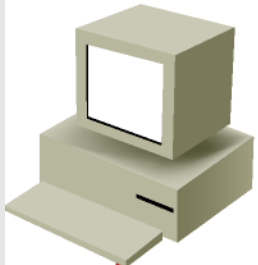


Host-to-Host Packet Delivery (3 of 22)

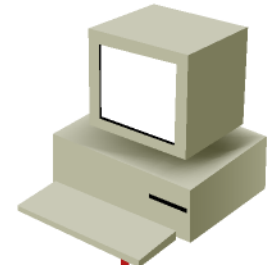
Layer 2: ARP, do you have a mapping for 192.168.3.2?

ARP: Is 192.168.3.2 in my ARP table? No, I guess Layer 2 will have to put the packet in the parking lot until I do an ARP.

SRC IP 192.168.3.1	DST IP 192.168.3.2	TCP SYN
------------------------------	------------------------------	-------------------



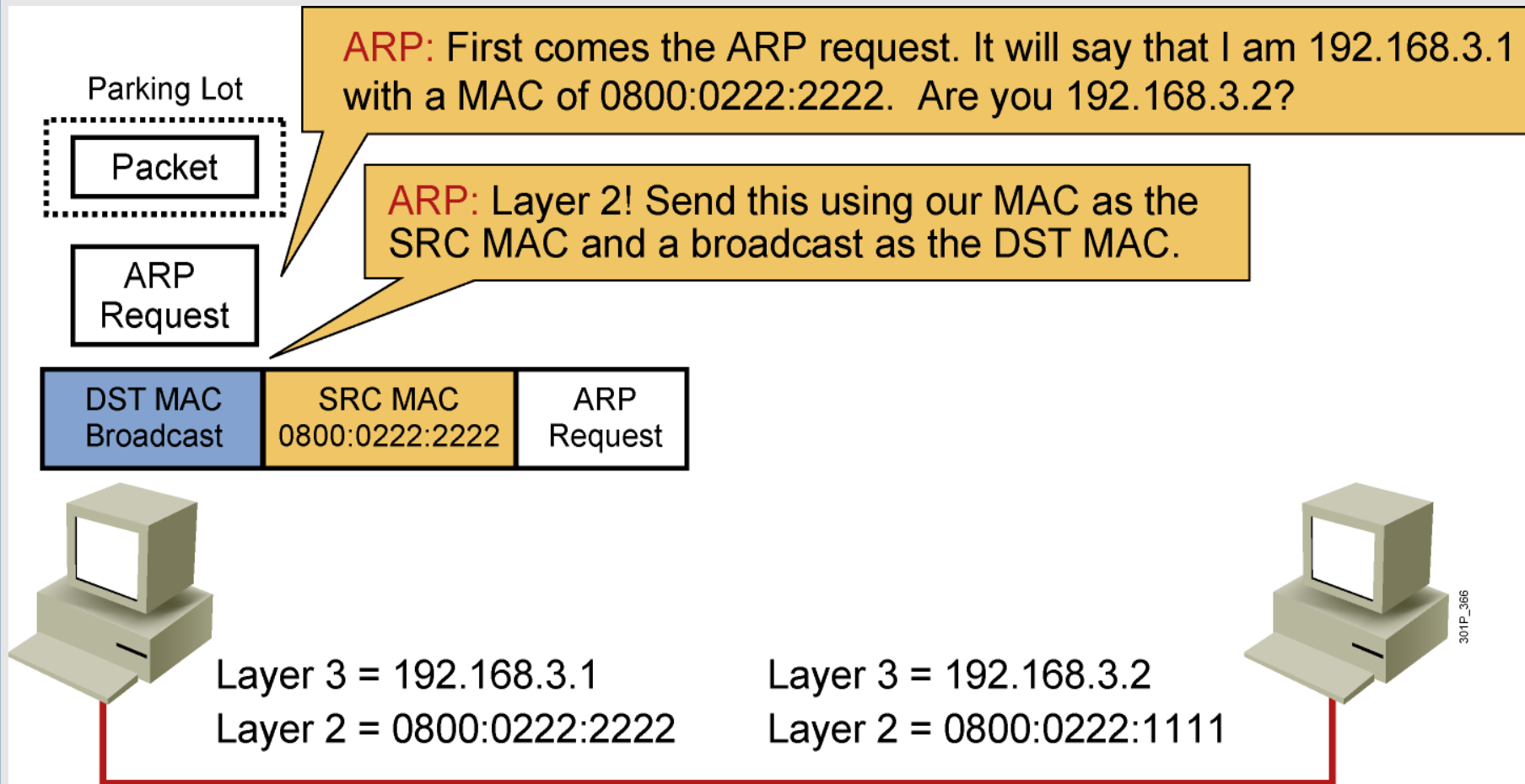
Layer 3 = 192.168.3.1
Layer 2 = 0800:0222:2222



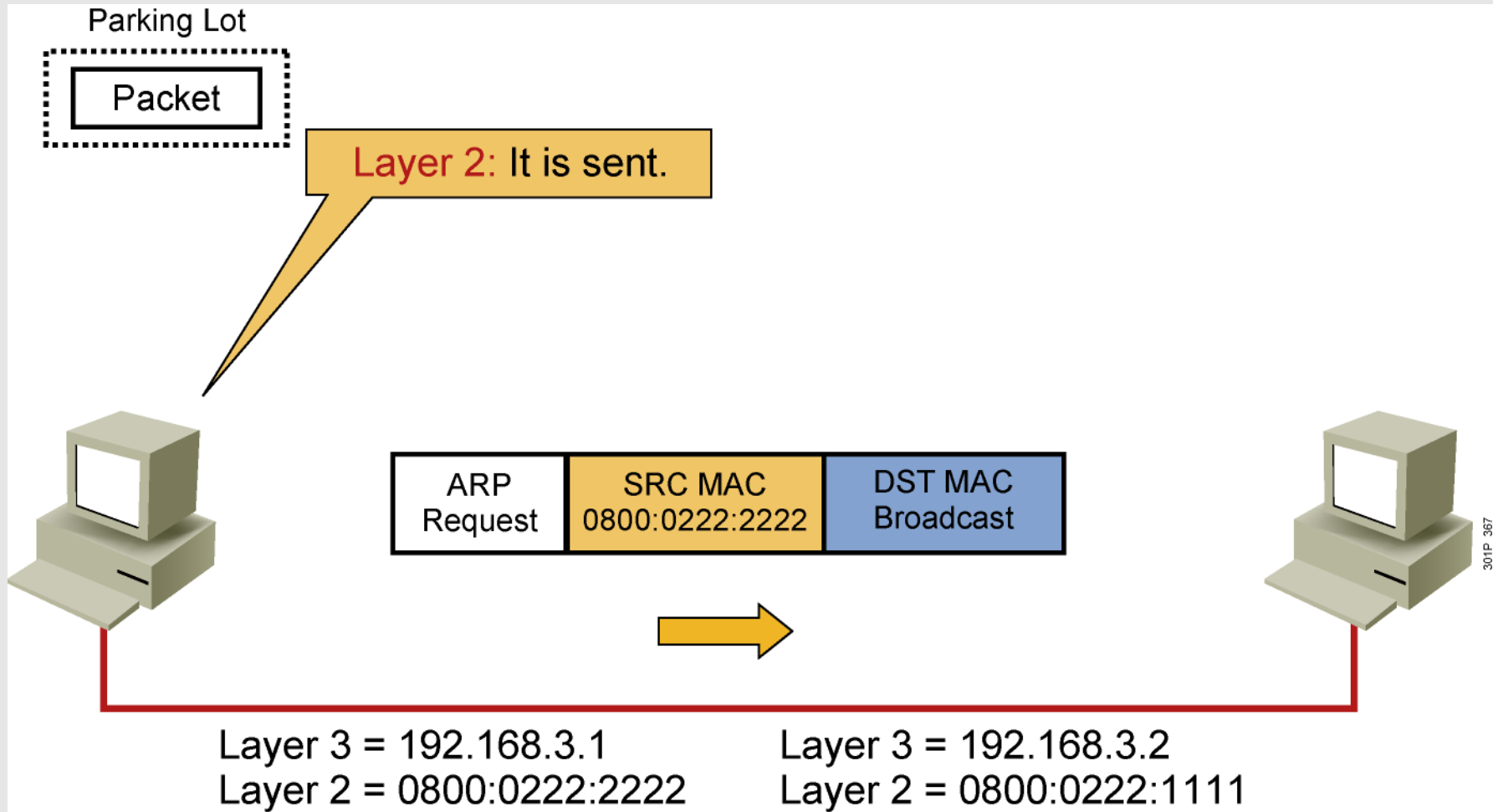
Layer 3 = 192.168.3.2
Layer 2 = 0800:0222:1111

301P_365

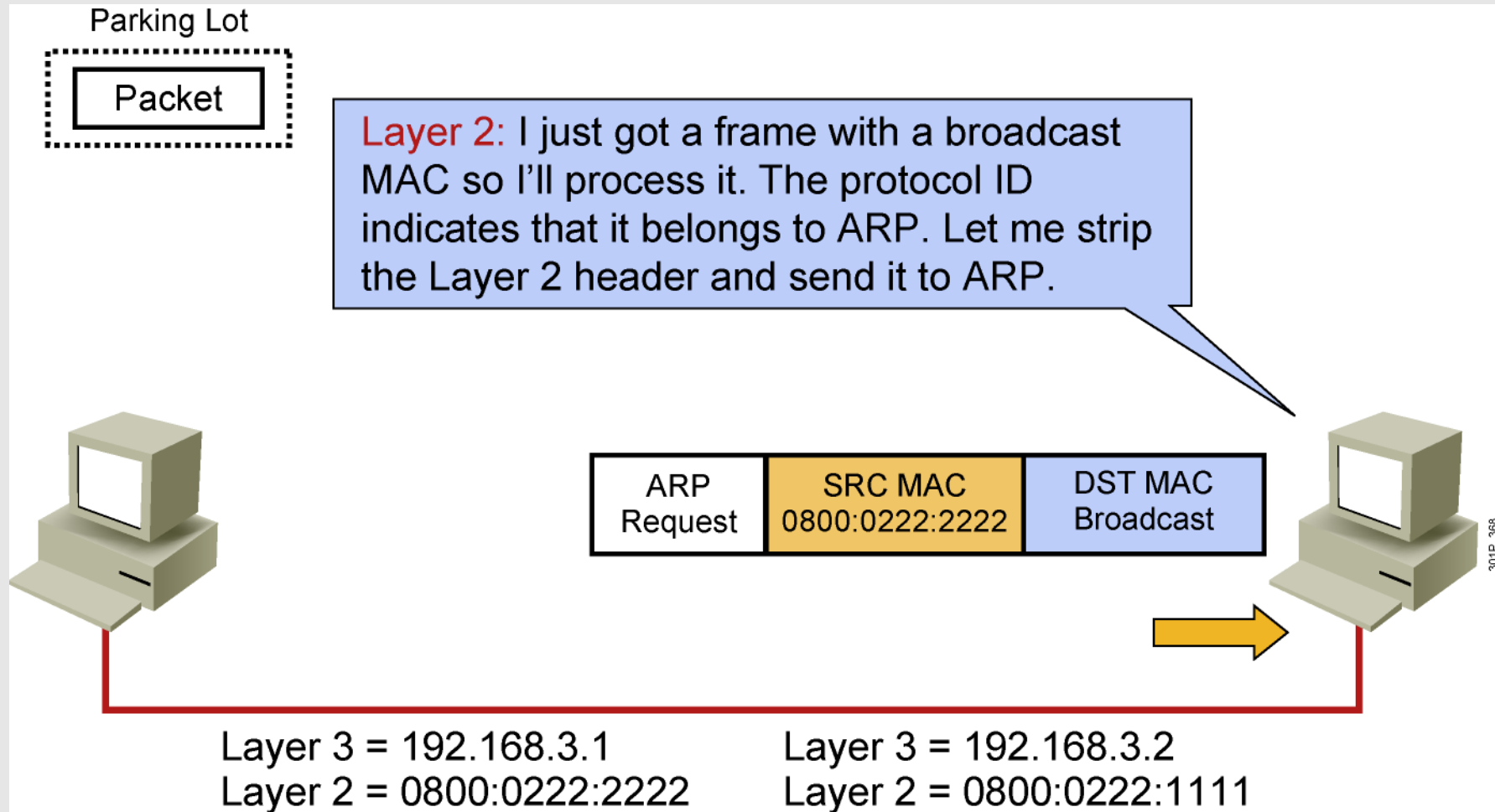
Host-to-Host Packet Delivery (4 of 22)



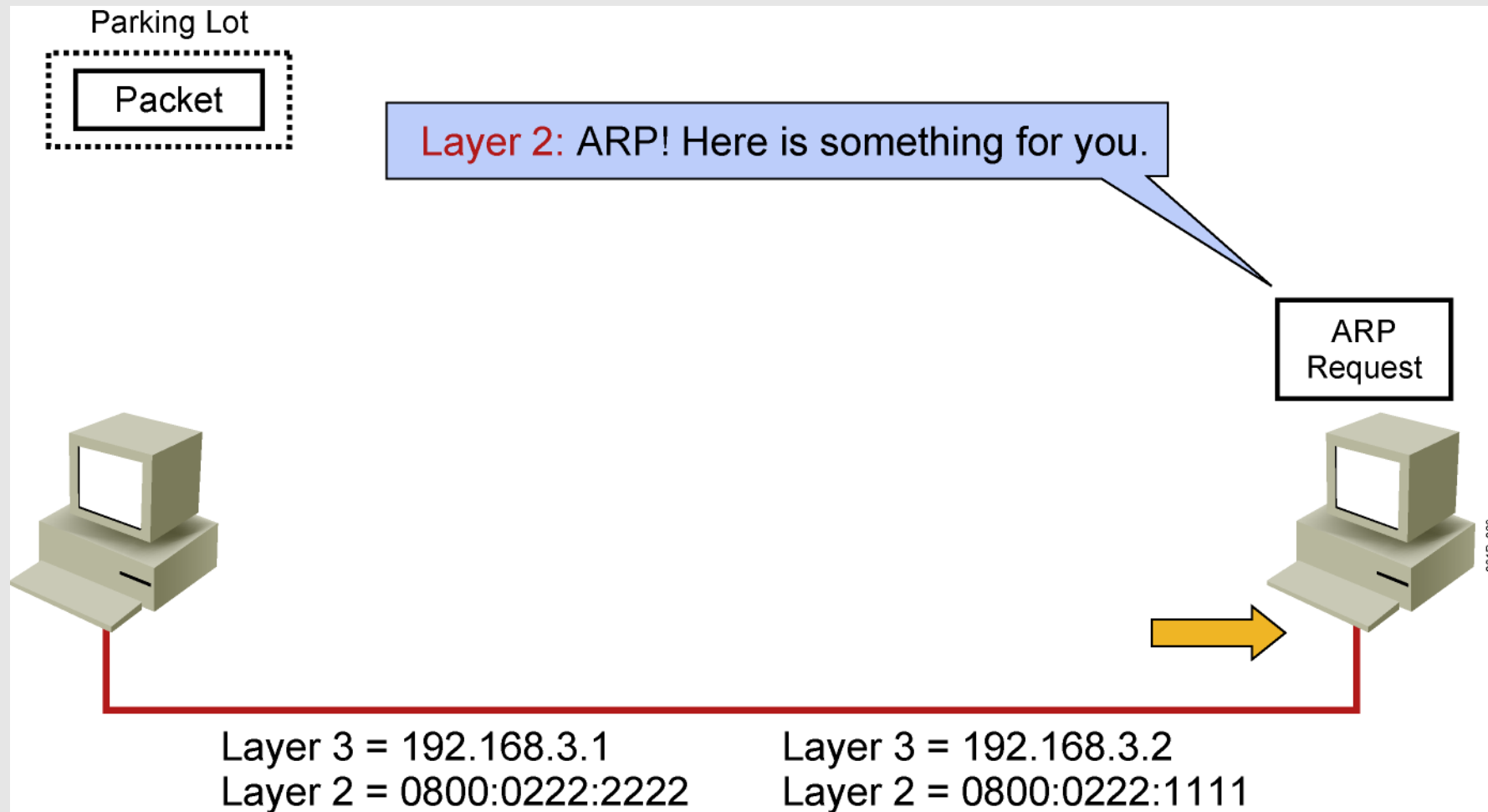
Host-to-Host Packet Delivery (5 of 22)



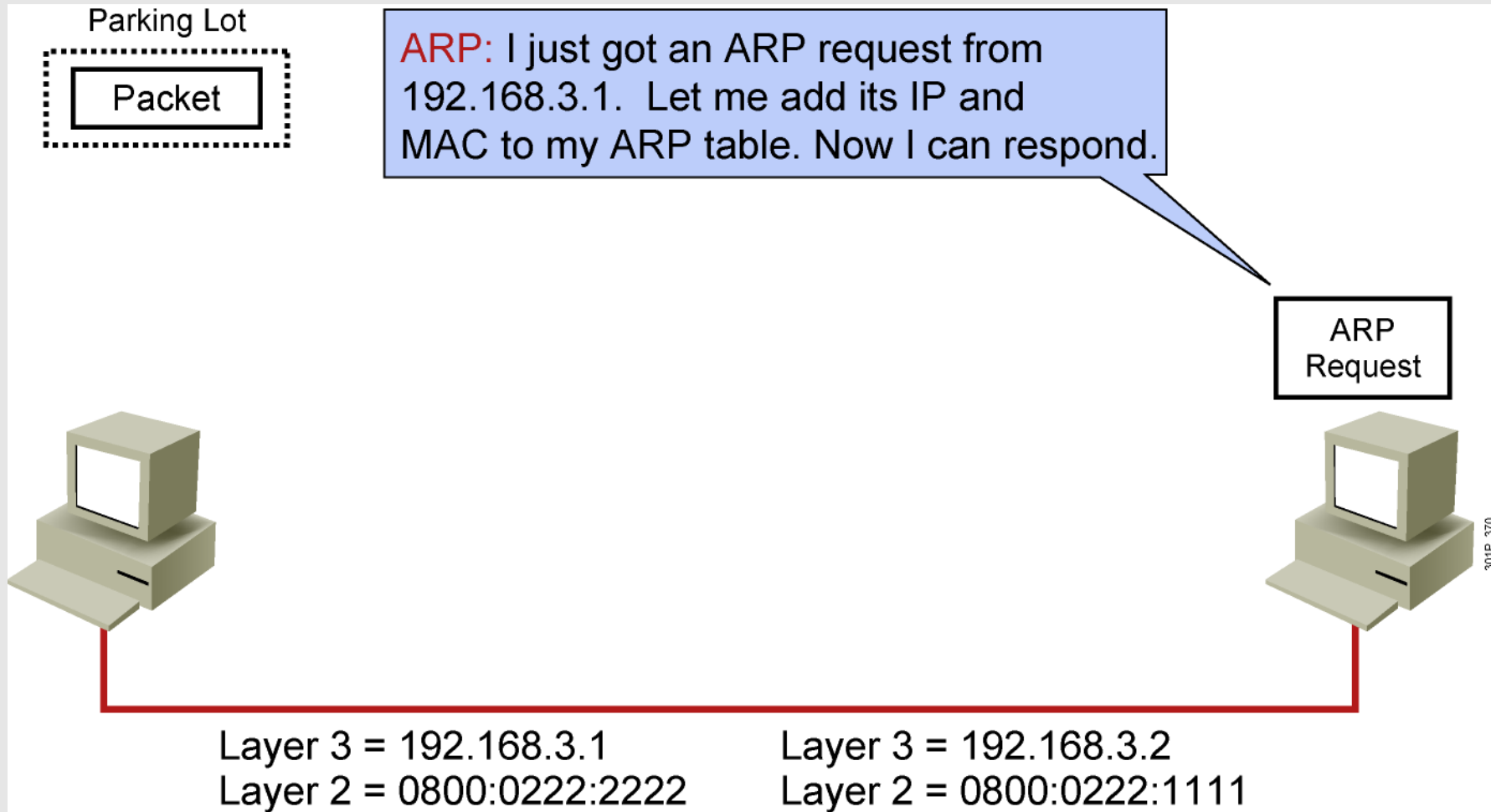
Host-to-Host Packet Delivery (6 of 22)



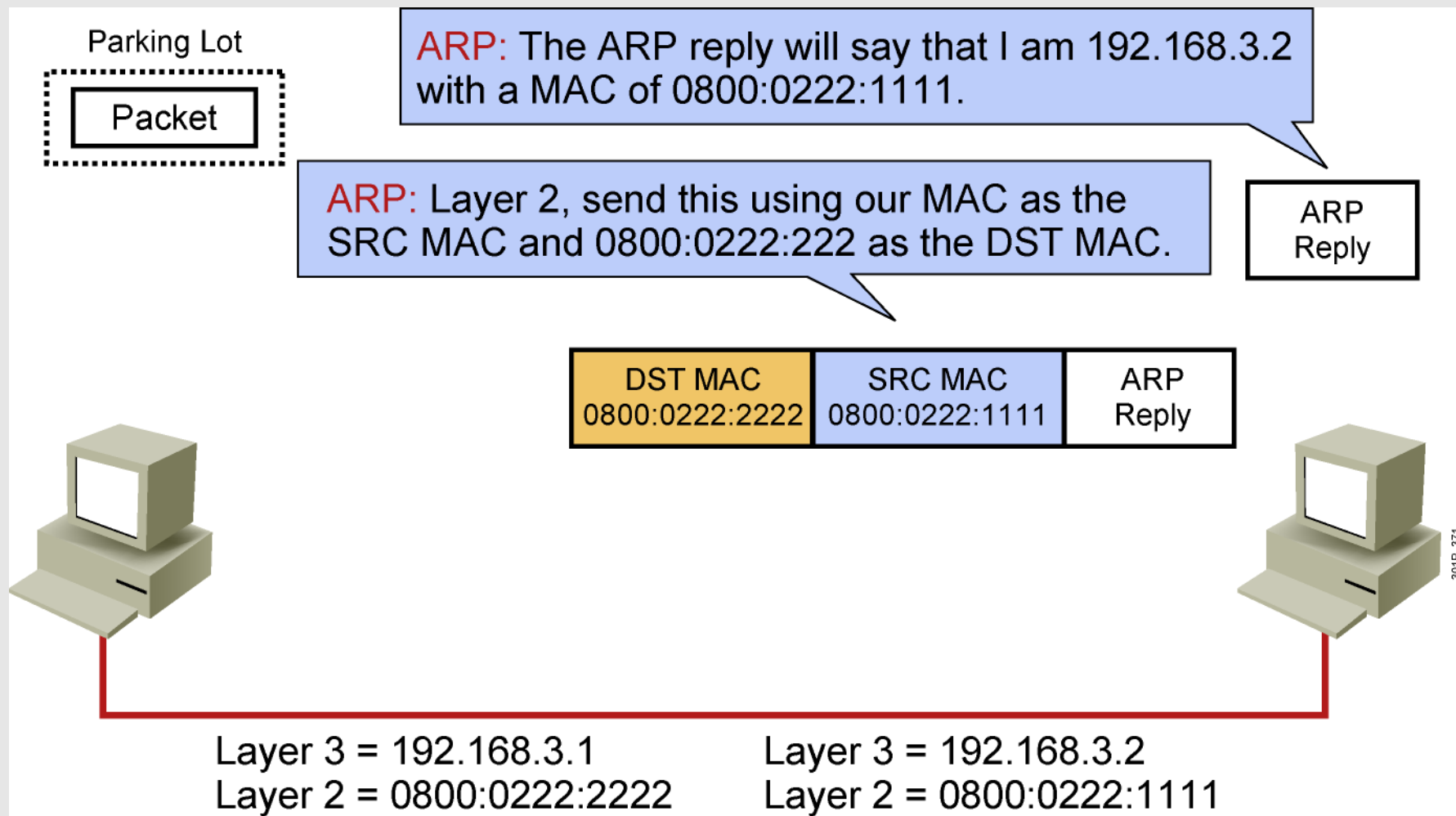
Host-to-Host Packet Delivery (7 of 22)



