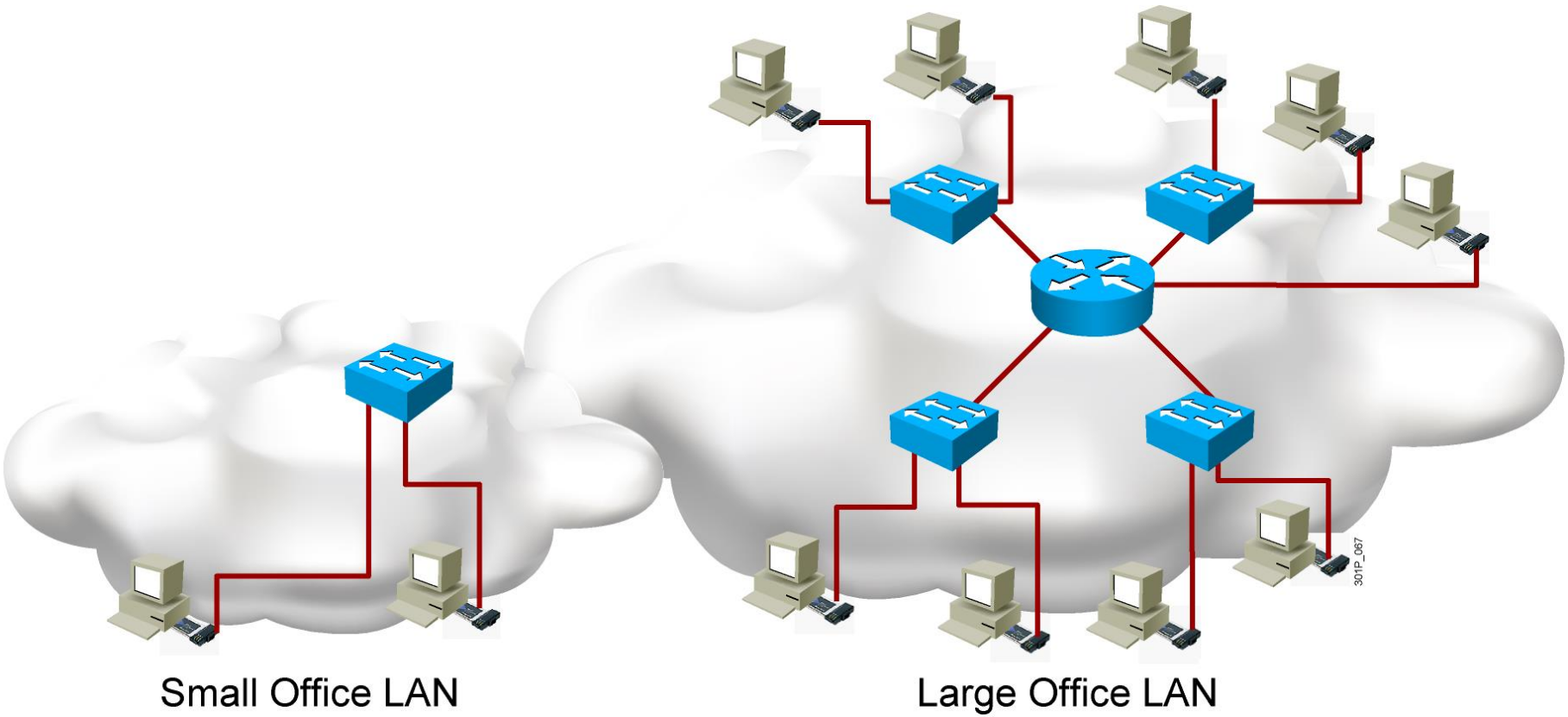
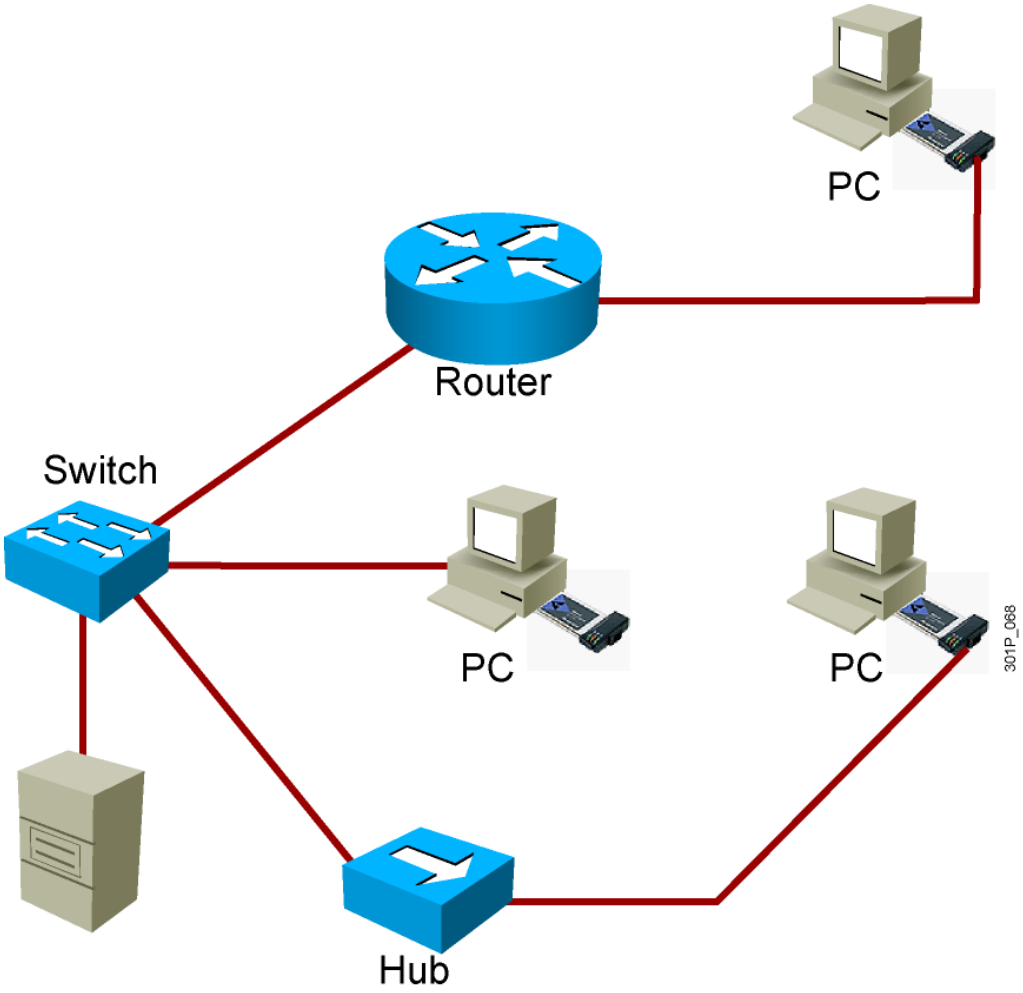
# Understanding Ethernet