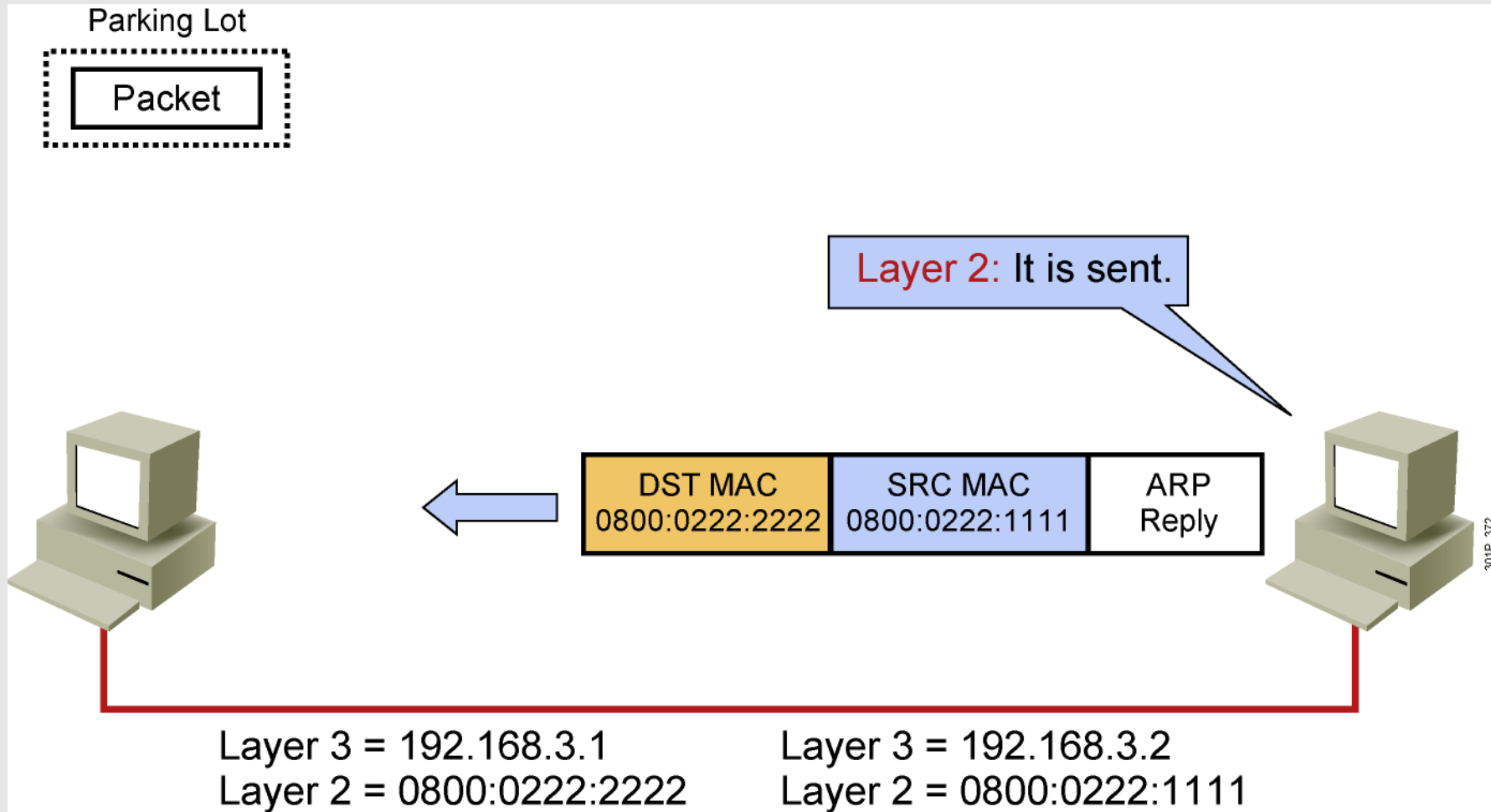
Host-to-Host Packet Delivery (8 of 22)



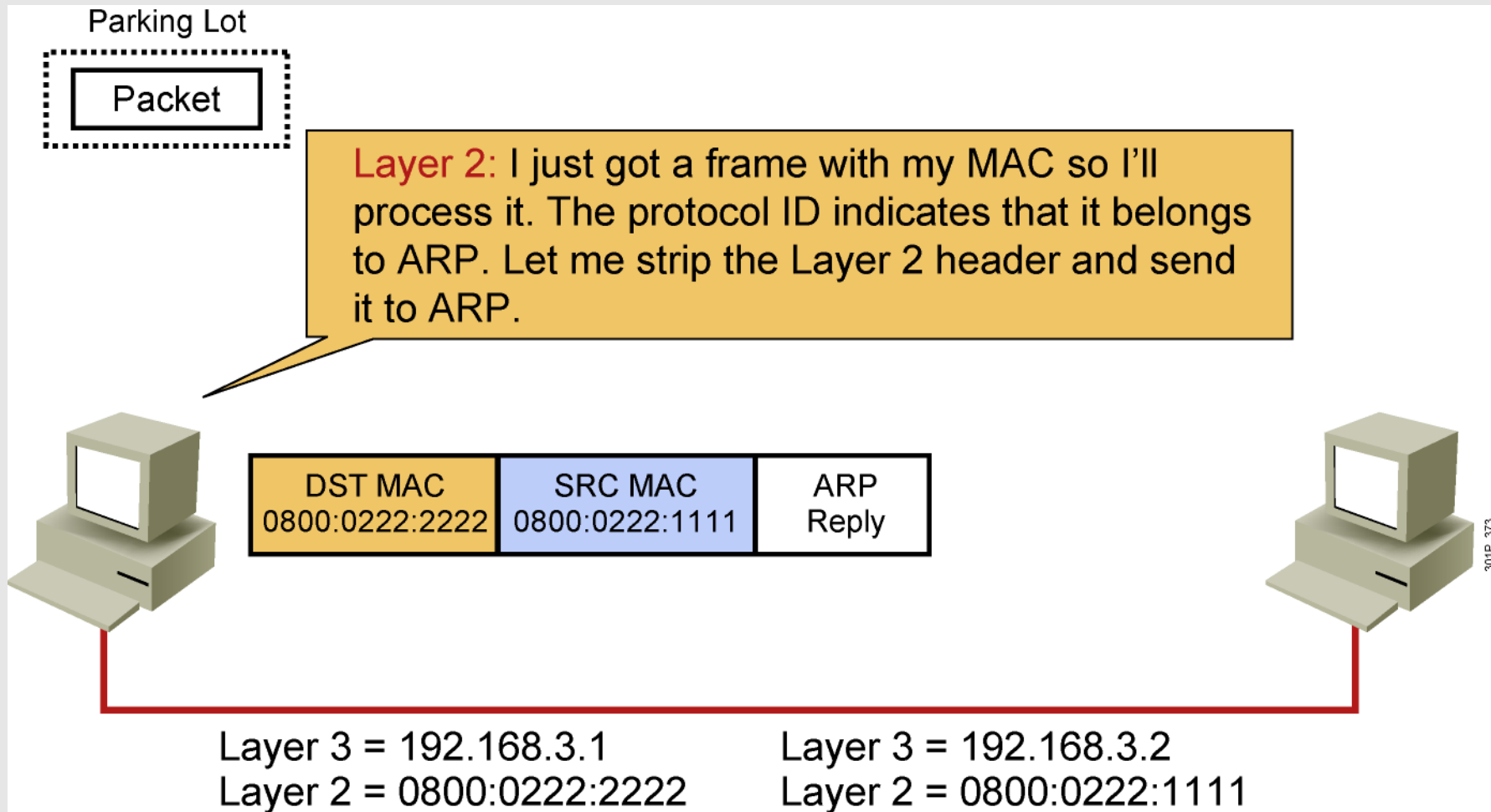
Host-to-Host Packet Delivery (9 of 22)



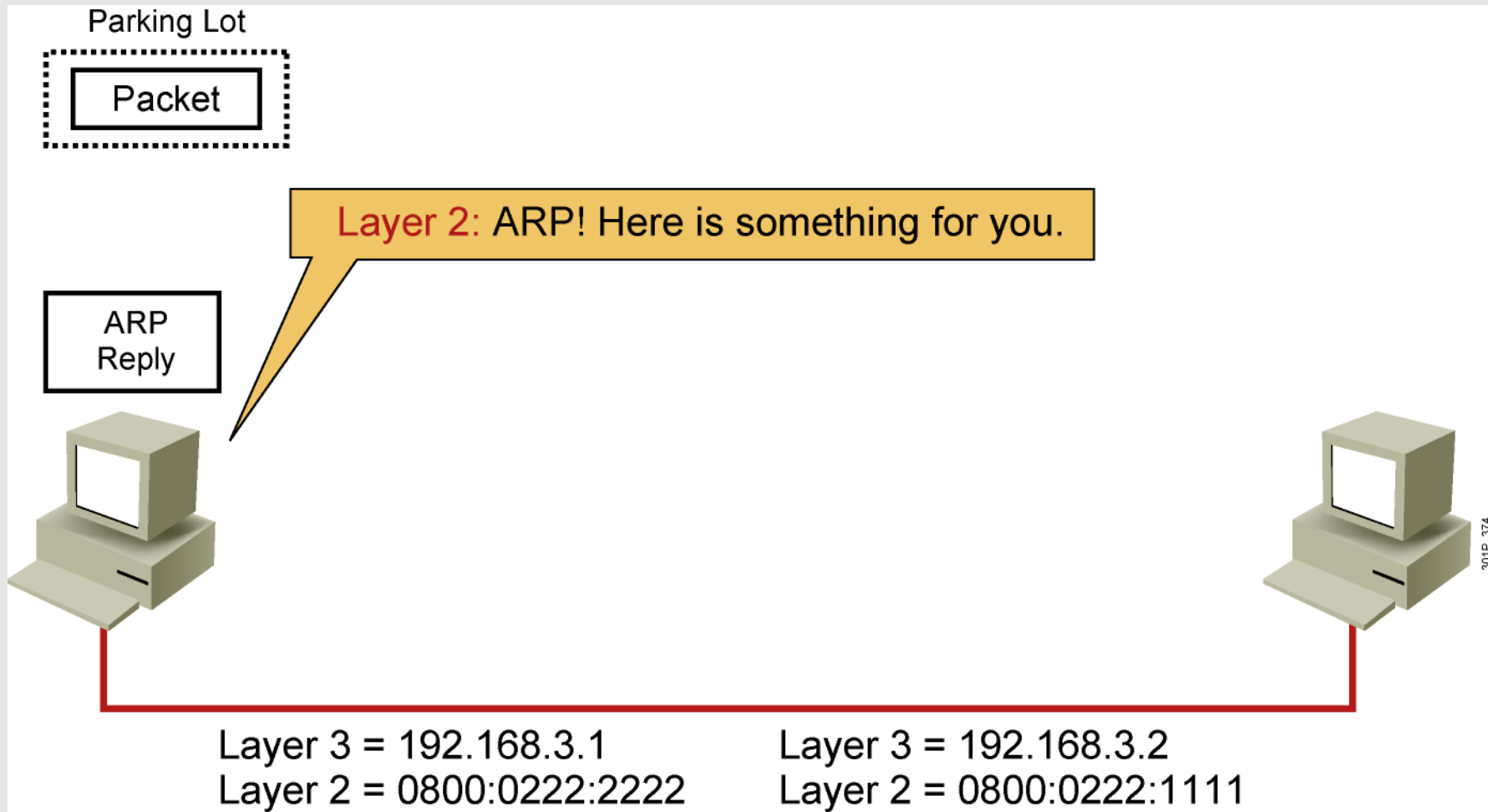
Host-to-Host Packet Delivery (10 of 22)



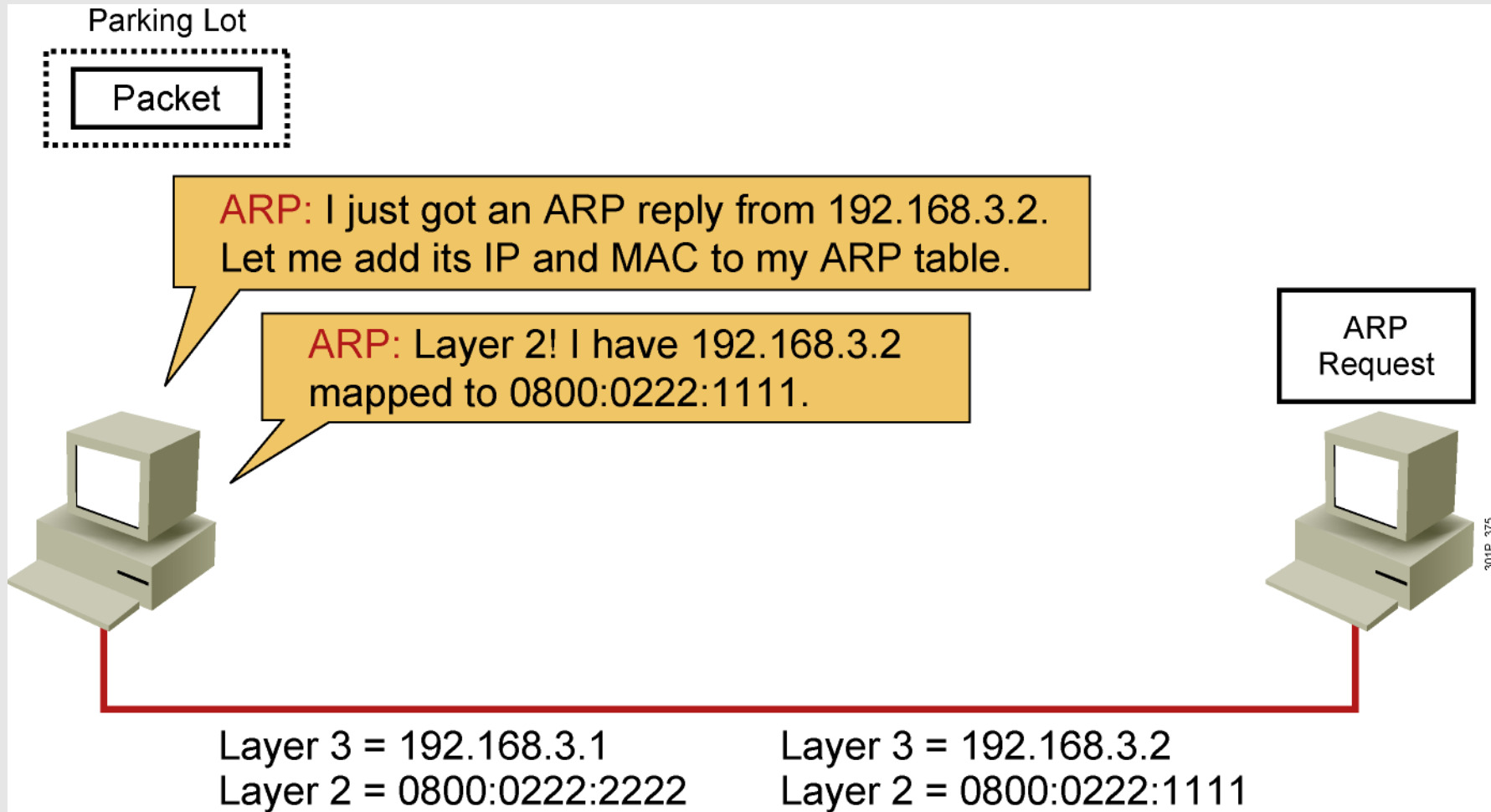
Host-to-Host Packet Delivery (11 of 22)



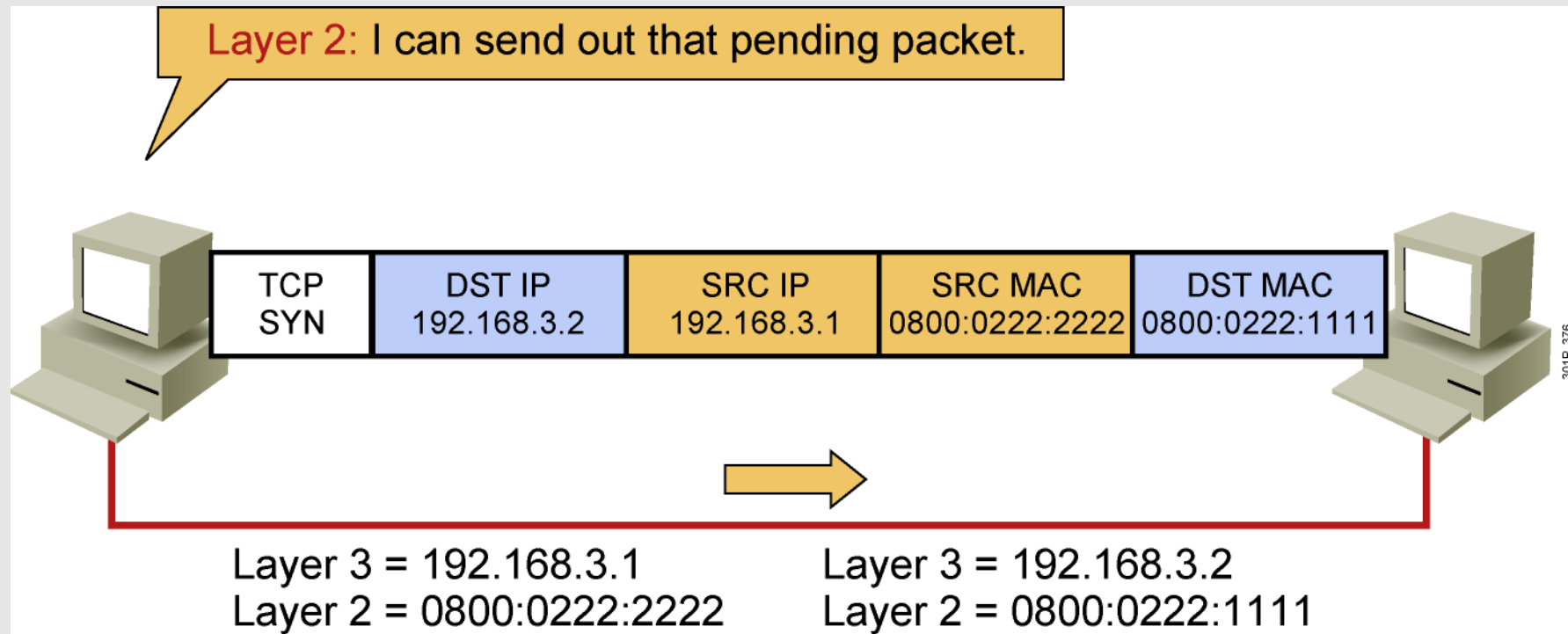
Host-to-Host Packet Delivery (12 of 22)



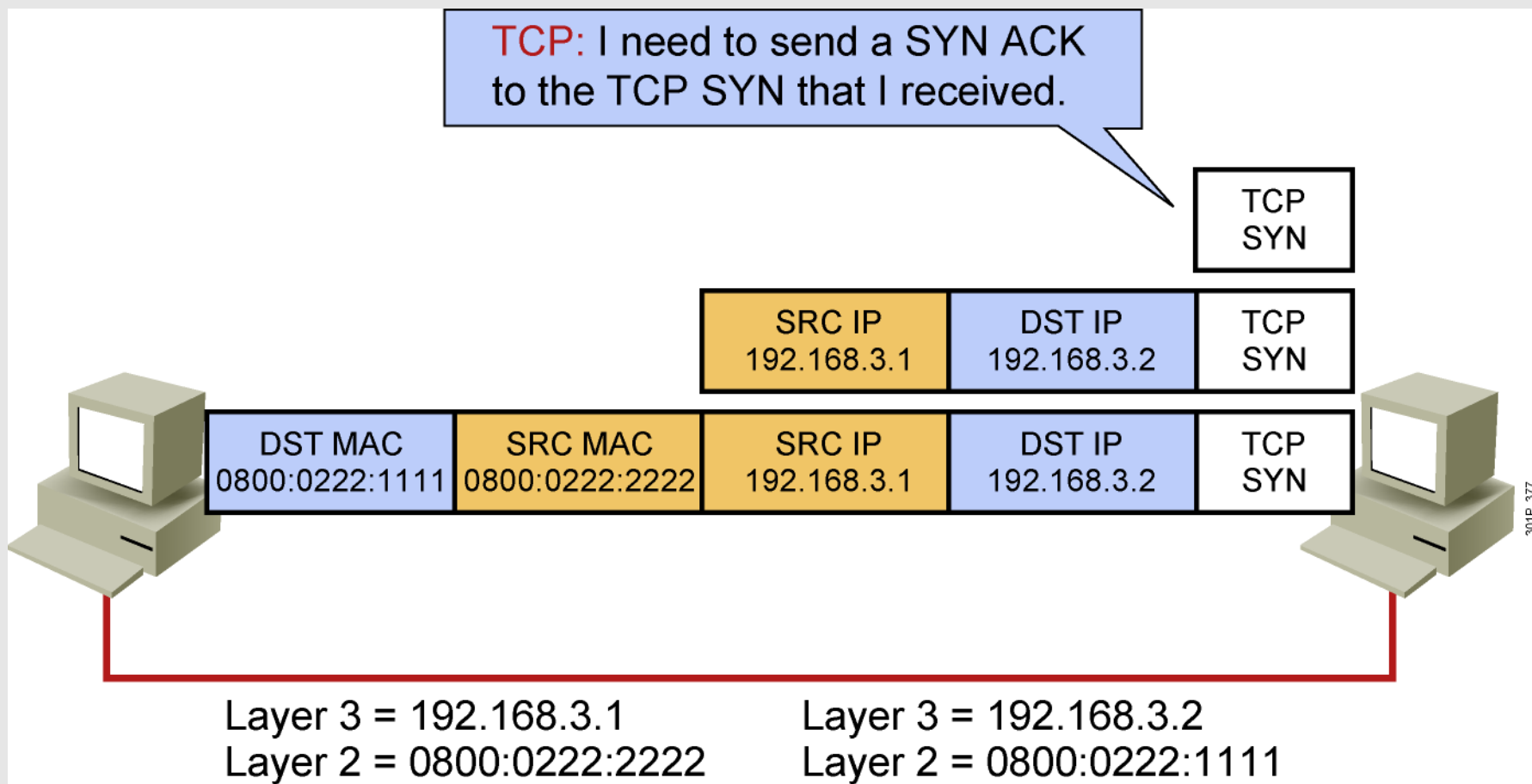
Host-to-Host Packet Delivery (13 of 22)