# Local Area Network



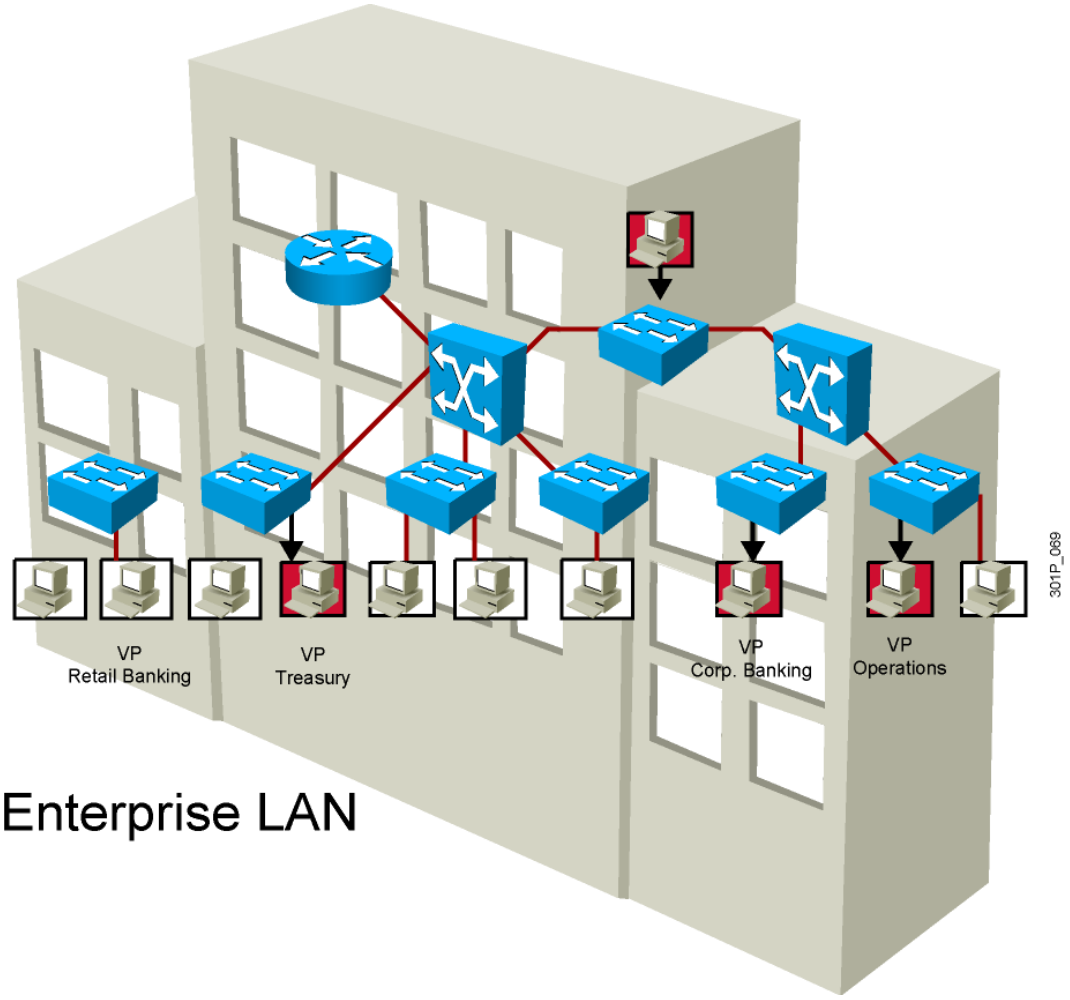
# LAN Components

- **Computers**
  - PCs
  - Servers
- **Interconnections**
  - NICs
  - Media
- **Network devices**
  - Hubs
  - Switches
  - Routers
- **Protocols**
  - Ethernet
  - IP
  - ARP
  - DHCP



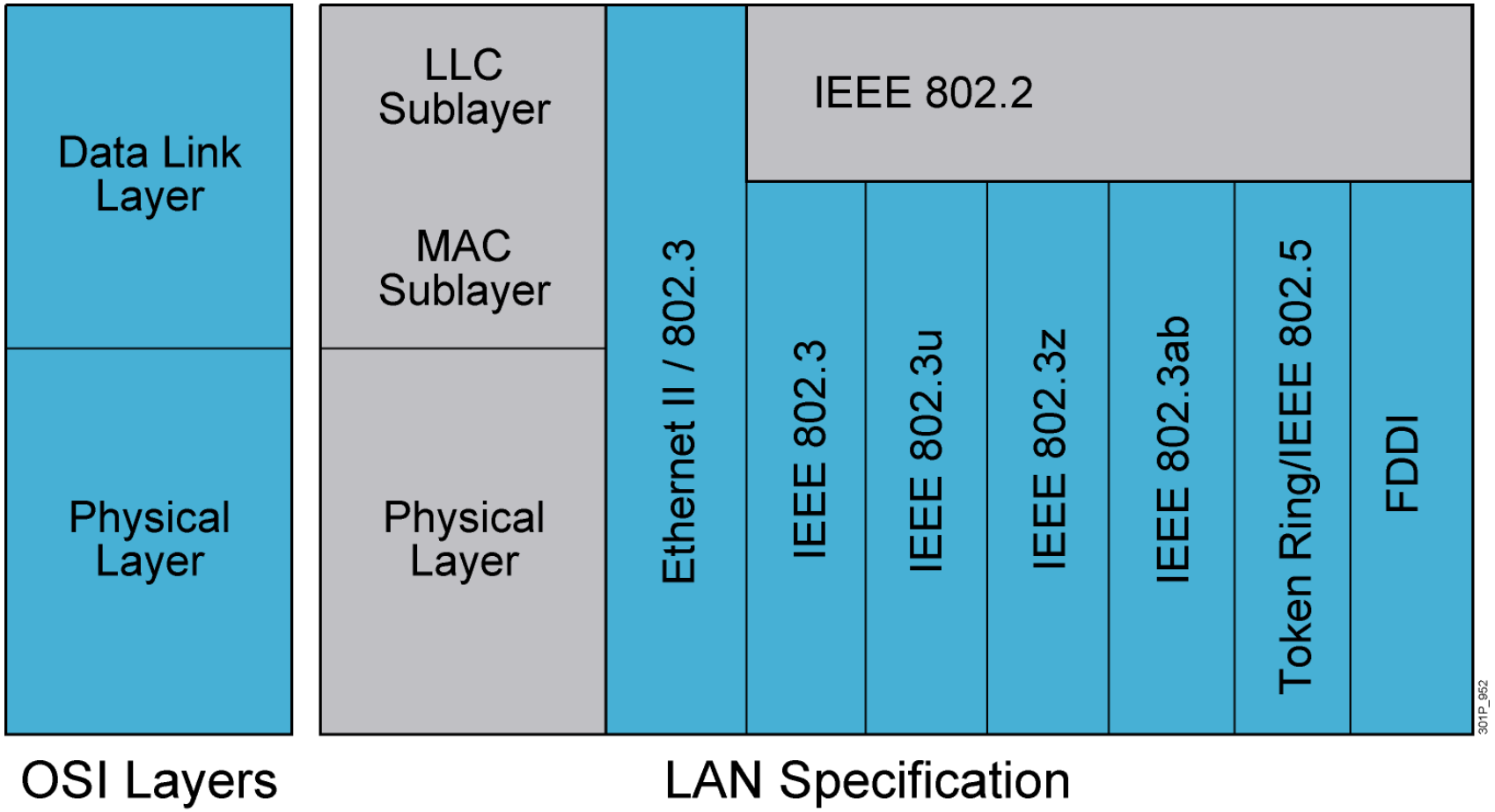
# LAN Sizes

SOHO
LAN

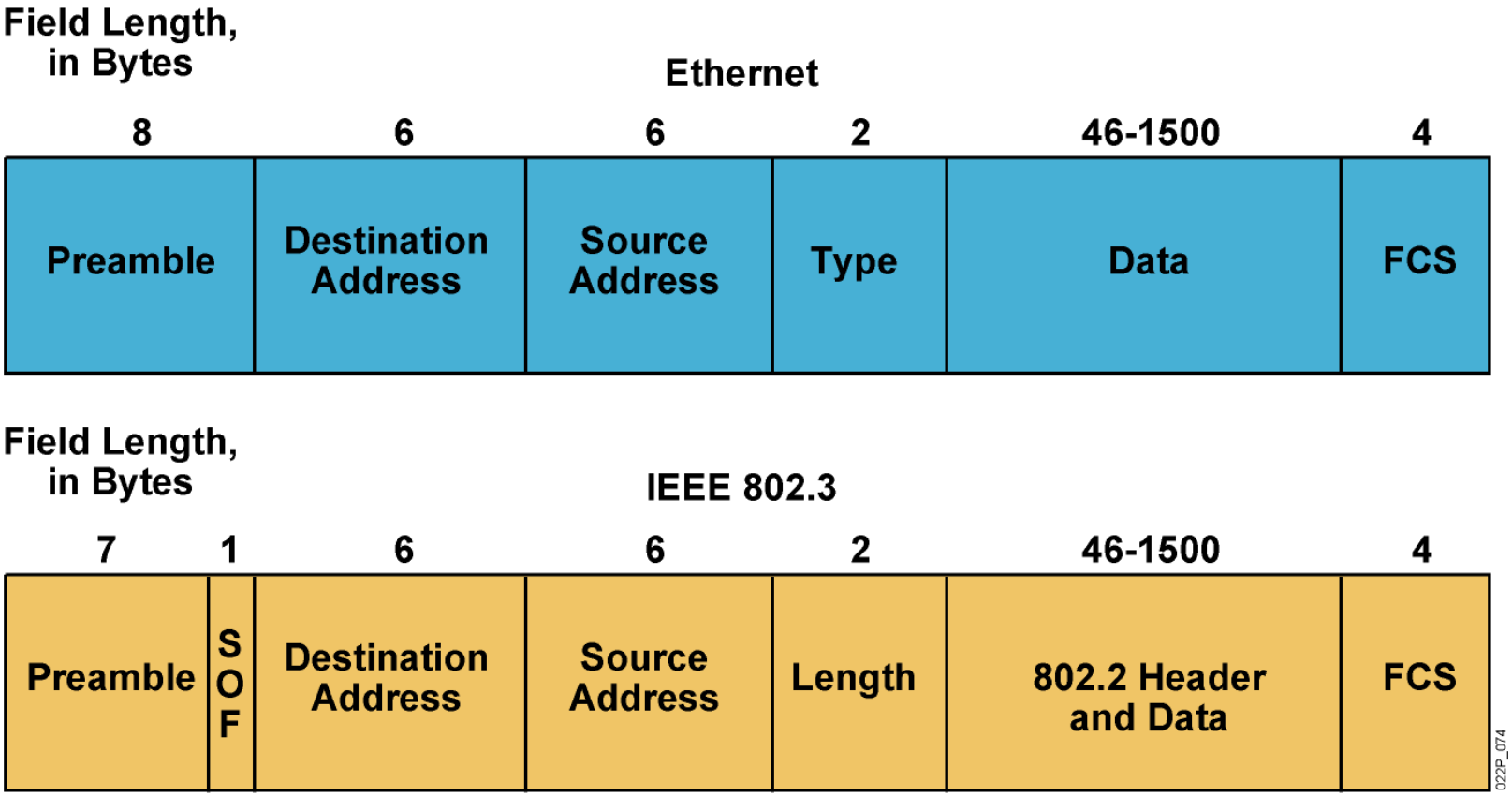



Enterprise LAN