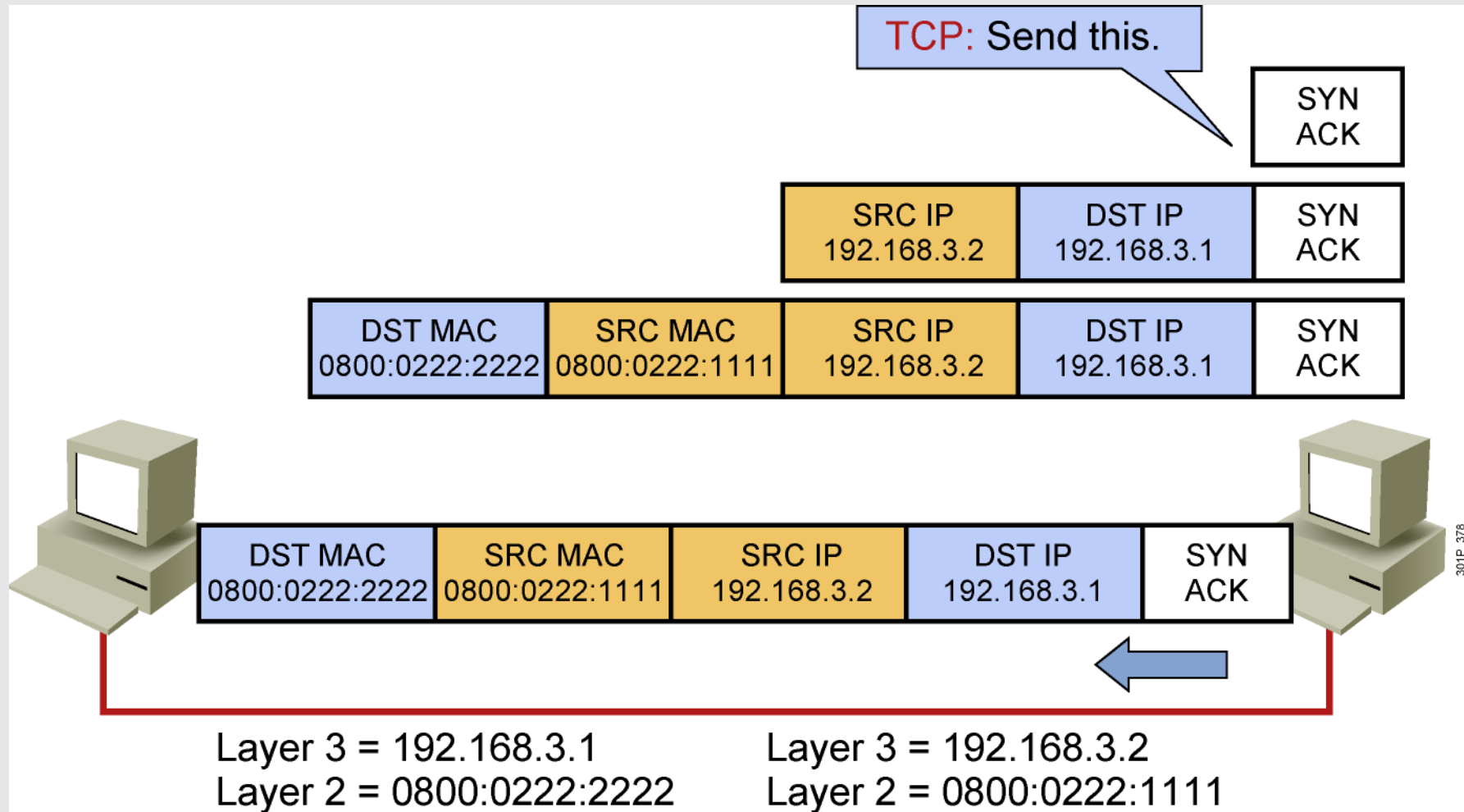
Host-to-Host Packet Delivery (14 of 22)



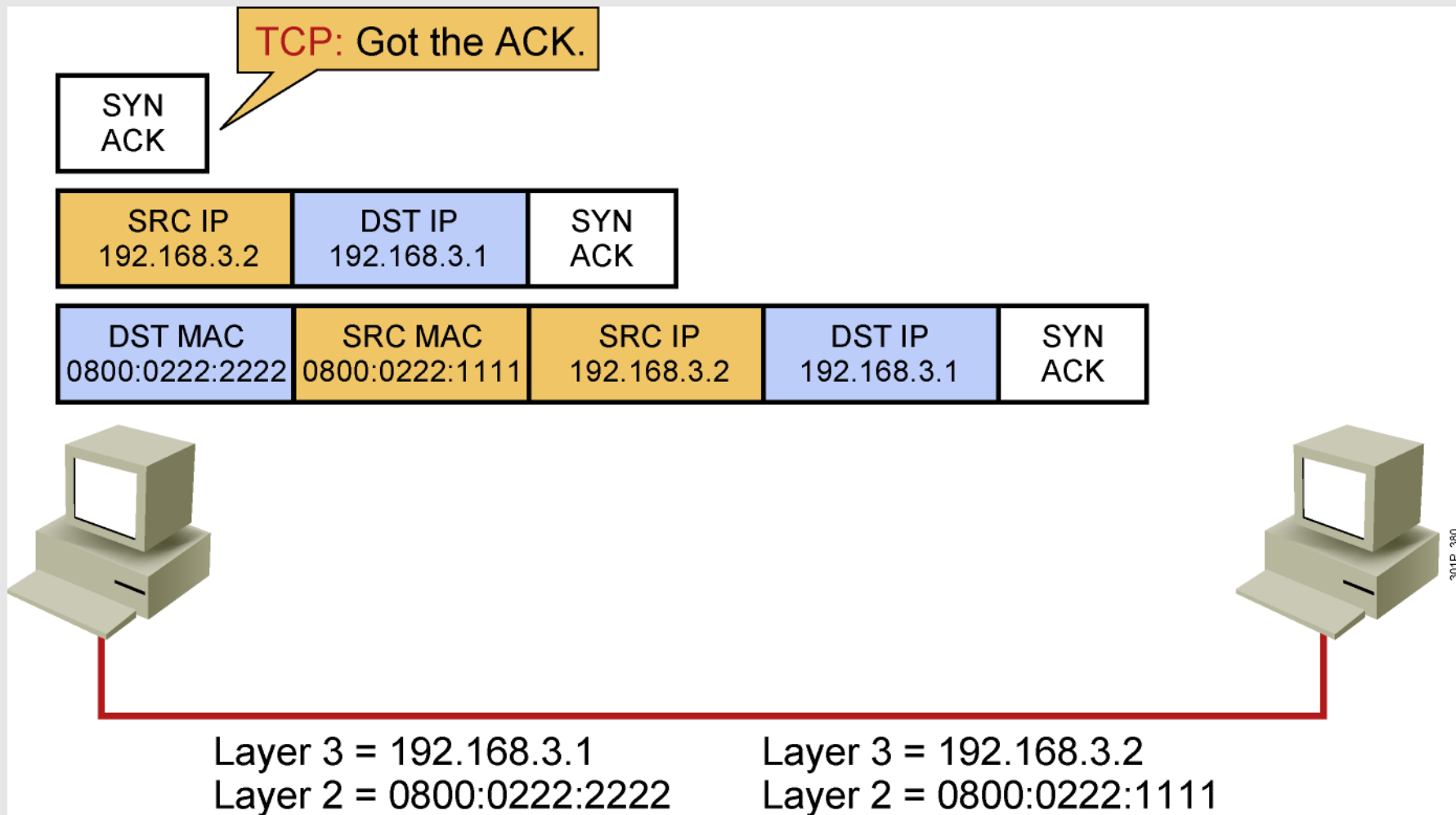
Host-to-Host Packet Delivery (15 of 22)



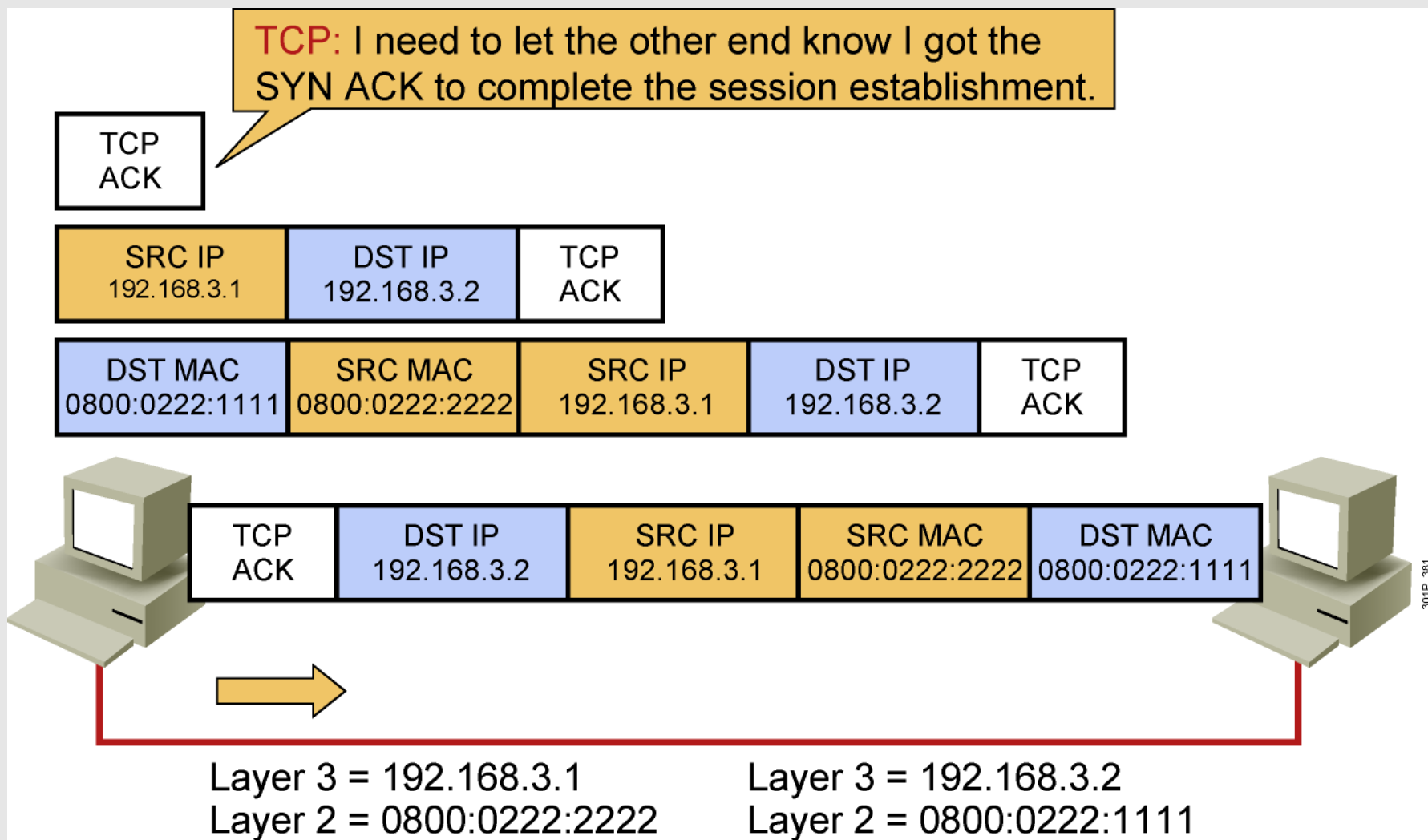
Host-to-Host Packet Delivery (16 of 22)



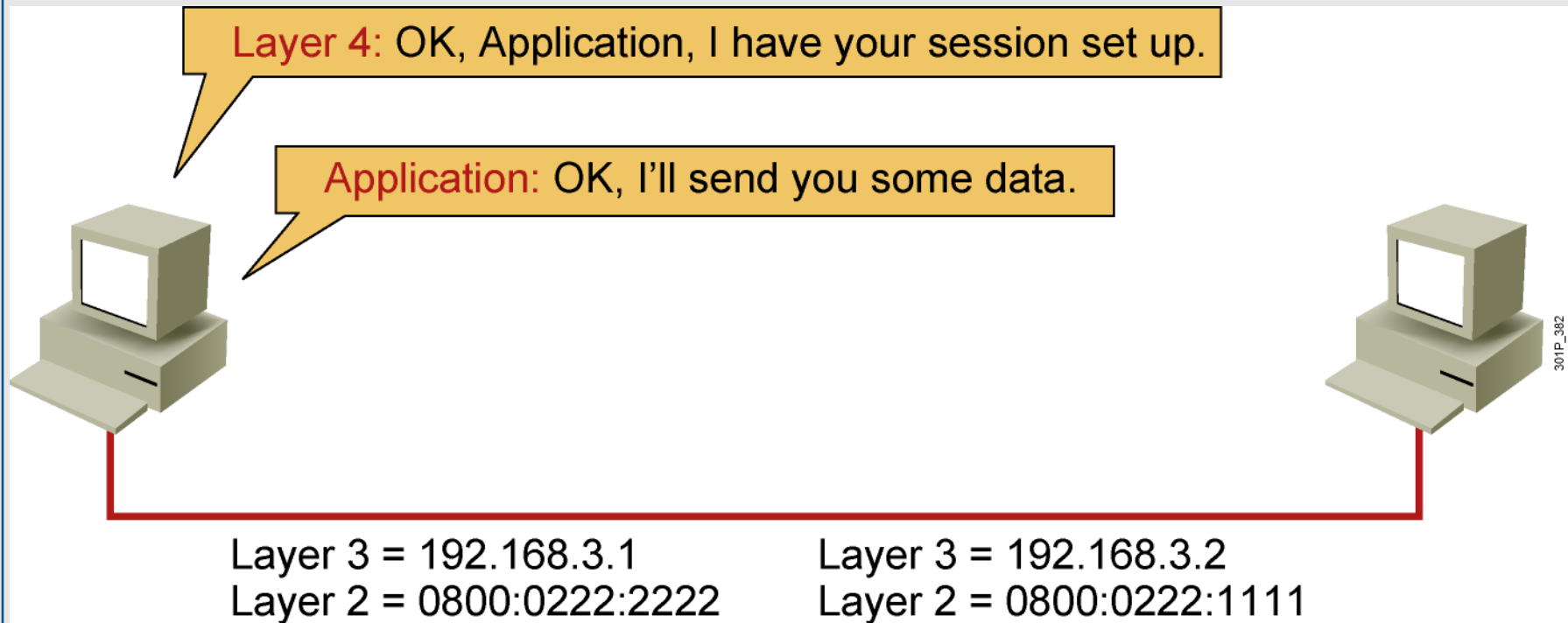
Host-to-Host Packet Delivery (17 of 22)



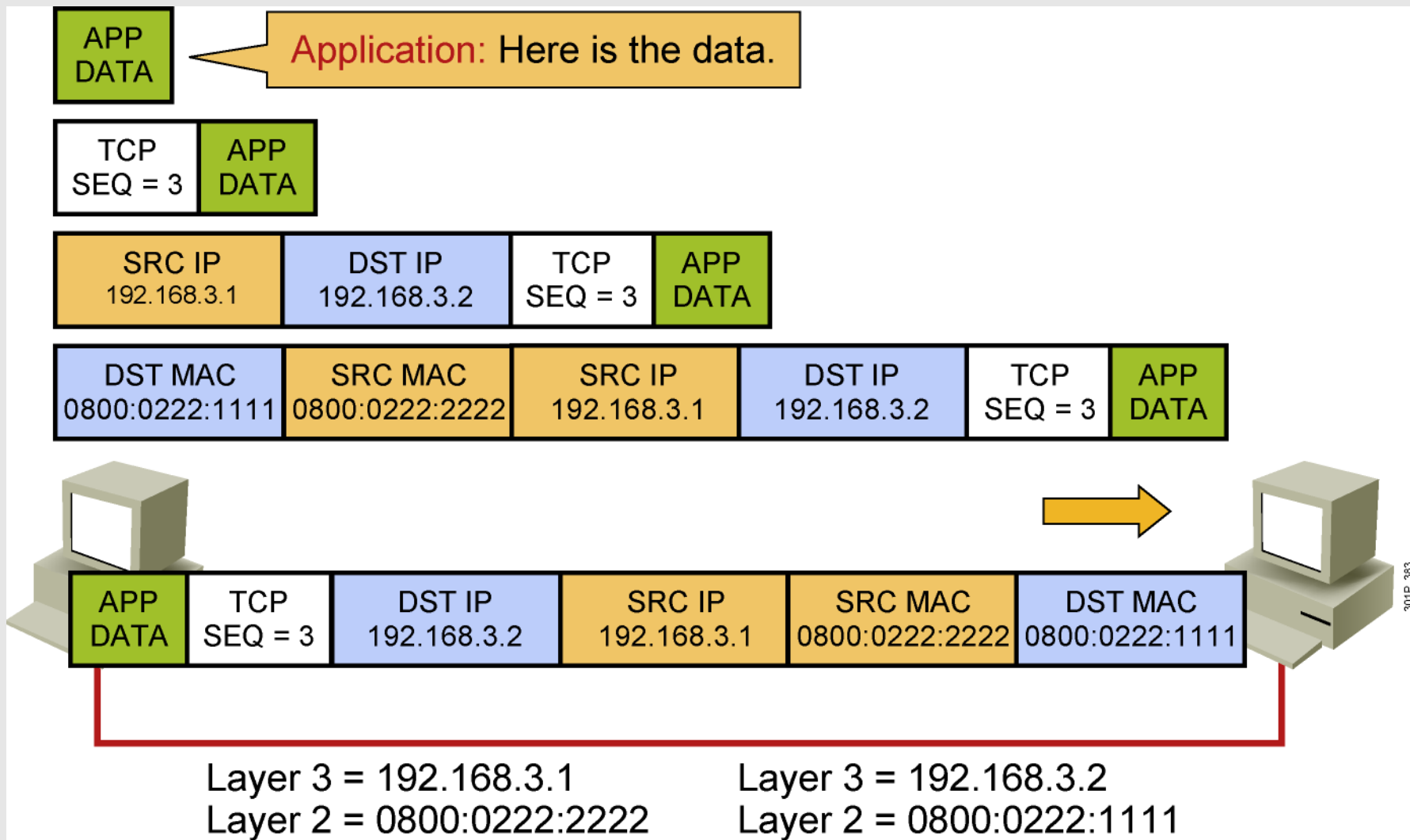
Host-to-Host Packet Delivery (18 of 22)



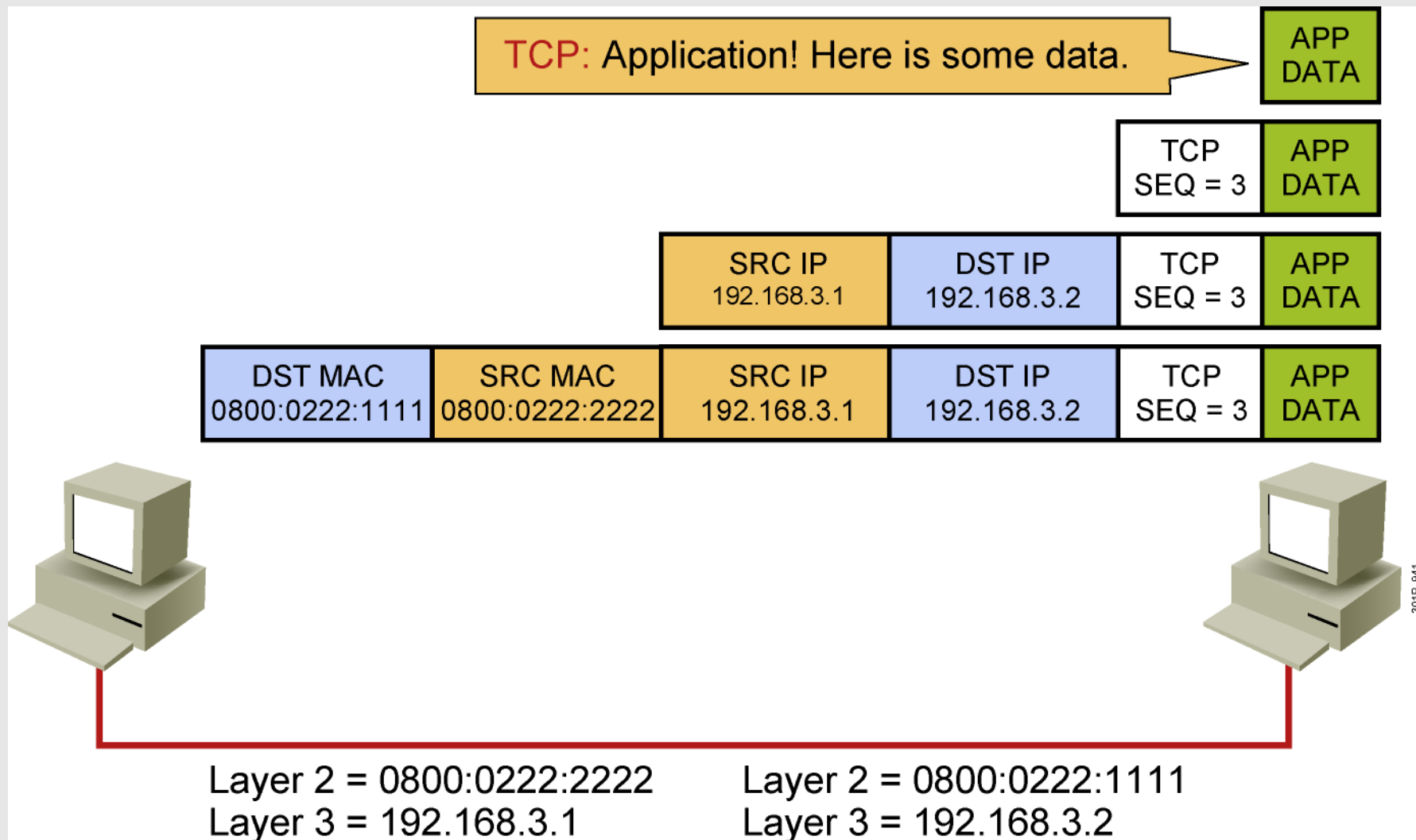
Host-to-Host Packet Delivery (19 of 22)