# LAN Standards

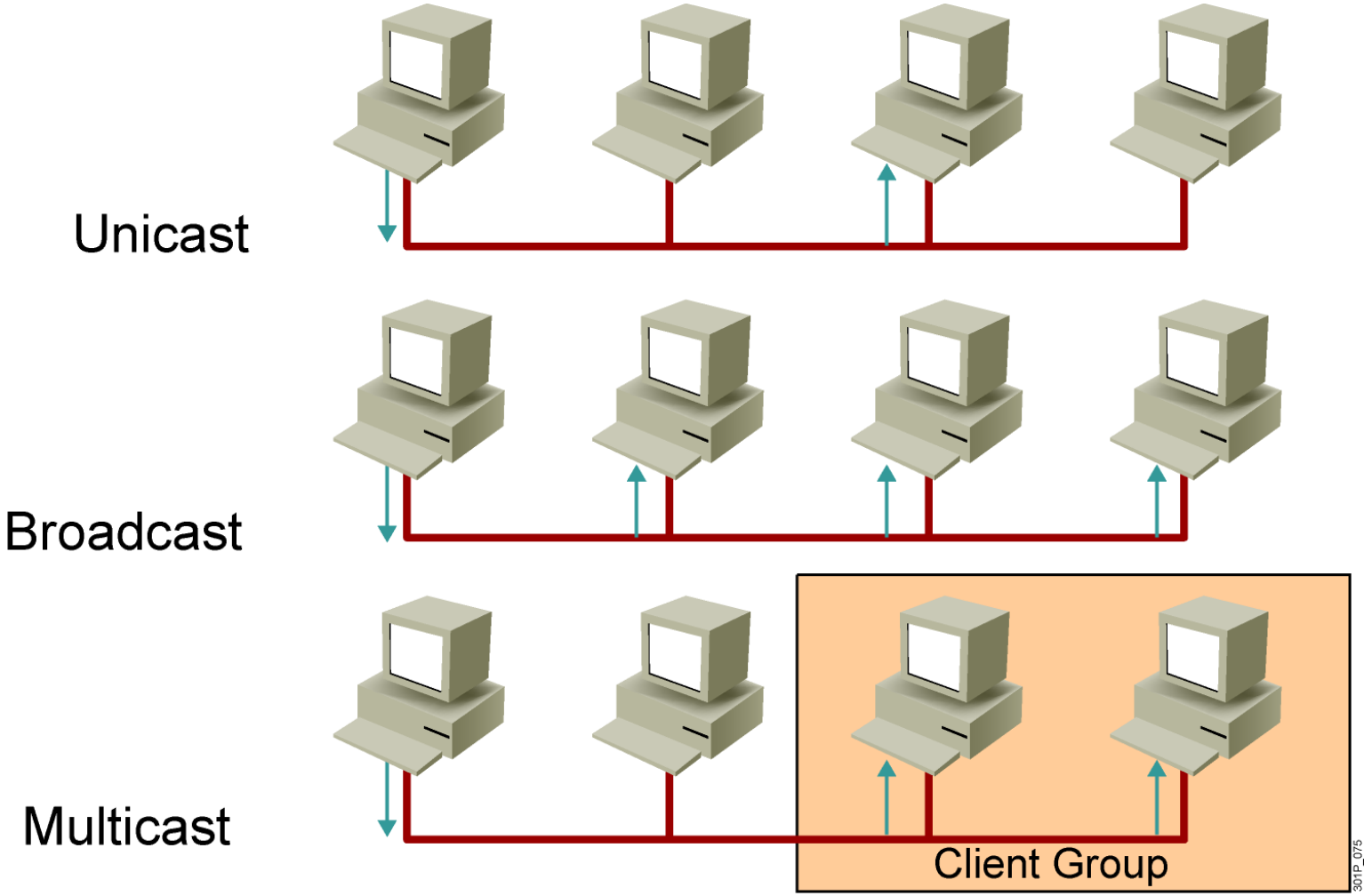


# Ethernet Frame Structure

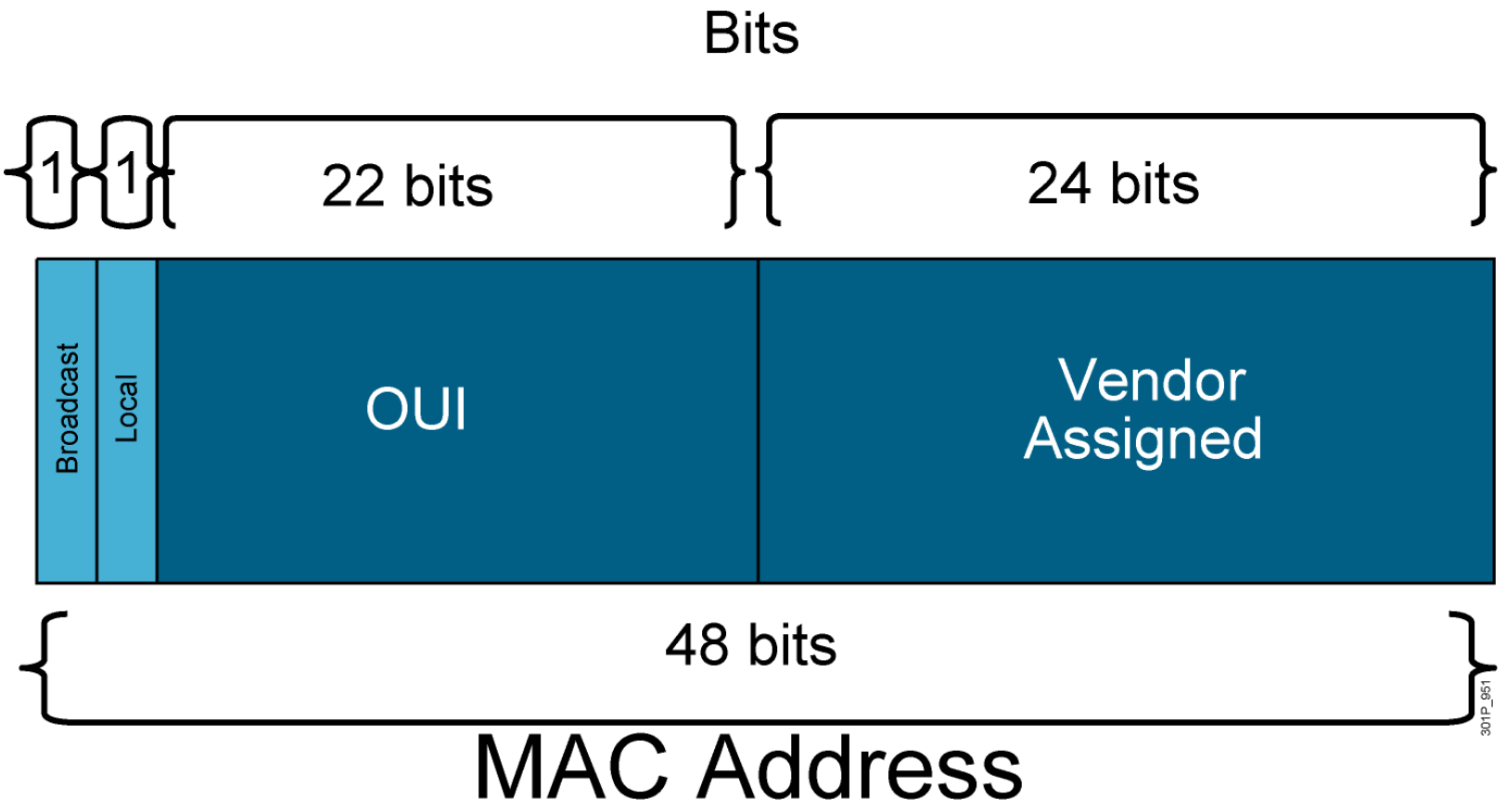