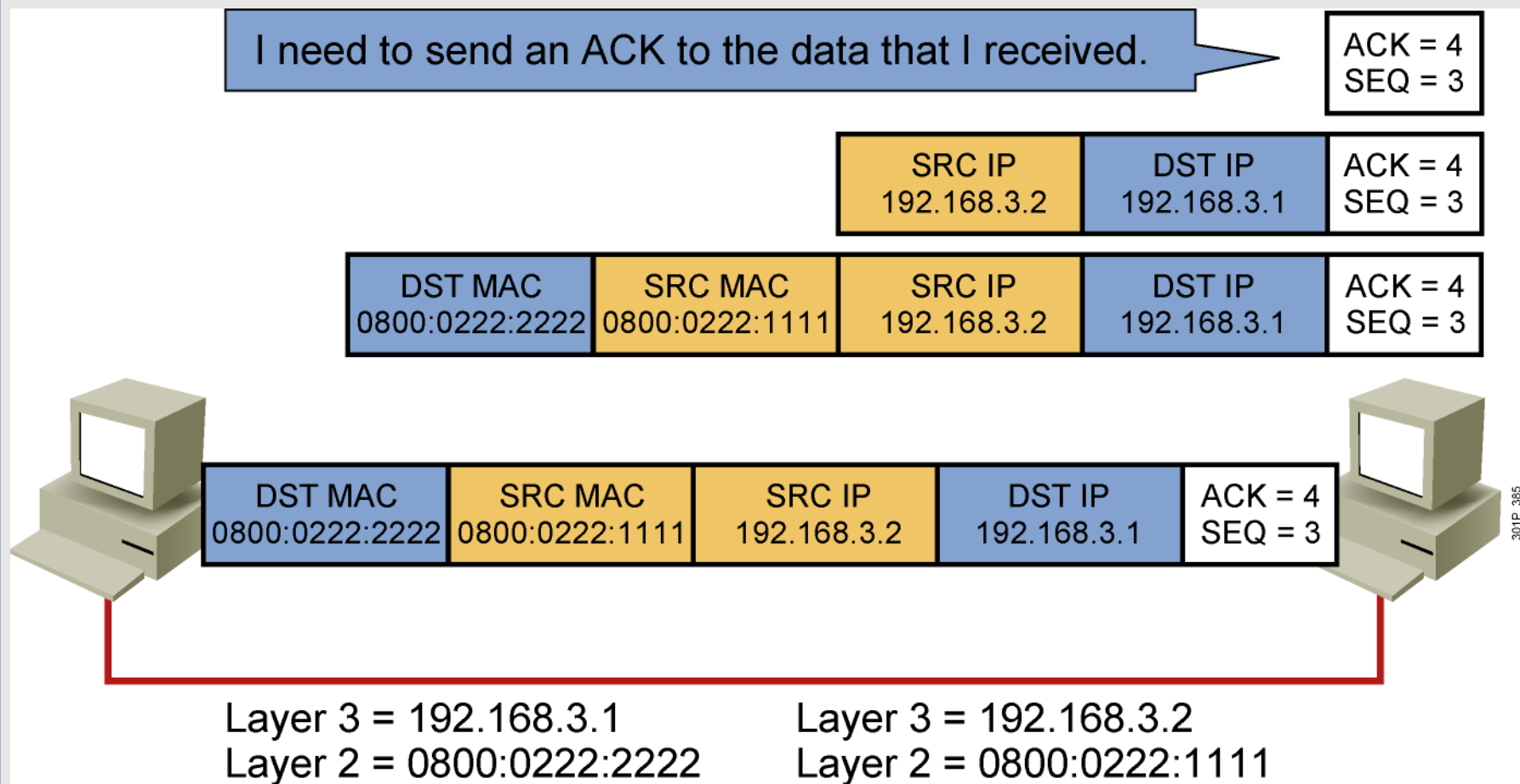
Host-to-Host Packet Delivery (20 of 22)



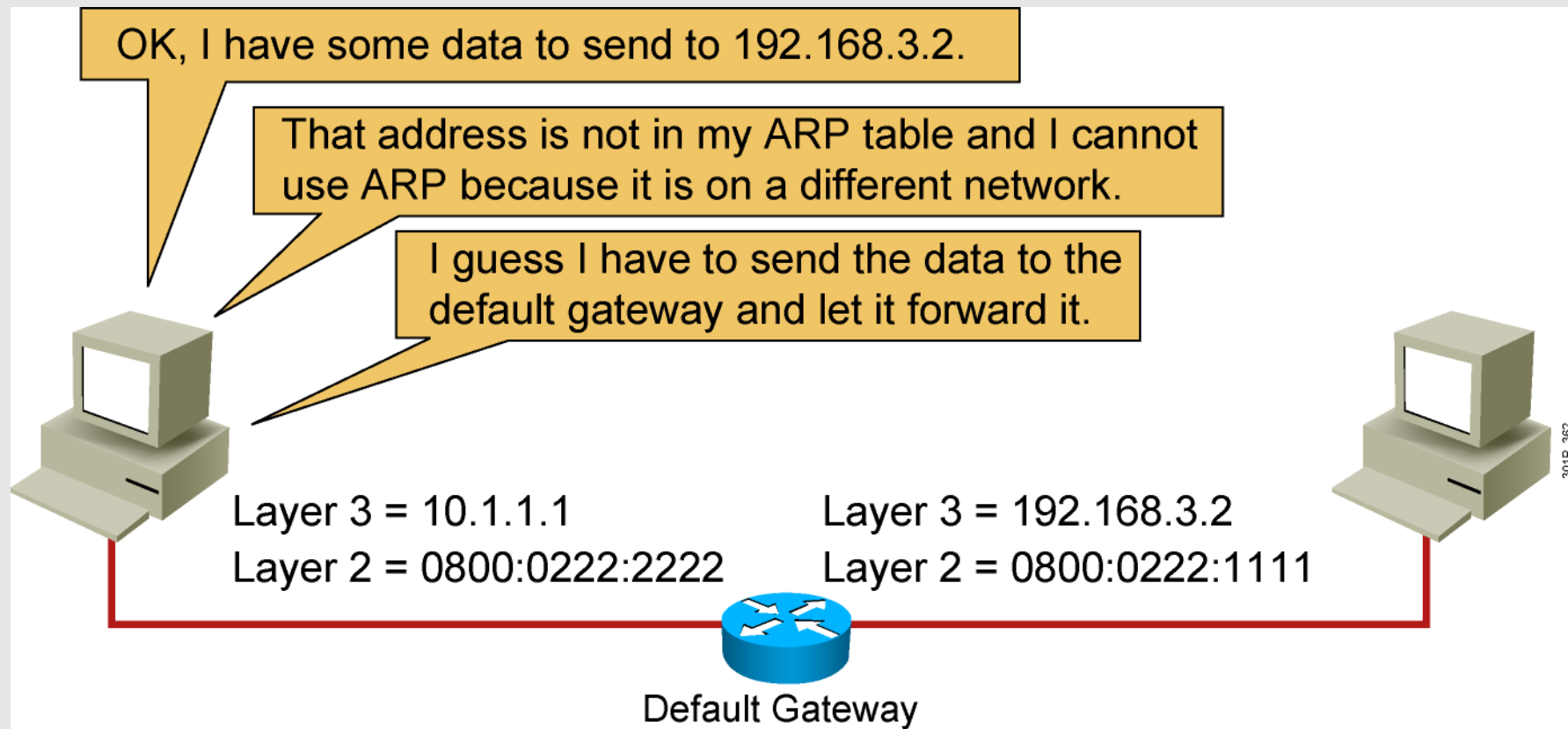
Host-to-Host Packet Delivery (21 of 22)



Host-to-Host Packet Delivery (22 of 22)



Default Gateway



Host-Based Tools: ping

C:\WINDOWS\system32\cmd.exe

C:\>ping example.com

Pinging example.com [192.0.34.166] with 32 bytes of data:

Reply from 192.0.34.166: bytes=32 time=19ms TTL=45

Reply from 192.0.34.166: bytes=32 time=18ms TTL=45

Reply from 192.0.34.166: bytes=32 time=19ms TTL=45

Reply from 192.0.34.166: bytes=32 time=17ms TTL=45

Ping statistics for 192.0.34.166:

 Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),

 Approximate round trip times in milli-seconds:

 Minimum = 17ms, Maximum = 19ms, Average = 18ms

C:\>

Host-Based Tools: Table

```

C:\WINNT\system32\cmd.exe
D:\>arp -a

Interface: 192.168.1.101 on Interface 0x1000003
  Internet Address      Physical Address      Type
  192.168.1.1           00-04-5a-22-ec-c7     dynamic
  192.168.1.40          00-02-4b-cc-d6-d9     dynamic
  192.168.1.42          00-02-fd-65-9f-82     dynamic
  192.168.1.43          00-03-6b-09-59-29     dynamic
  192.168.1.100         00-02-4b-cc-d6-d0     dynamic
  192.168.1.135         00-03-6d-1e-6a-a5     dynamic
  192.168.1.149         00-50-8b-f7-cf-59     dynamic

D:\>_
  
```

Host-Based Tools: tracert

```

C:\WINDOWS\system32\cmd.exe
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\Documents and Settings\pvancil>tracert yahoo.com

Tracing route to yahoo.com [66.94.234.13]
over a maximum of 30 hops:

  1      1 ms      1 ms      1 ms      rtp-pvancil-vpn.cisco.com [10.83.2.161]
  2      67 ms     59 ms     57 ms     rtp5-access-sdg1-t10.cisco.com [10.82.96.2]
  3      58 ms     58 ms     57 ms     rtp5-access-gw1-vlan100.cisco.com [10.83.100.9]

  4      58 ms     58 ms     57 ms     rtp7-bb-gw1-ge5-8.cisco.com [10.81.254.117]
  5      60 ms     59 ms     57 ms     rtp5-rbb-gw1-ge4-2.cisco.com [10.81.254.181]
  6      58 ms     59 ms     60 ms     rtp5-corp-gw1.cisco.com [10.81.254.194]
  7      59 ms     58 ms     58 ms     rtp7-dmzbb-gw1.cisco.com [64.102.241.135]
  8      60 ms     60 ms     58 ms     rtp1-isp-gw1-g1-2.cisco.com [64.102.254.193]
  9      59 ms     58 ms     58 ms     rtp5-isp-ssw1-v110.cisco.com [64.102.254.174]
 10      59 ms     59 ms     58 ms     rtp5-isp-ssw1-v151.cisco.com [64.102.254.249]
 11      60 ms     60 ms     59 ms     rtp1-isp-gw1-v100.cisco.com [64.102.254.165]
 12      64 ms     66 ms     65 ms     sl-gw20-rly-1-0.sprintlink.net [144.232.244.209]

 13      64 ms     66 ms     68 ms     sl-bb20-rly-3-2.sprintlink.net [144.232.14.29]
 14      66 ms     64 ms     65 ms     sl-bb24-rly-9-0.sprintlink.net [144.232.14.122]

 15      66 ms     66 ms     69 ms     sl-st22-ash-5-0.sprintlink.net [144.232.20.155]

 16      67 ms     68 ms     67 ms     te-4-2.car4.Washington1.Level3.net [4.68.111.169]
 17      67 ms    127 ms     68 ms     ae-2-54.bbr2.Washington1.Level3.net [4.68.121.97]

 18     136 ms      *      137 ms     as-1-0.bbr2.SanJose1.Level3.net [64.159.0.242]
 19     134 ms    136 ms    133 ms     ae-23-52.car3.SanJose1.Level3.net [4.68.123.45]

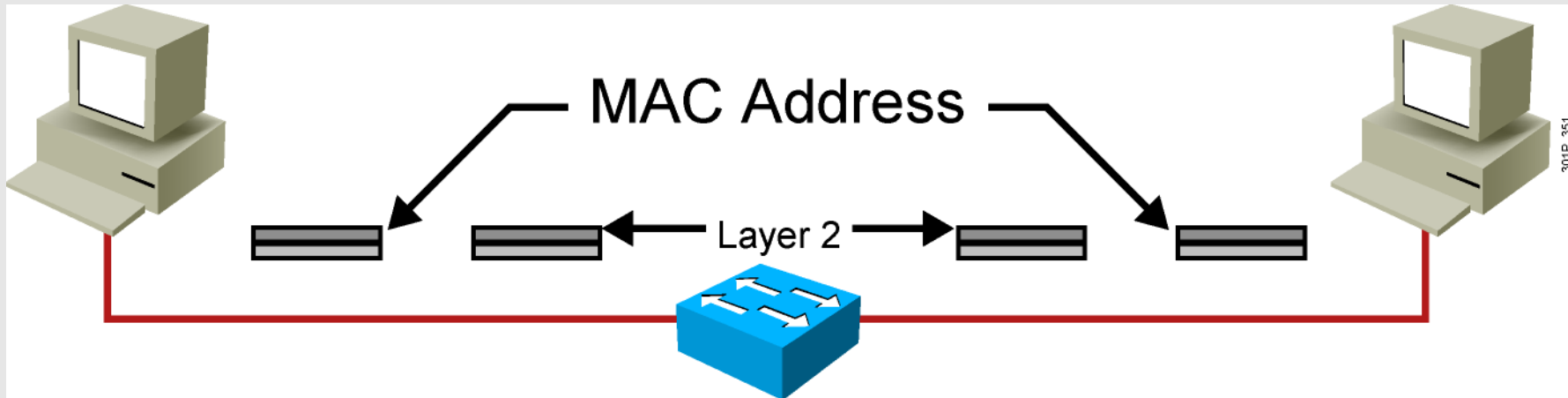
 20     142 ms    135 ms    135 ms     4.71.112.14
 21     133 ms    134 ms    134 ms     ge-3-0-0-p271.msr2.scd.yahoo.com [216.115.106.19]
 22     135 ms    135 ms    135 ms     ten-2-3-bas1.scd.yahoo.com [66.218.82.221]
 23     136 ms    136 ms    135 ms     w2.rc.vip.scd.yahoo.com [66.94.234.13]

Trace complete.

```

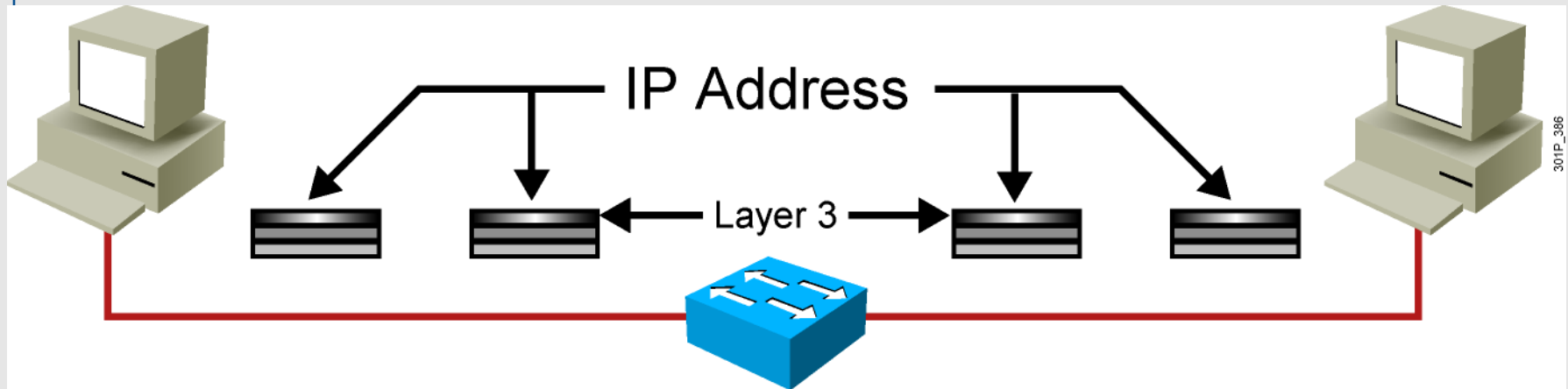
IV. Exploring the packet Delivery Process 2 (layer 2)

Layer 2 Addressing



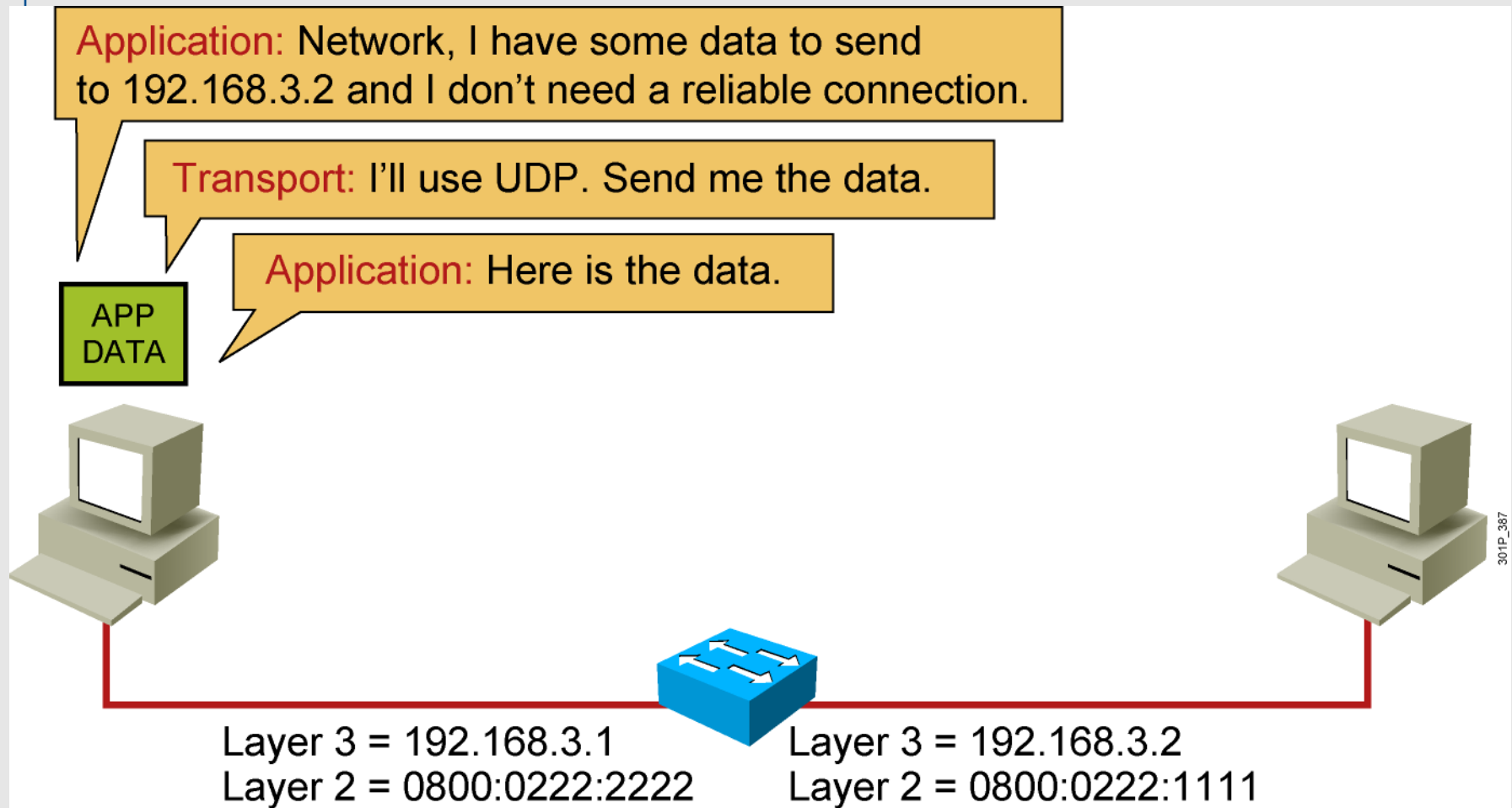
- Uses MAC address
- Assigned to end devices

Layer 3 Addressing

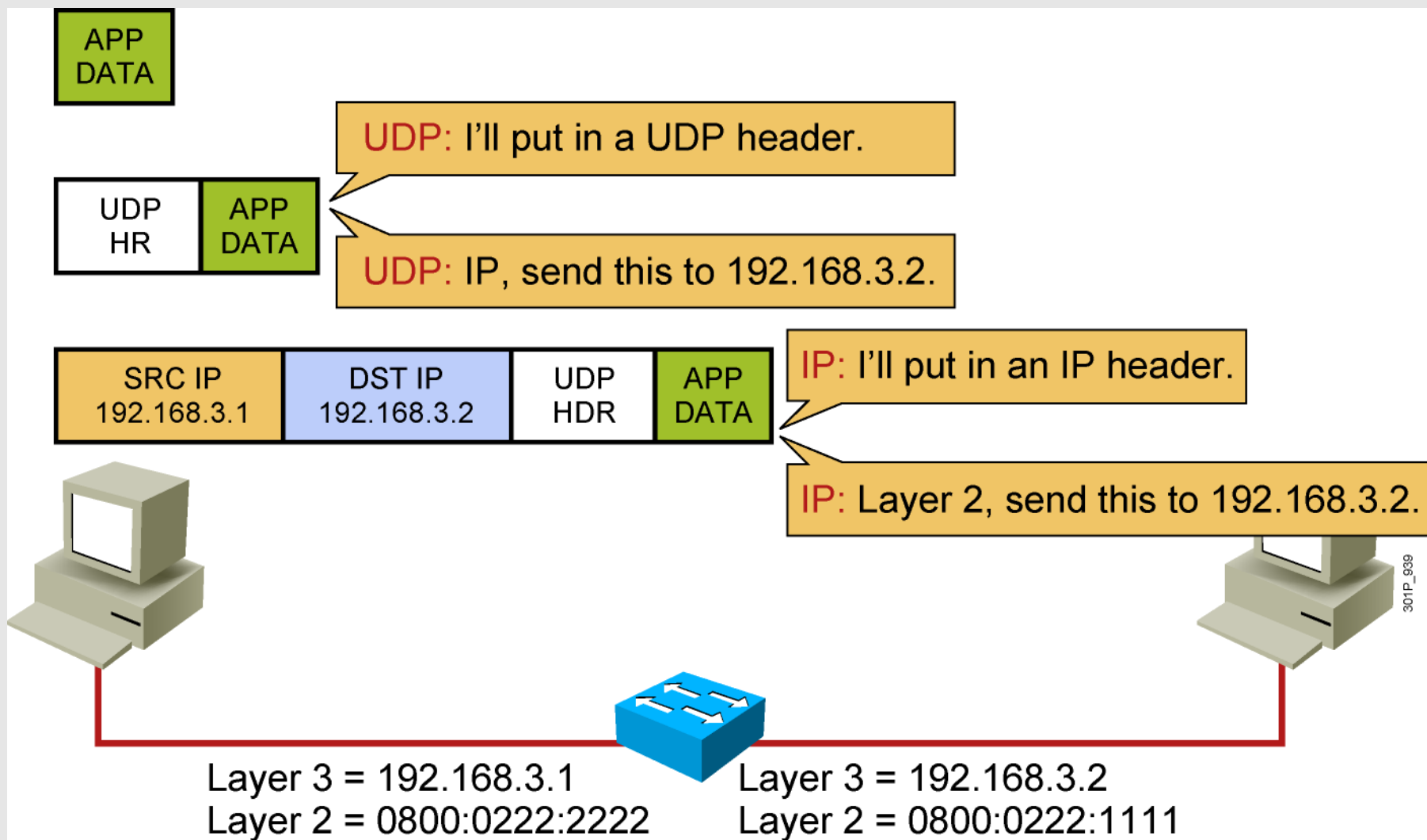


- Each NOS has its own Layer 3 address format.
- OSI uses NSAP.
- TCP/IP uses IP.

Host-to-Host Packet Delivery (1 of 10)



Host-to-Host Packet Delivery (2 of 10)

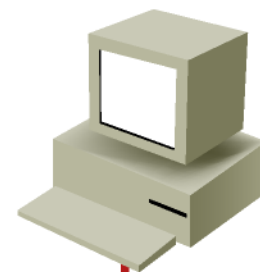
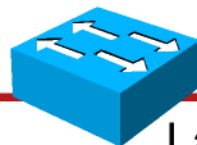
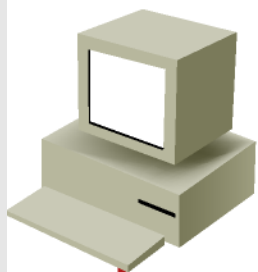


Host-to-Host Packet Delivery (3 of 10)

Layer 2: ARP, do you have a mapping for 192.168.3.2 ?

ARP: Is 192.168.3.2 in my ARP table? No, I guess Layer 2 will have to hold the packet while I resolve the addressing.

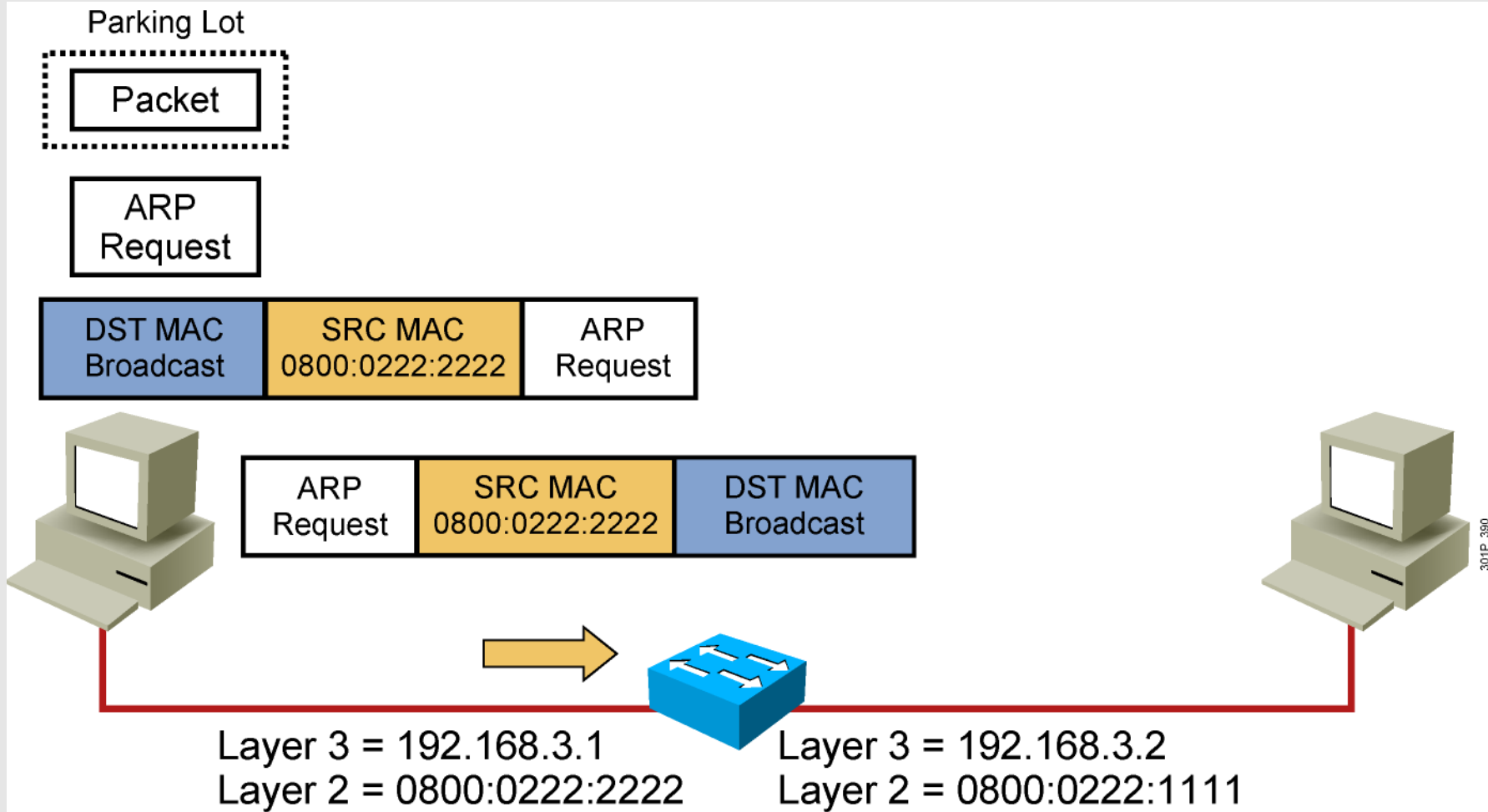
SRC IP 192.168.3.1	DST IP 192.168.3.2	UDP HDR	APP DATA
-----------------------	-----------------------	------------	-------------



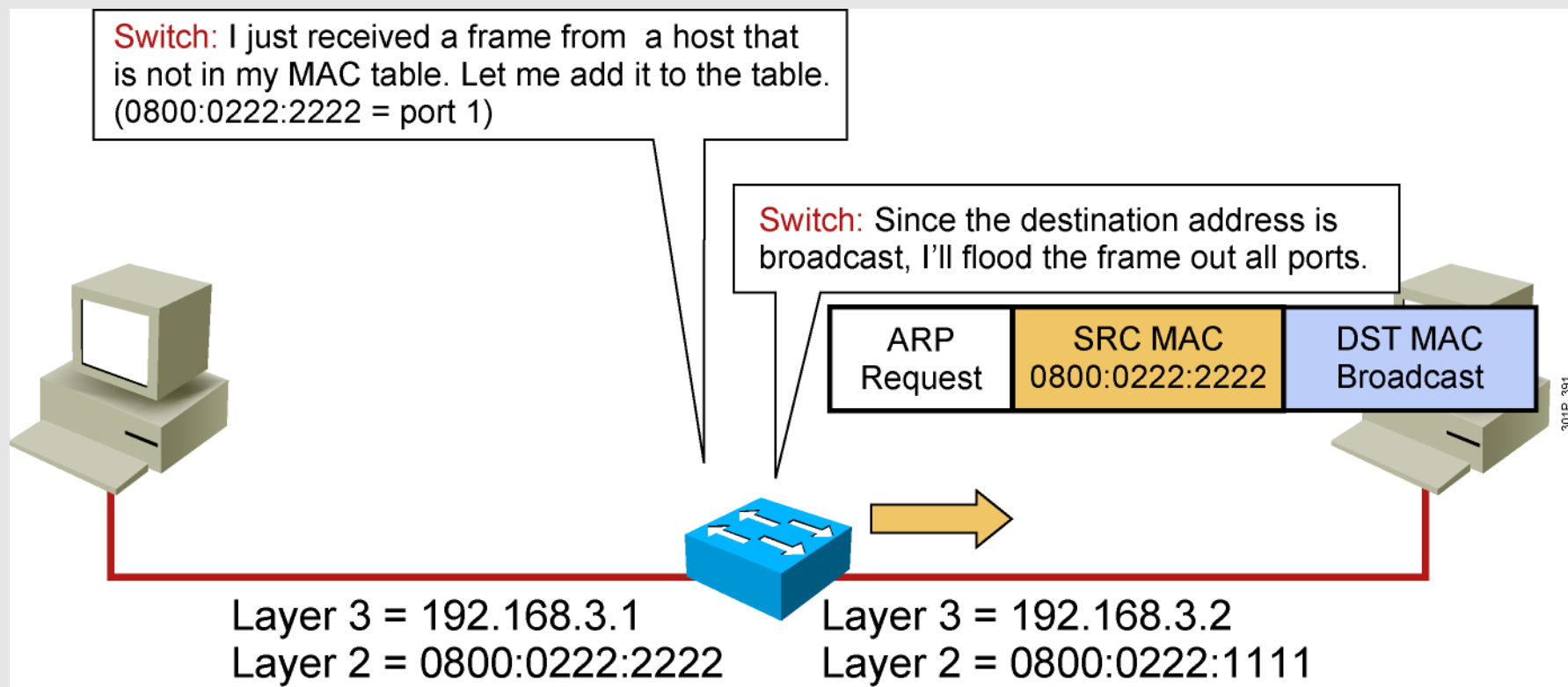
Layer 3 = 192.168.3.1
Layer 2 = 0800:0222:2222

Layer 3 = 192.168.3.2
Layer 2 = 0800:0222:1111

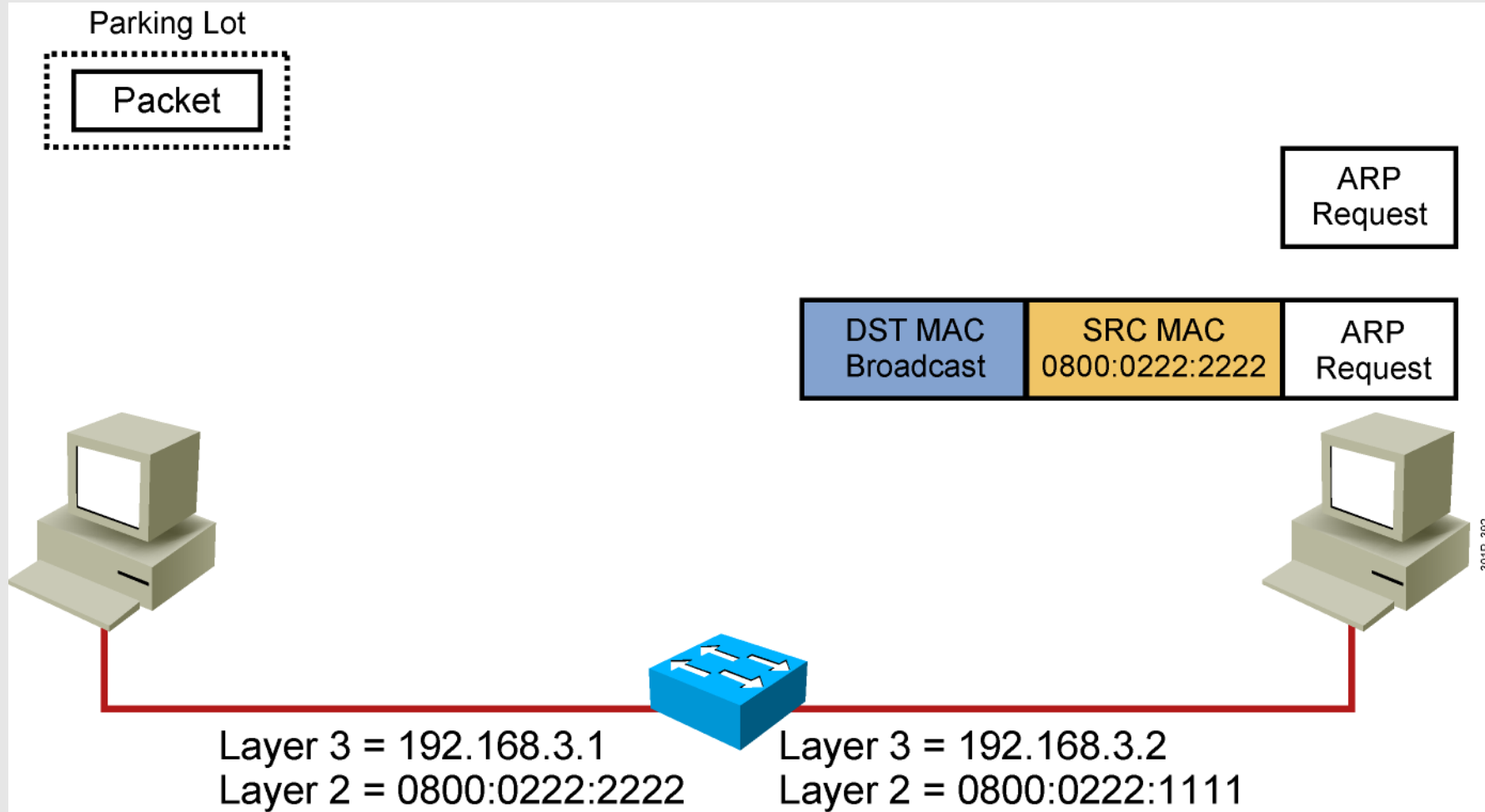
Host-to-Host Packet Delivery (4 of 10)



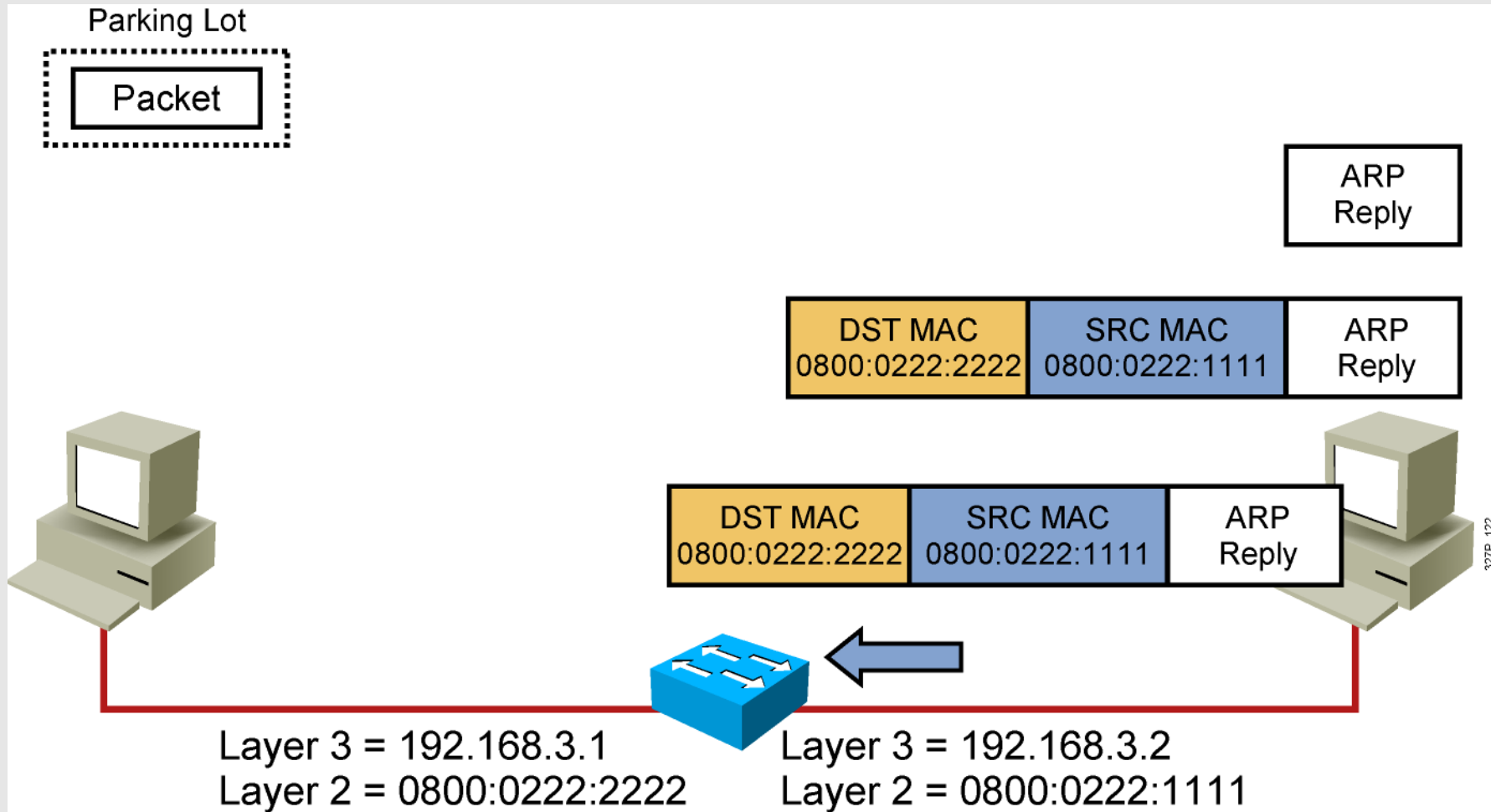
Host-to-Host Packet Delivery (5 of 10)



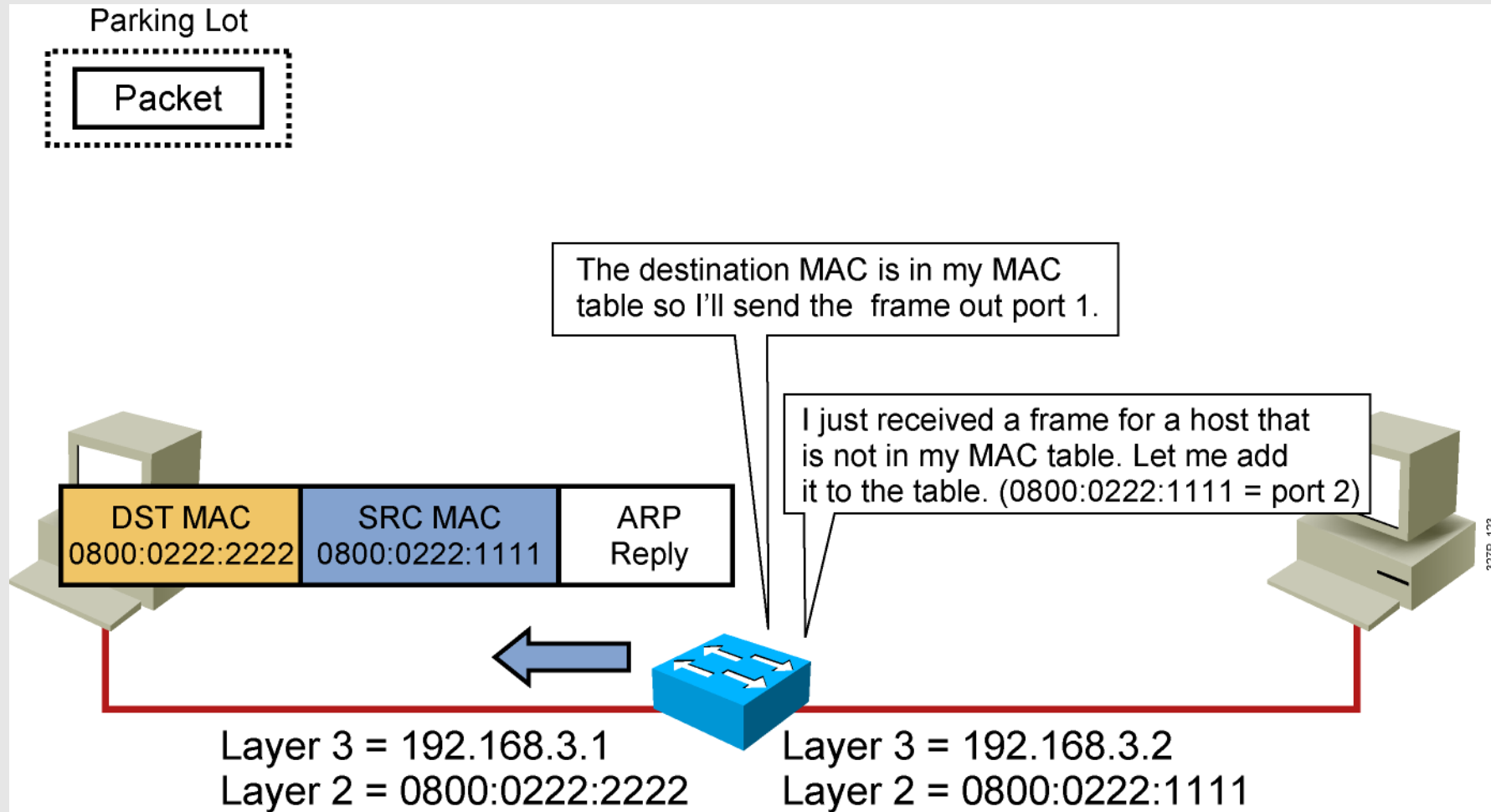
Host-to-Host Packet Delivery (6 of 10)