SOF = Start-of-Frame Delimiter
FCS = Frame Check Sequence

# Communicating Within the LAN

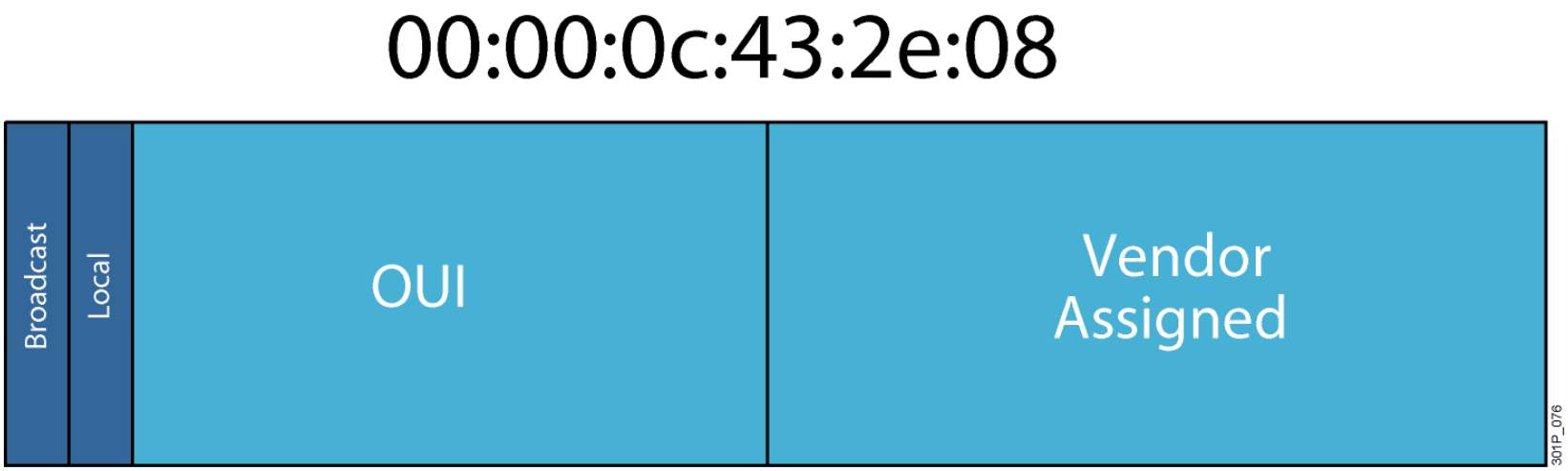