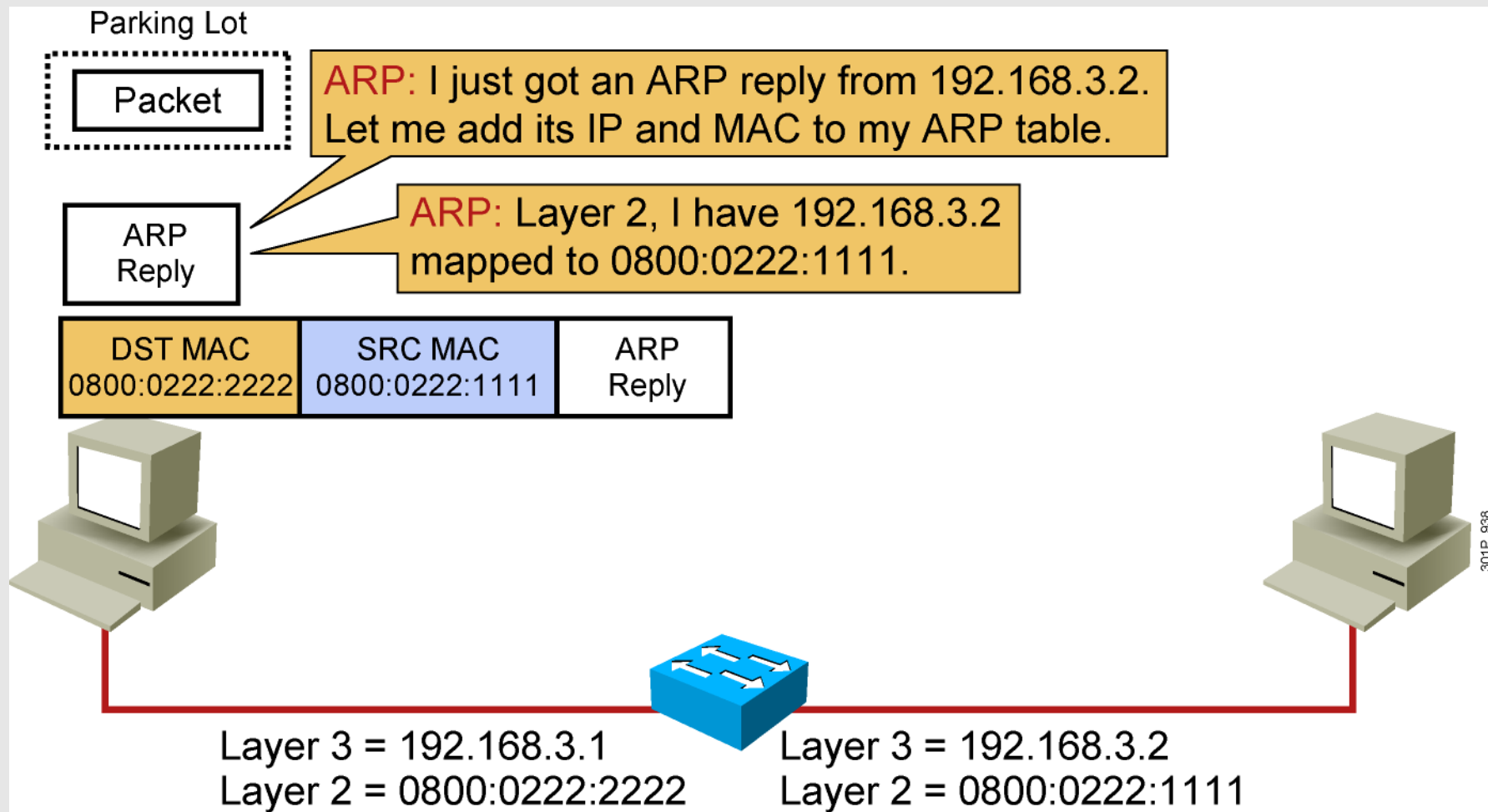
Host-to-Host Packet Delivery (7 of 10)



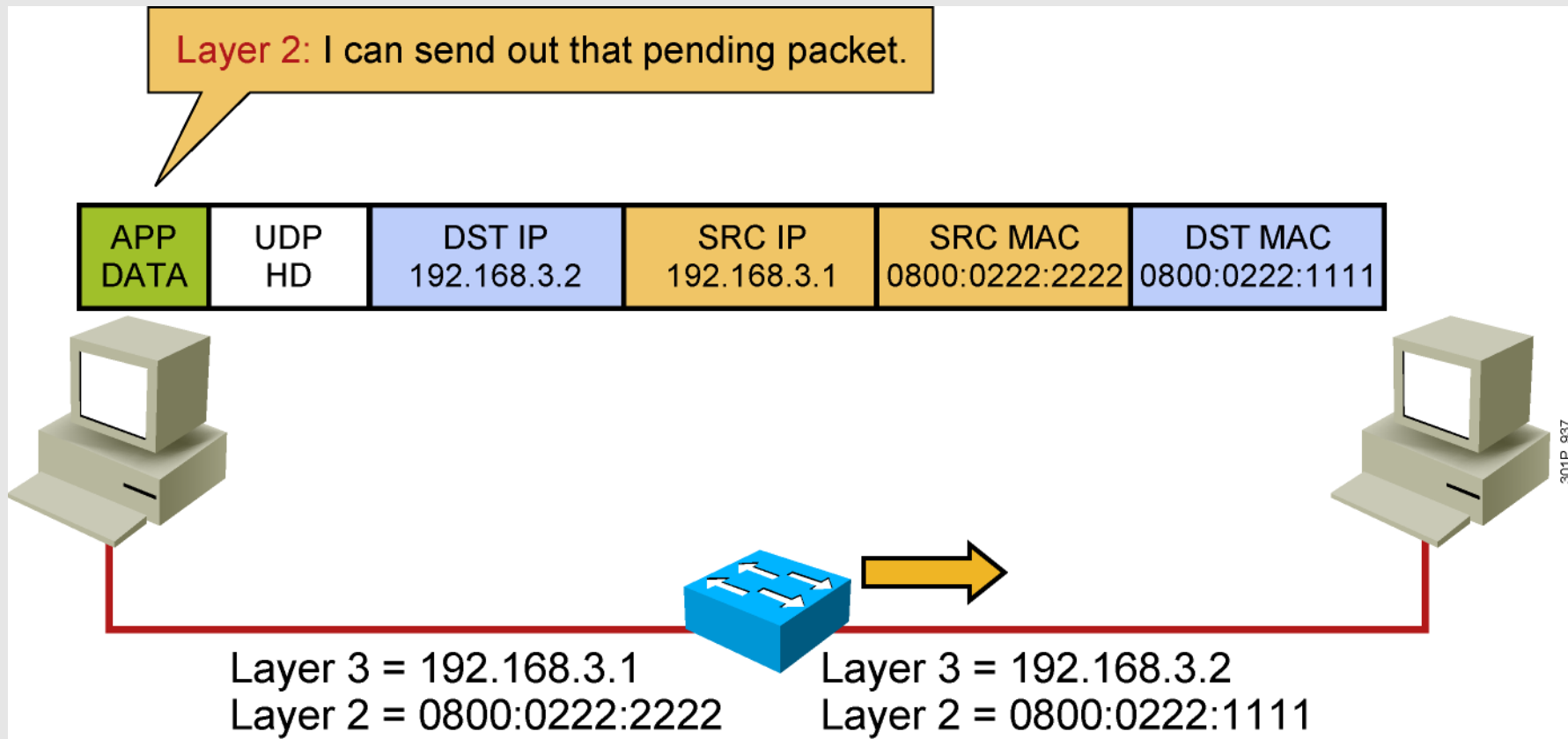
Host-to-Host Packet Delivery (8 of 10)



Host-to-Host Packet Delivery (9 of 10)

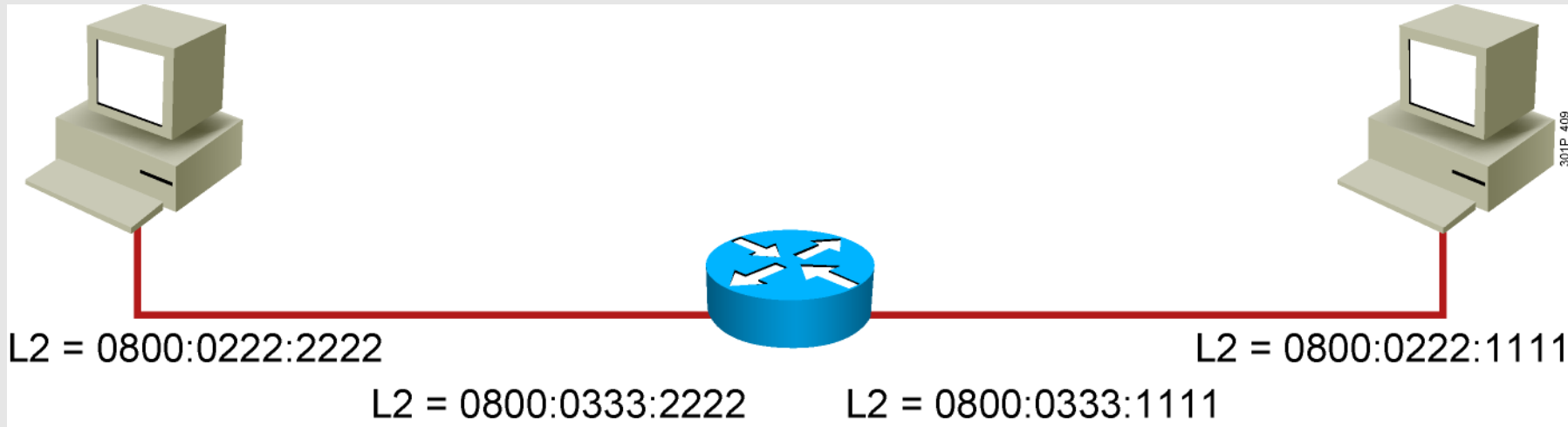


Host-to-Host Packet Delivery (10 of 10)

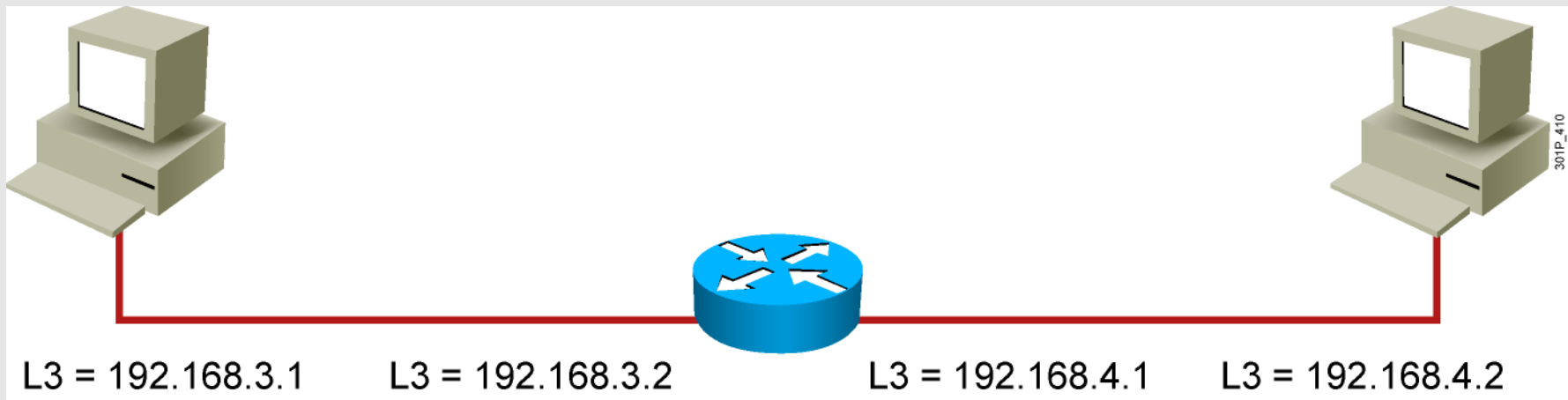


V. Exploring the packet Delivery Process 3 (layer 3)

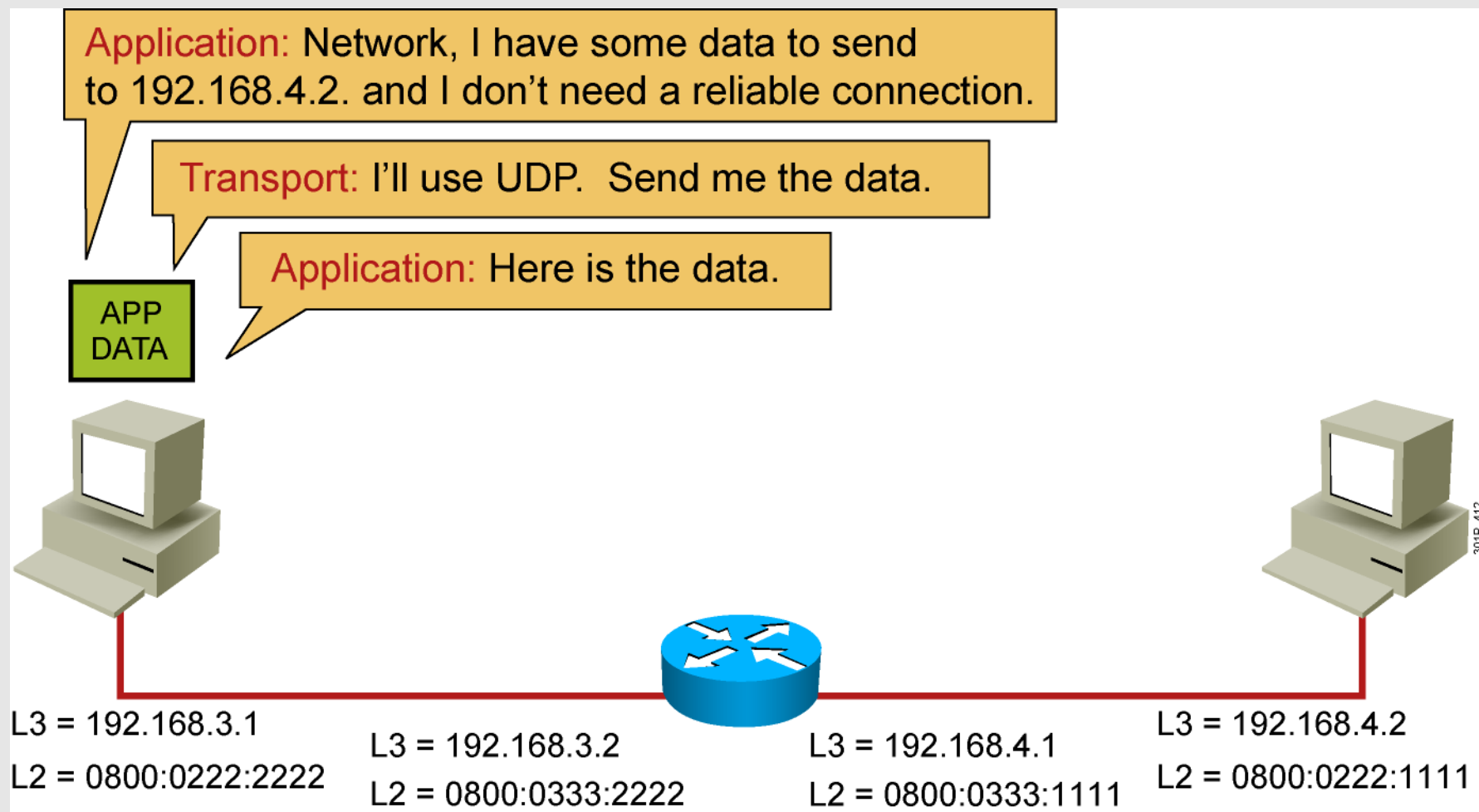
Layer 2 Addressing



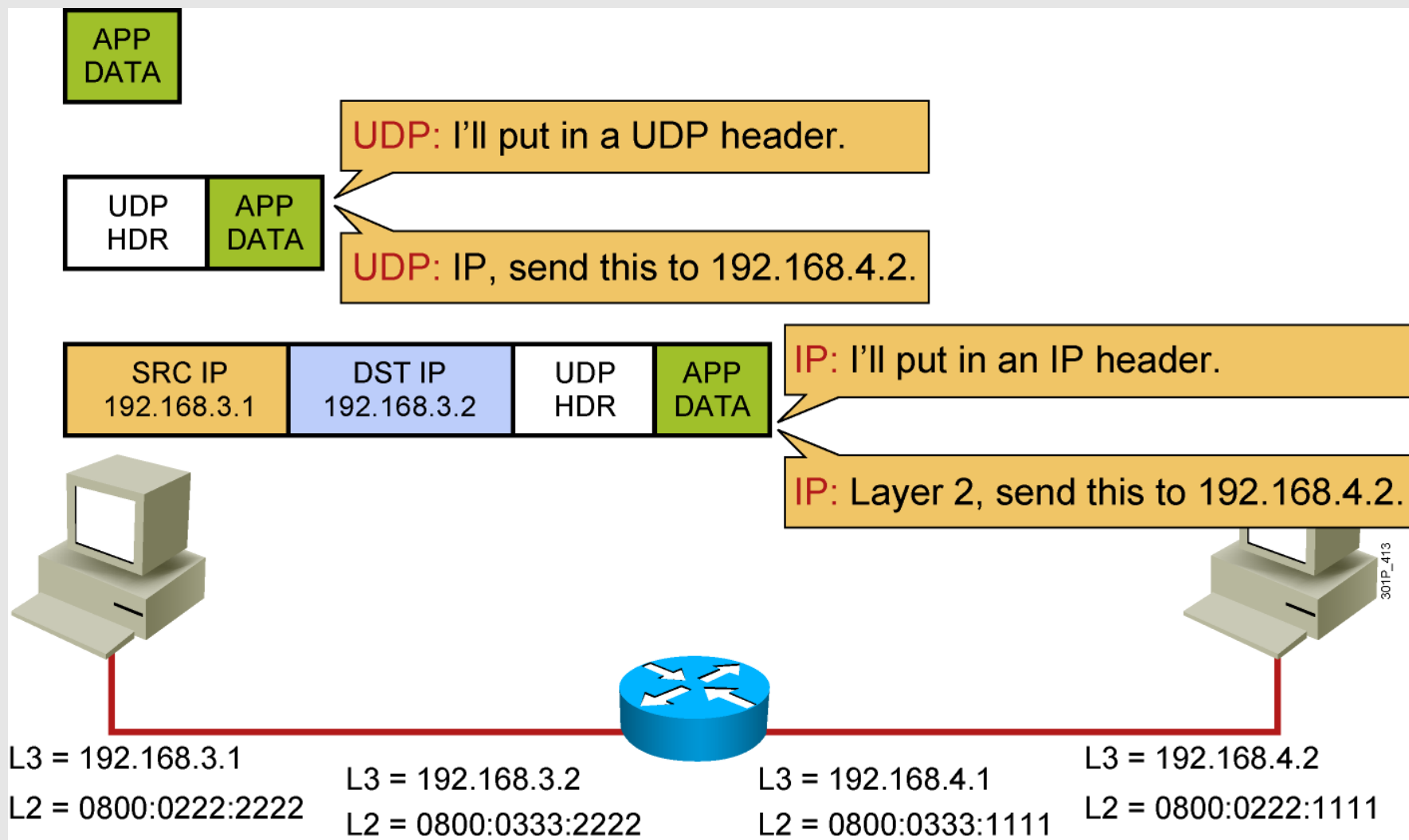
Layer 3 Addressing



Host-to-Host Packet Delivery (1 of 17)



Host-to-Host Packet Delivery (2 of 17)

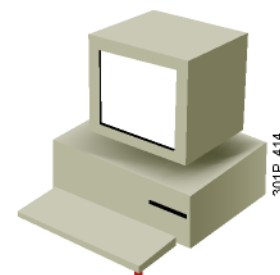
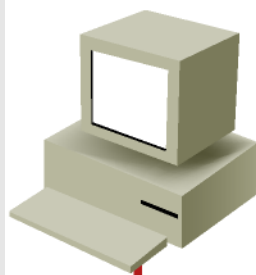


Host-to-Host Packet Delivery (3 of 17)

Layer 2: ARP, do you have a mapping for 192.168.4.2?

ARP: No, Layer 2 will have to hold the packet while I resolve the addressing.