# MAC Address Components

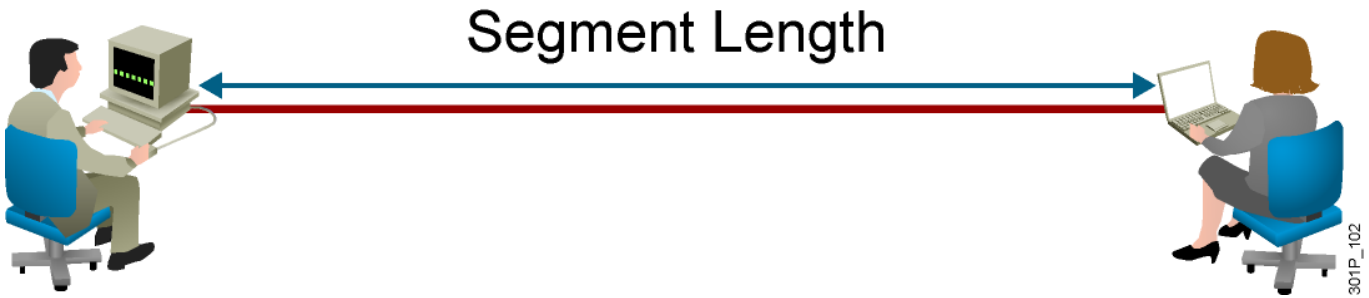



**OUI**: Organizational Unique Identifier