SRC IP 192.168.3.1	DST IP 192.168.4.2	UDP HDR	APP DATA
-----------------------	-----------------------	------------	-------------



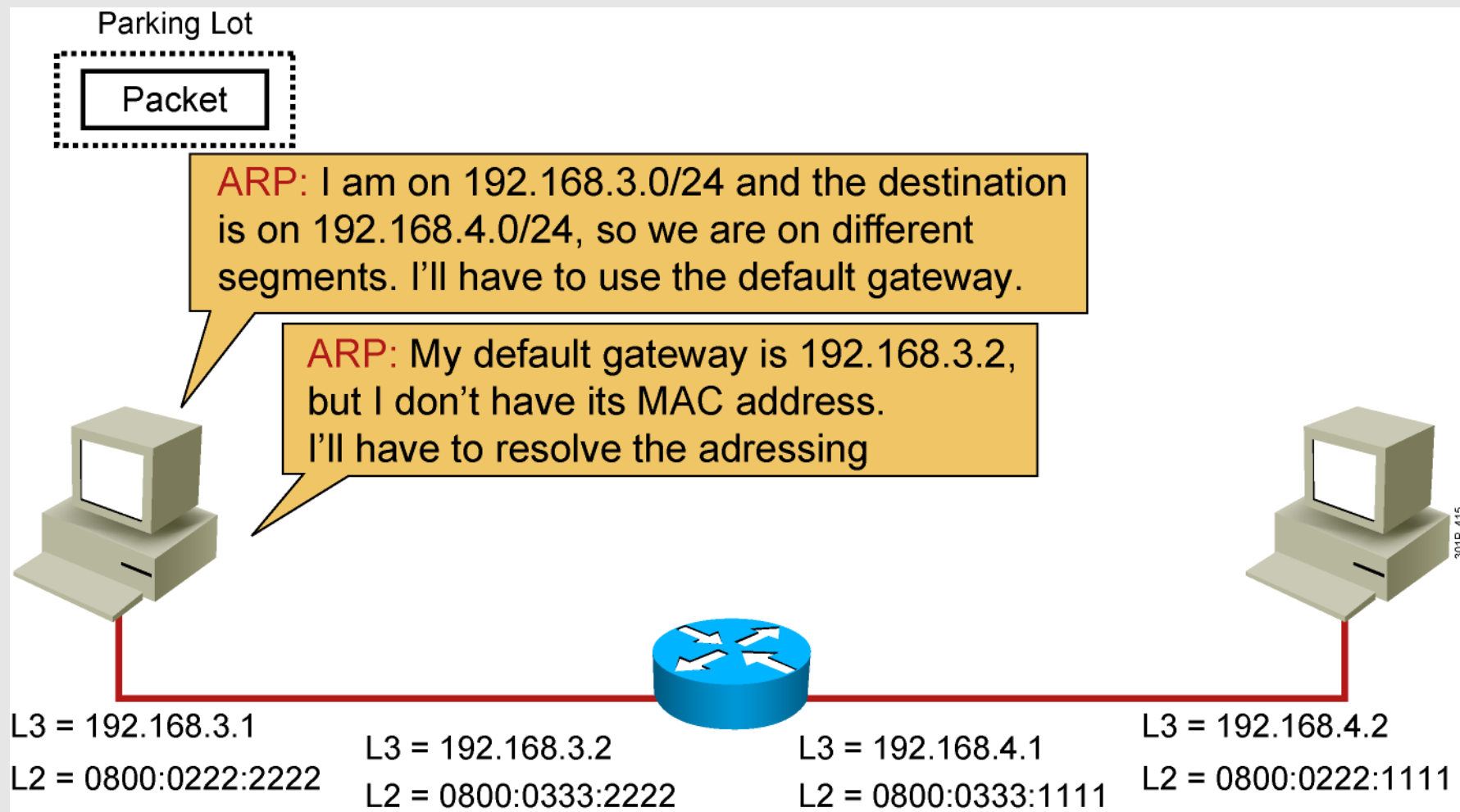
L3 = 192.168.3.1
L2 = 0800:0222:2222

L3 = 192.168.3.2
L2 = 0800:0333:2222

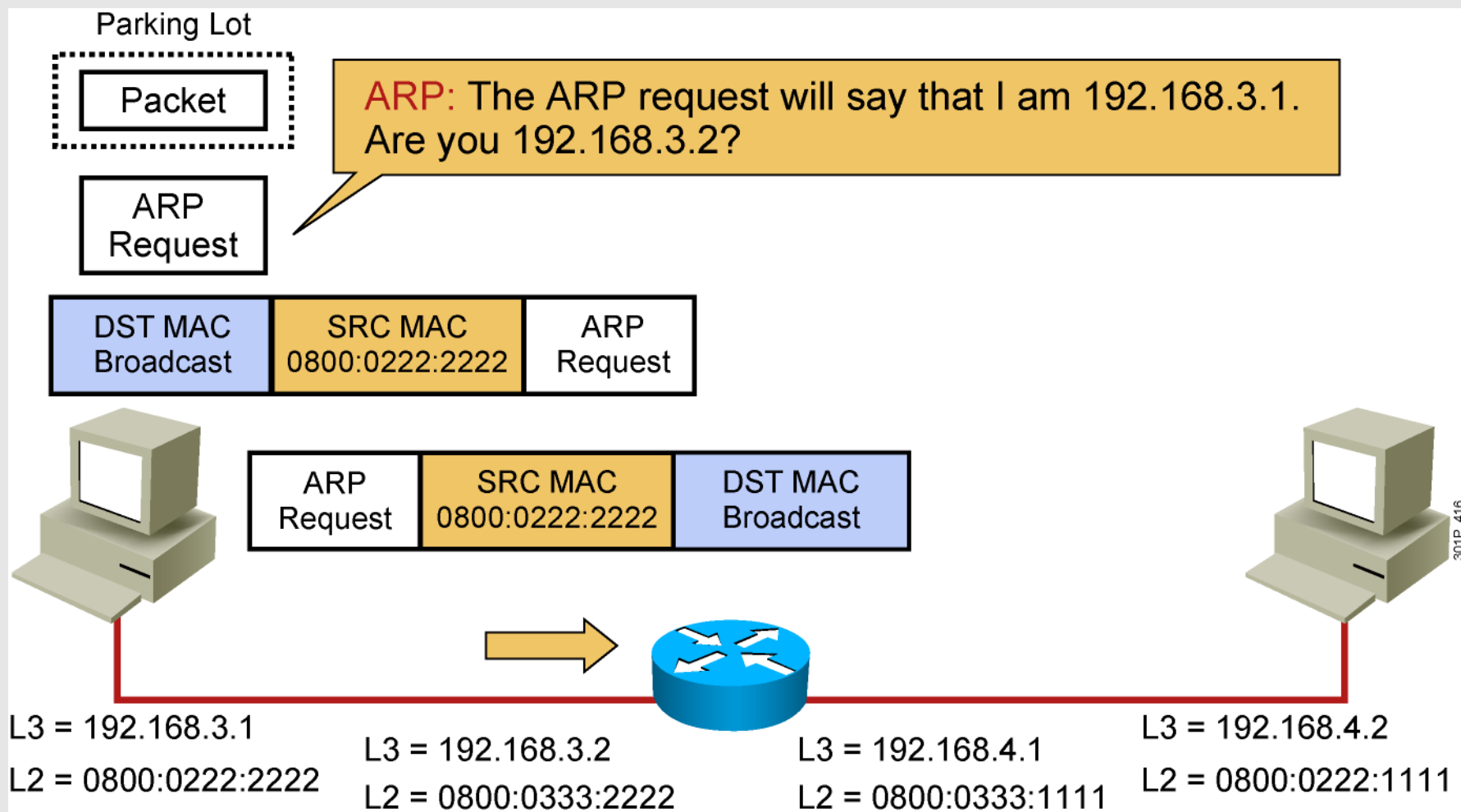
L3 = 192.168.4.1
L2 = 0800:0333:1111

L3 = 192.168.4.2
L2 = 0800:0222:1111

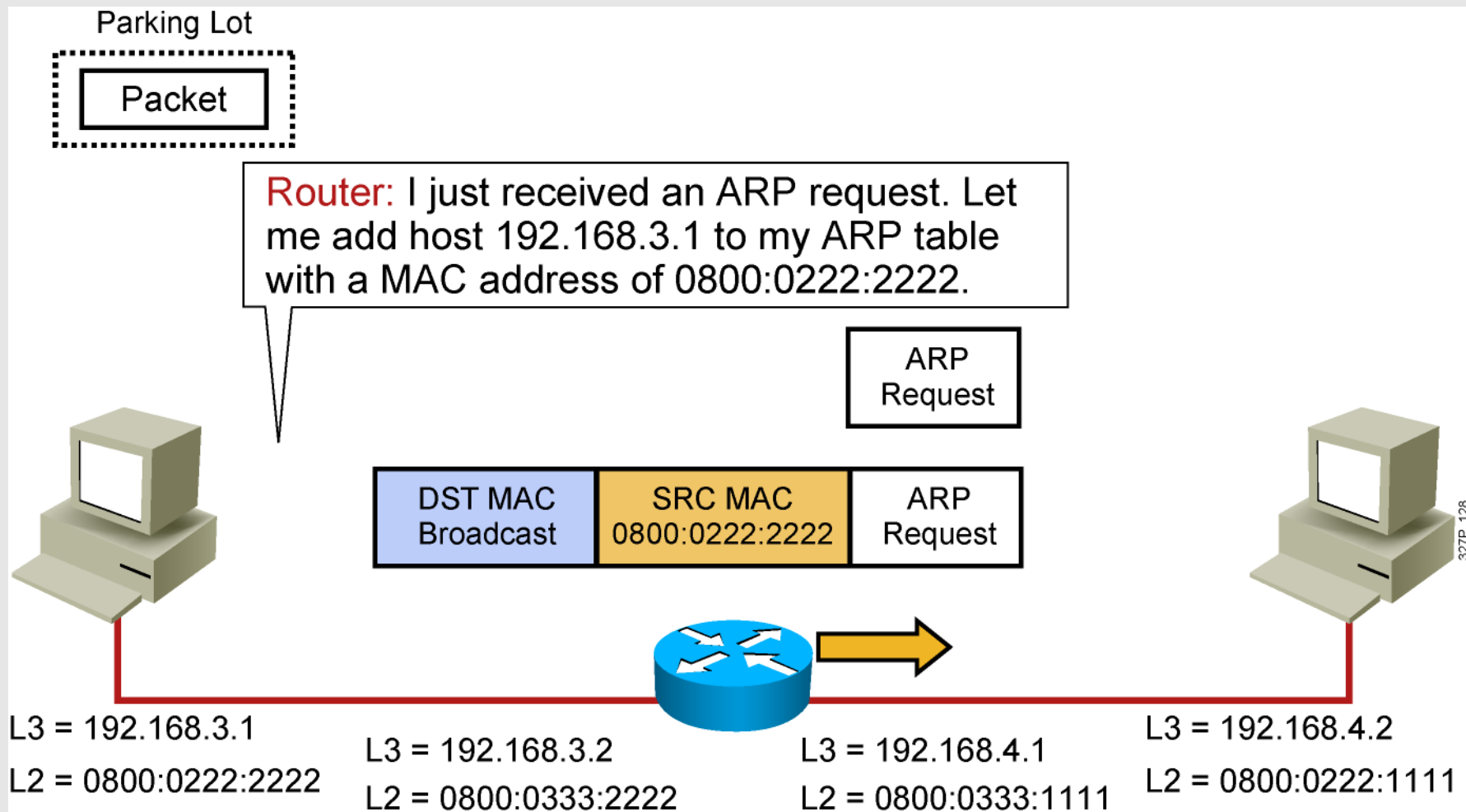
Host-to-Host Packet Delivery (4 of 17)



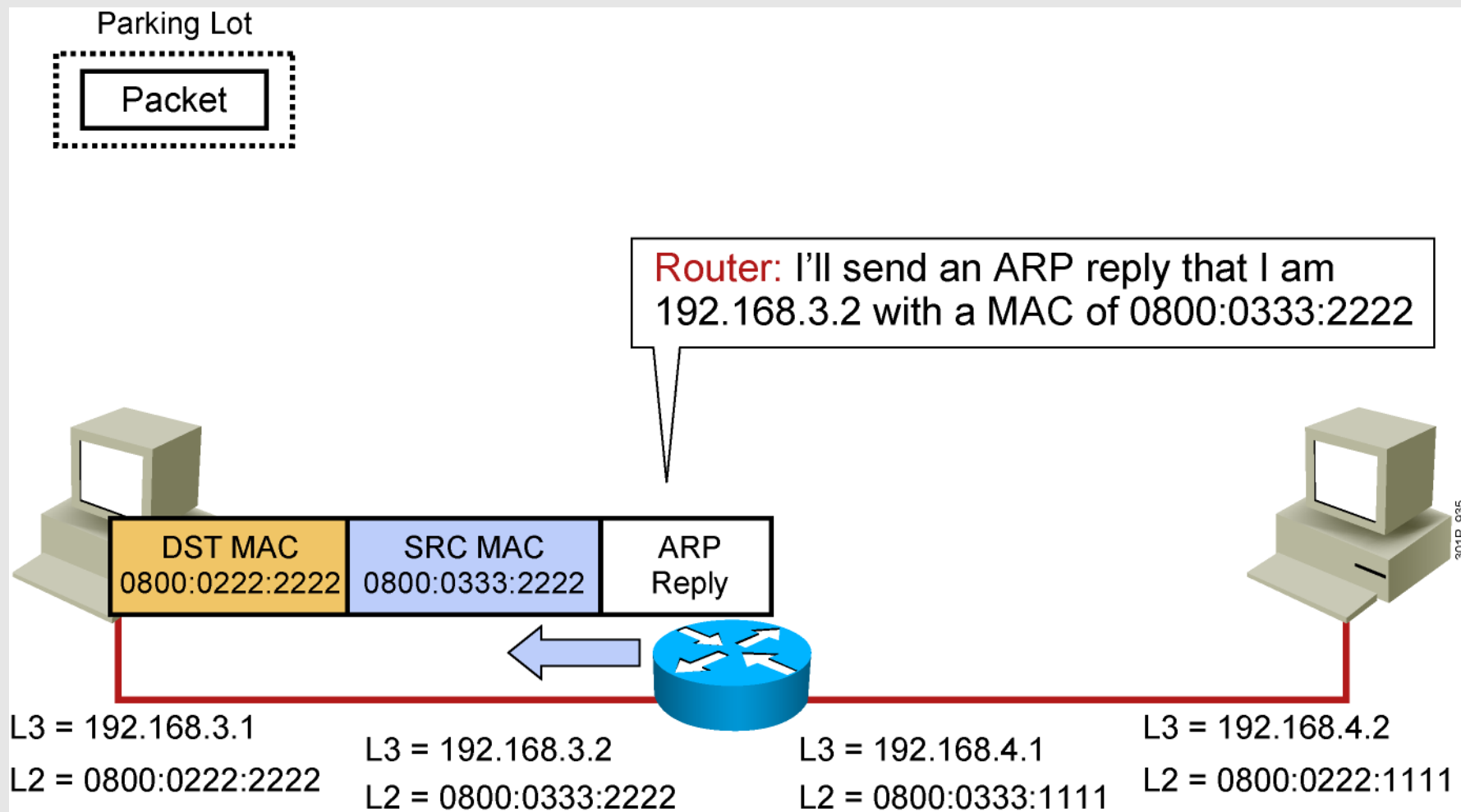
Host-to-Host Packet Delivery (5 of 17)



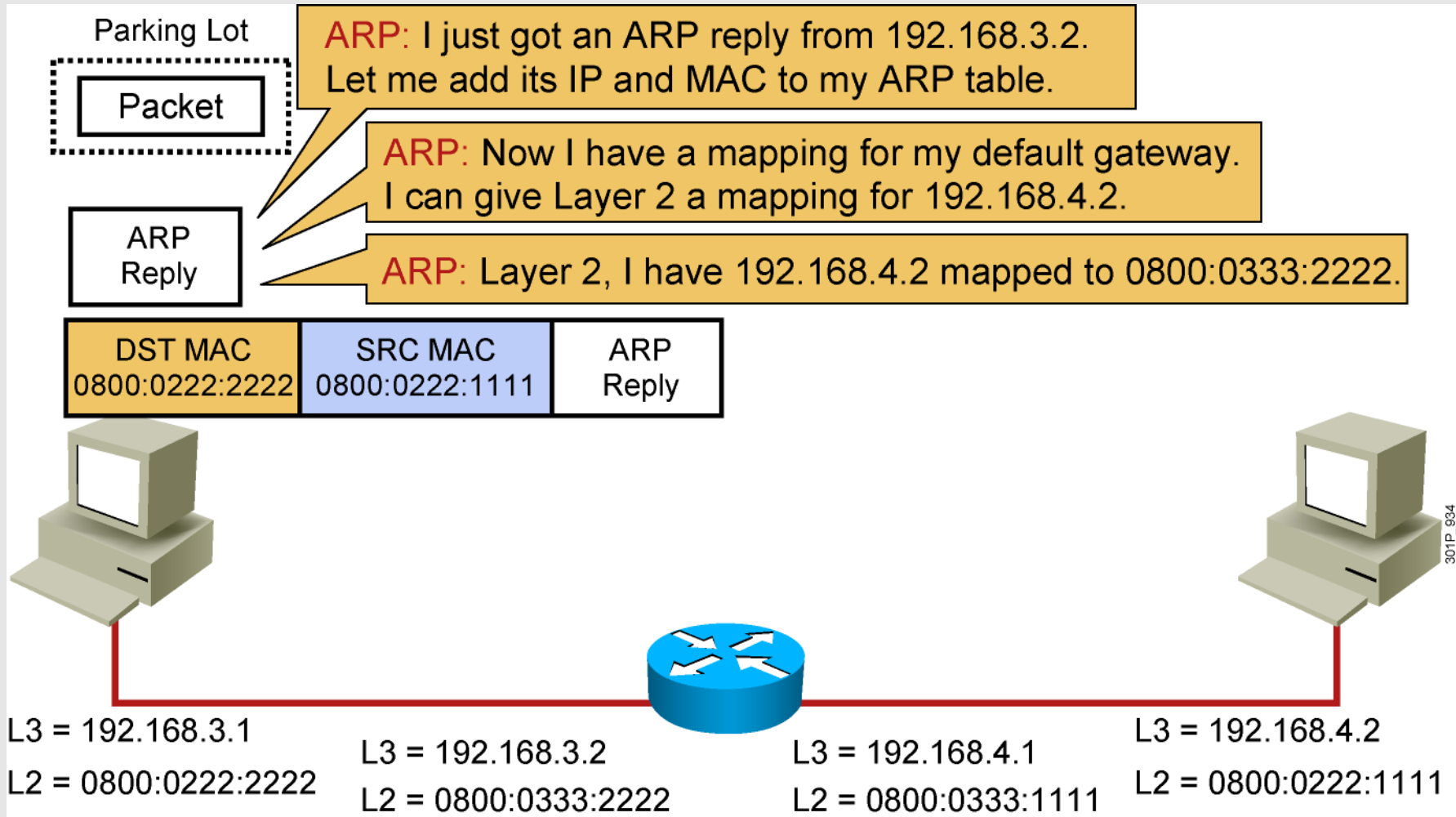
Host-to-Host Packet Delivery (6 of 17)



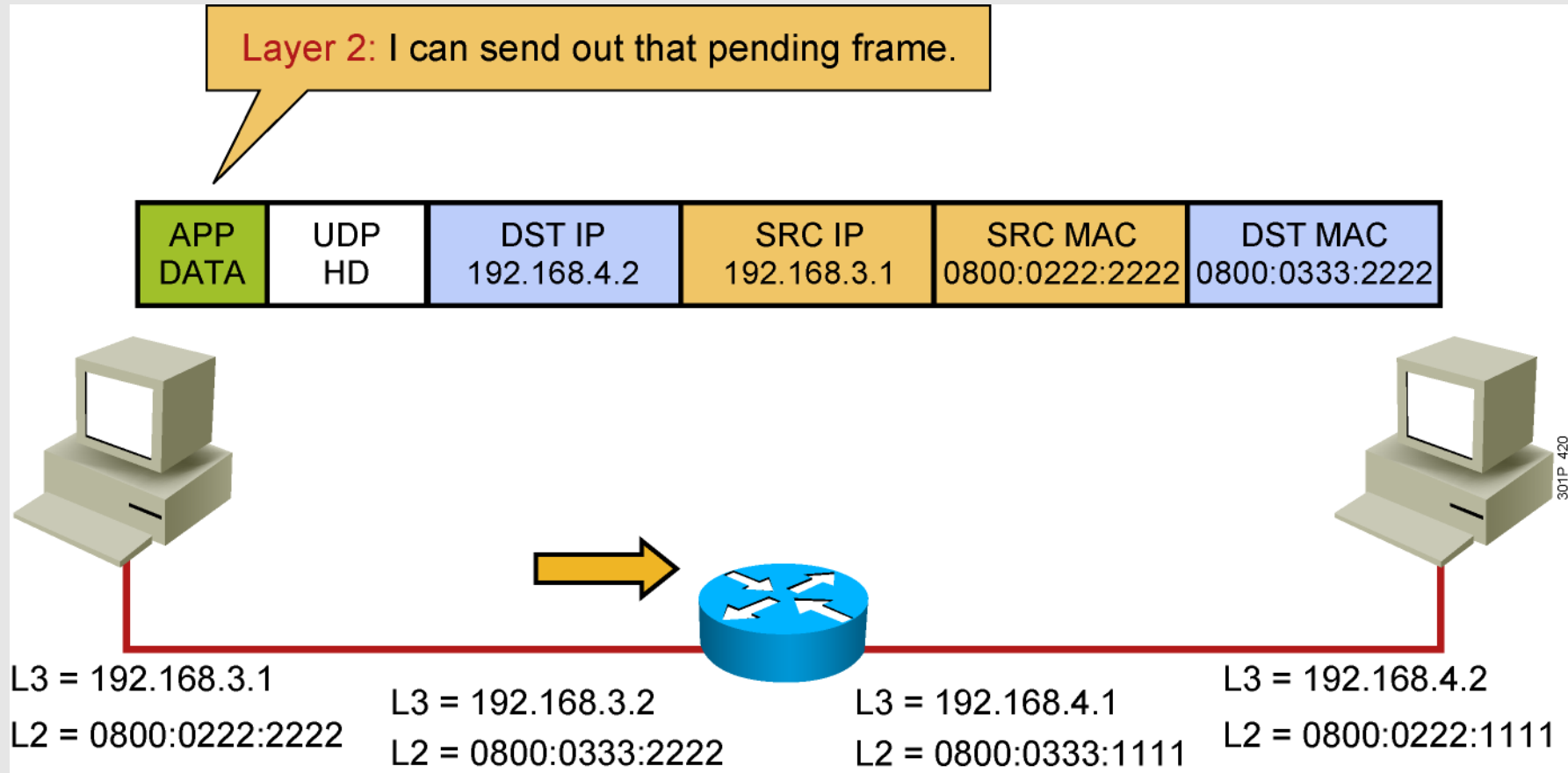
Host-to-Host Packet Delivery (7 of 17)



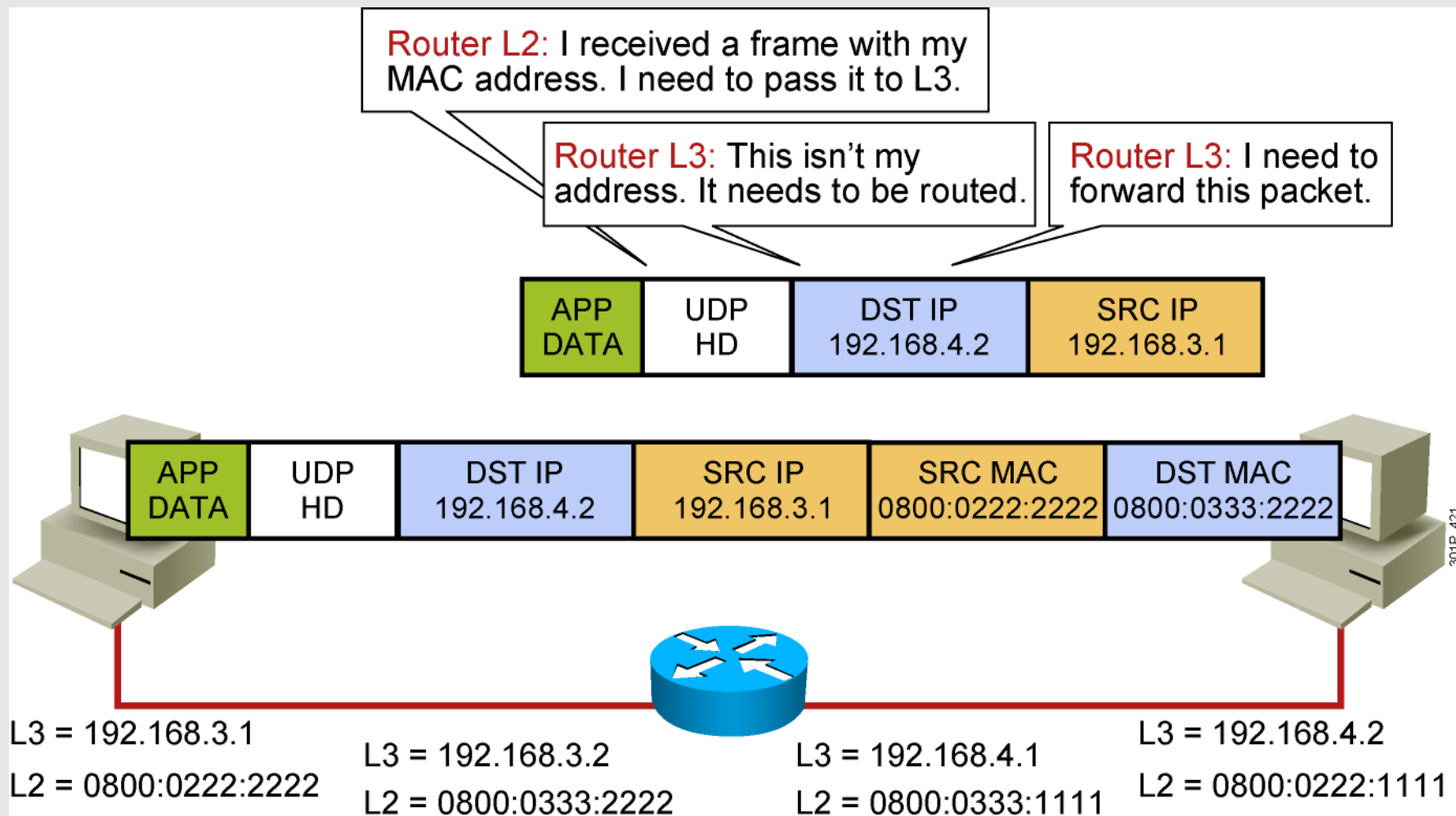
Host-to-Host Packet Delivery (8 of 17)



Host-to-Host Packet Delivery (9 of 17)



Host-to-Host Packet Delivery (10 of 17)

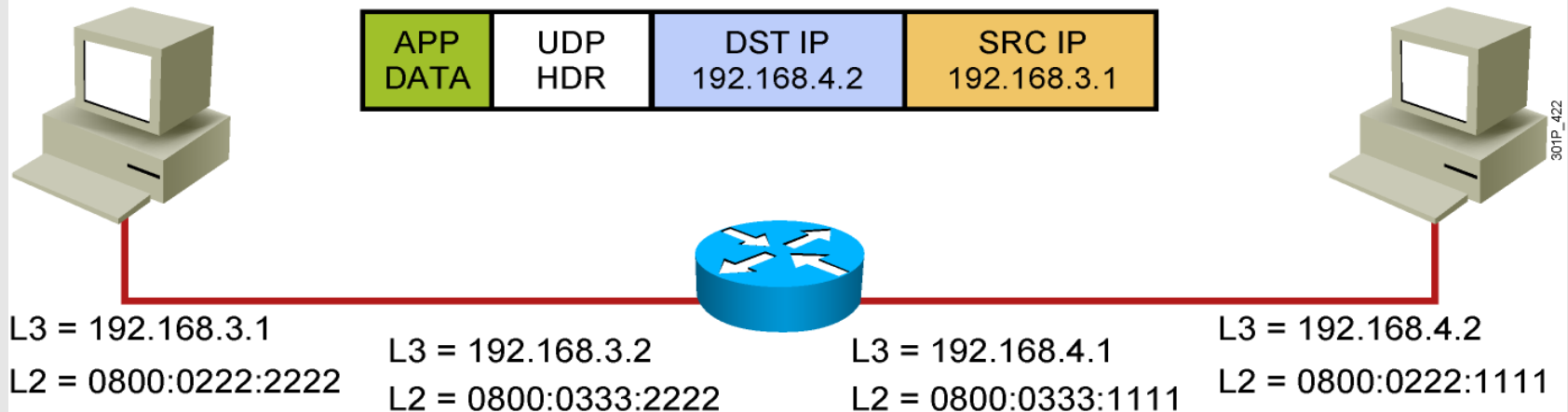


Host-to-Host Packet Delivery (11 of 17)

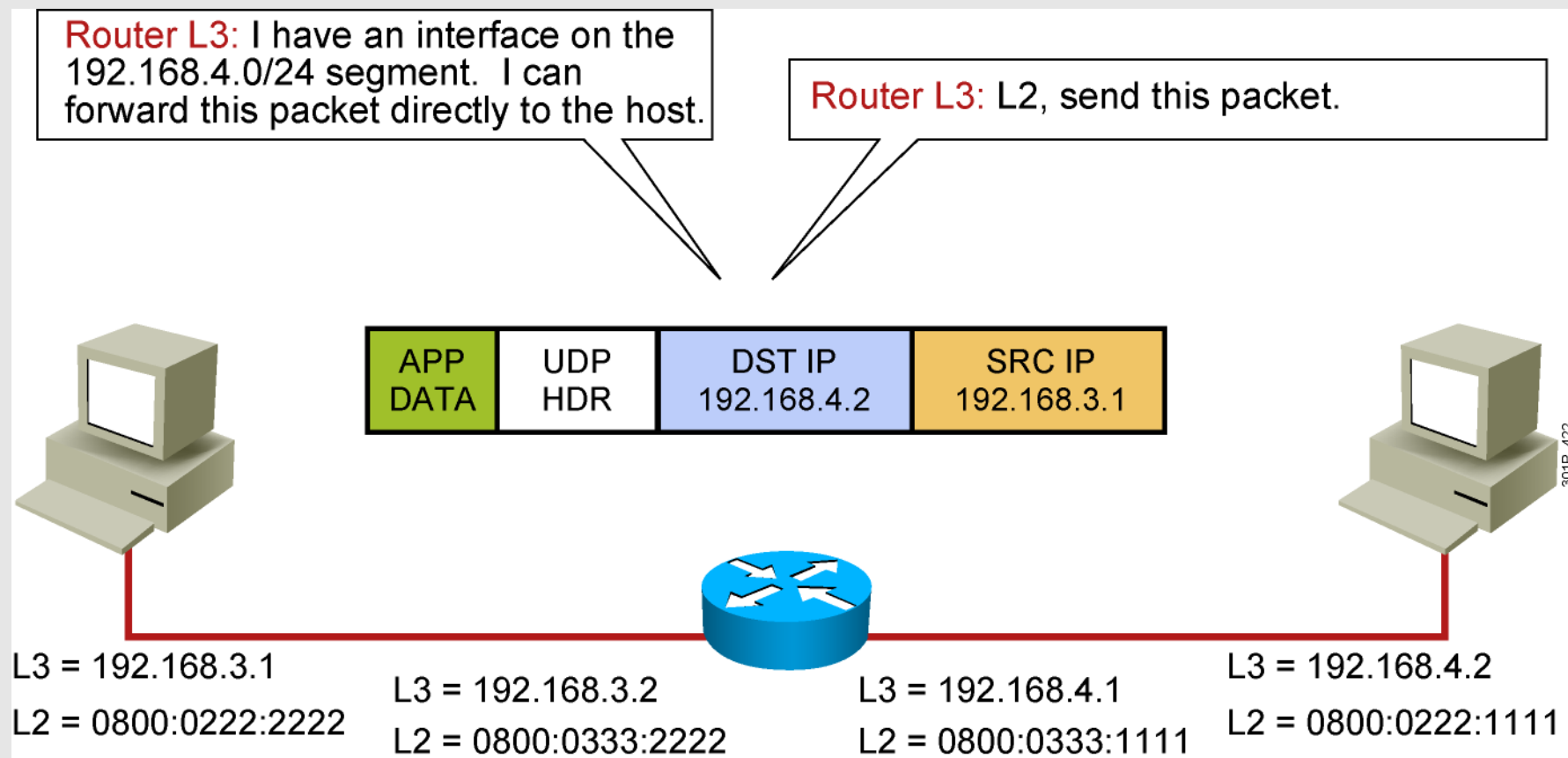
Destination	Next Hop	Interface
192.168.3.0/24	Connected	fa 0/0
192.168.4.0/24	Connected	fa 0/1

Router L3: I have an interface on the 192.168.4.0/24 segment. I can forward this packet directly to the host.

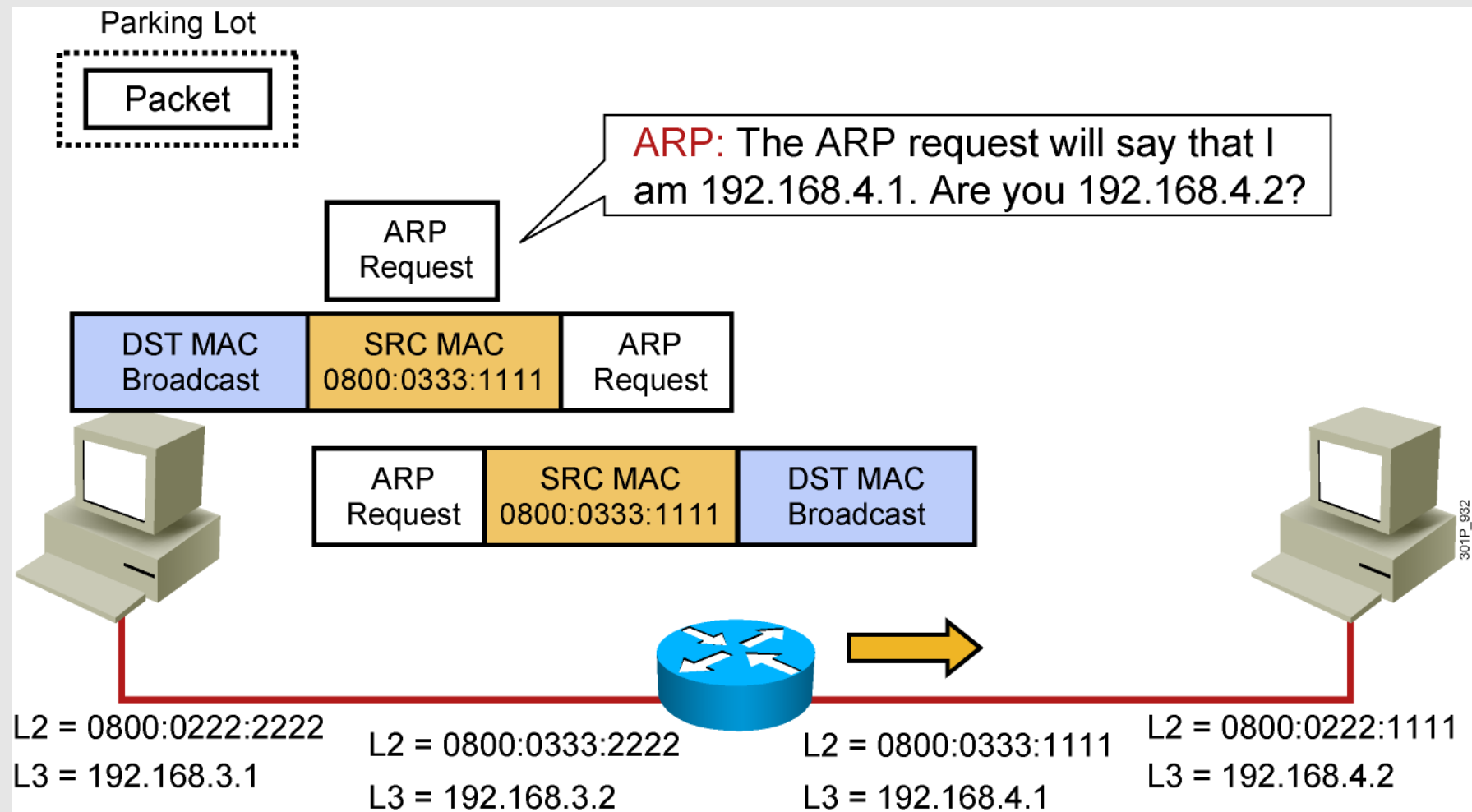
Router L3: L2, send this packet.



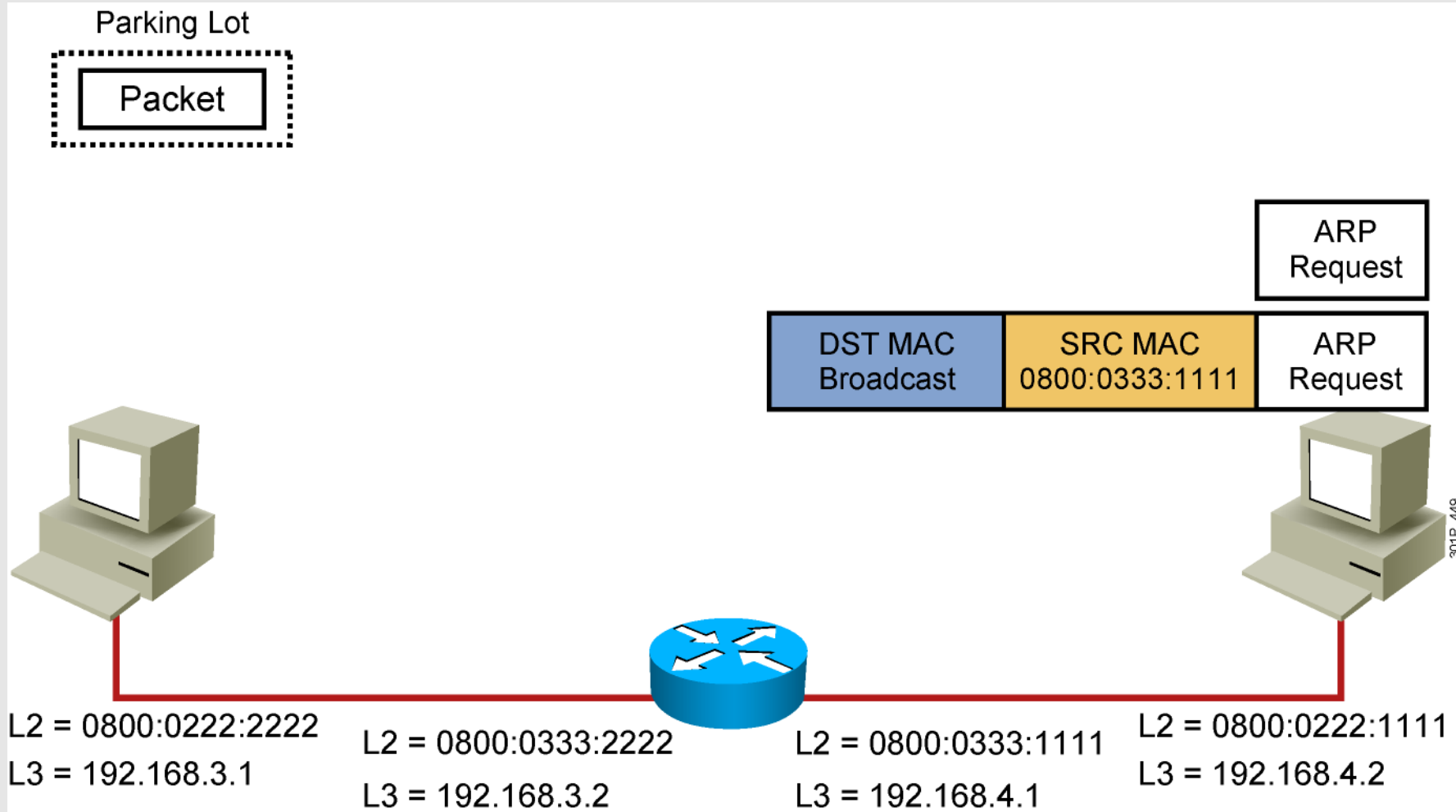
Host-to-Host Packet Delivery (12 of 17)



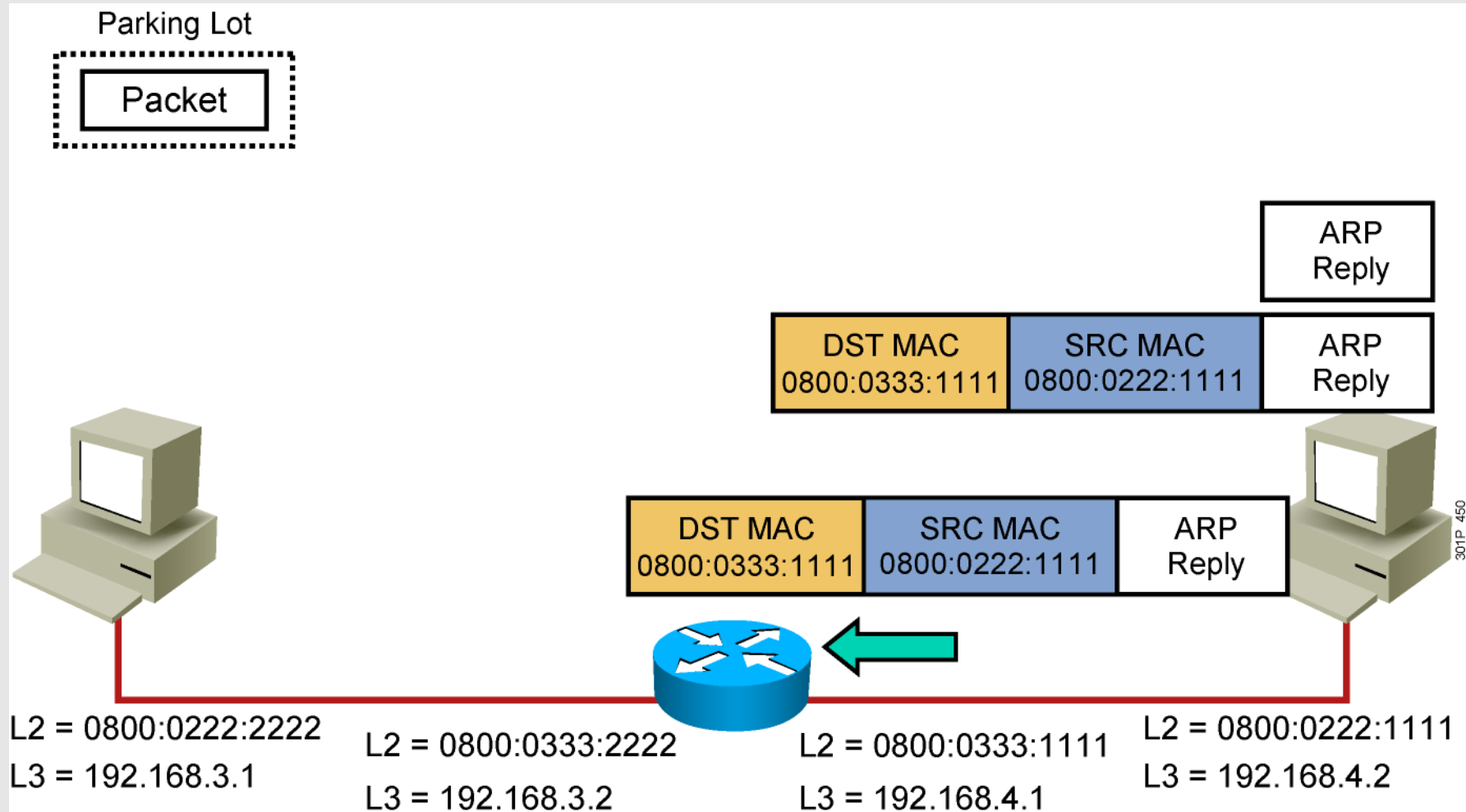
Host-to-Host Packet Delivery (13 of 17)



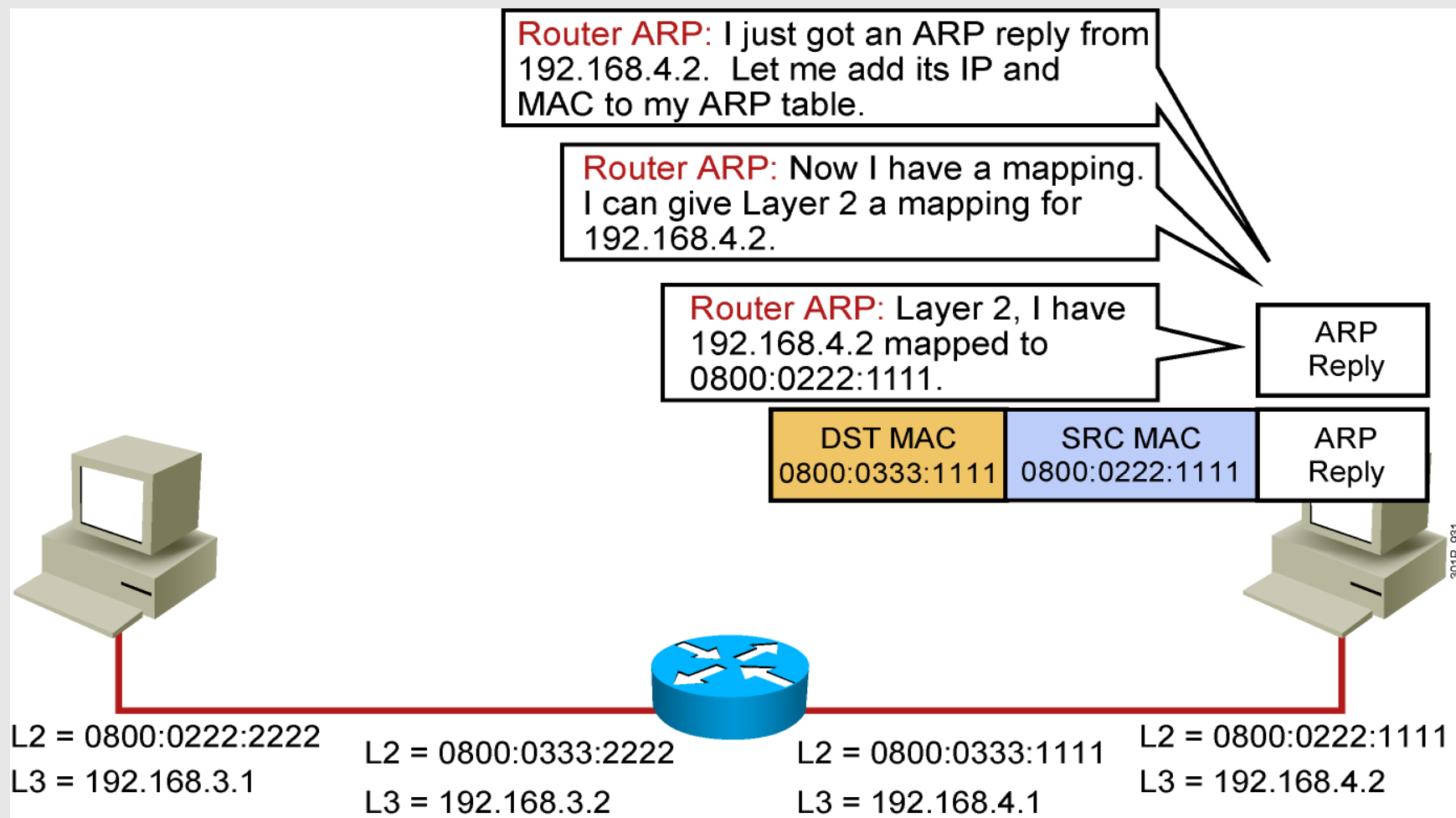
Host-to-Host Packet Delivery (14 of 17)



Host-to-Host Packet Delivery (15 of 17)



Host-to-Host Packet Delivery (16 of 17)



Host-to-Host Packet Delivery (17 of 17)