# MAC Addresses

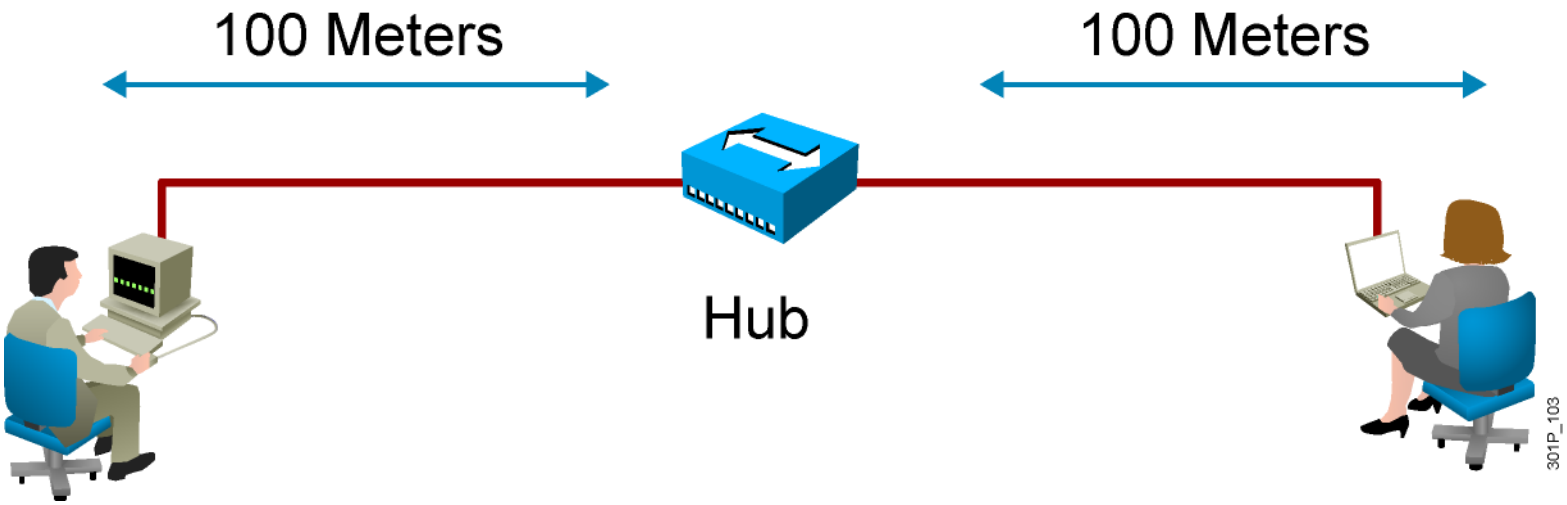


# LAN Segment Limitations



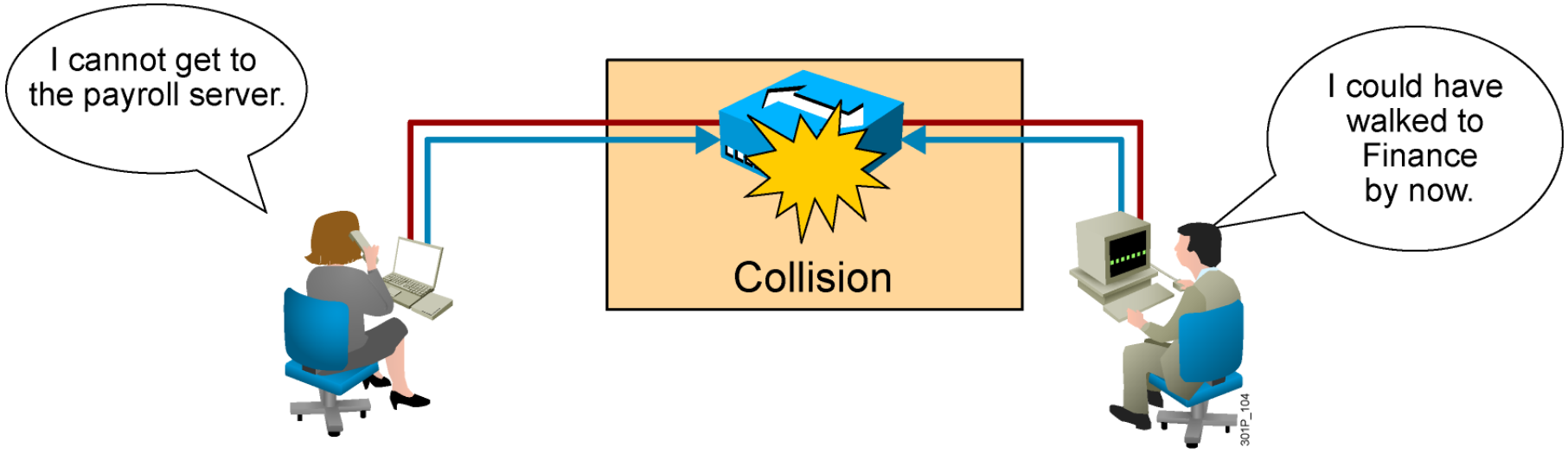

- Signals degrade with transmission distance.
- Each Ethernet type has a maximum segment length.

# Extending LAN Segments

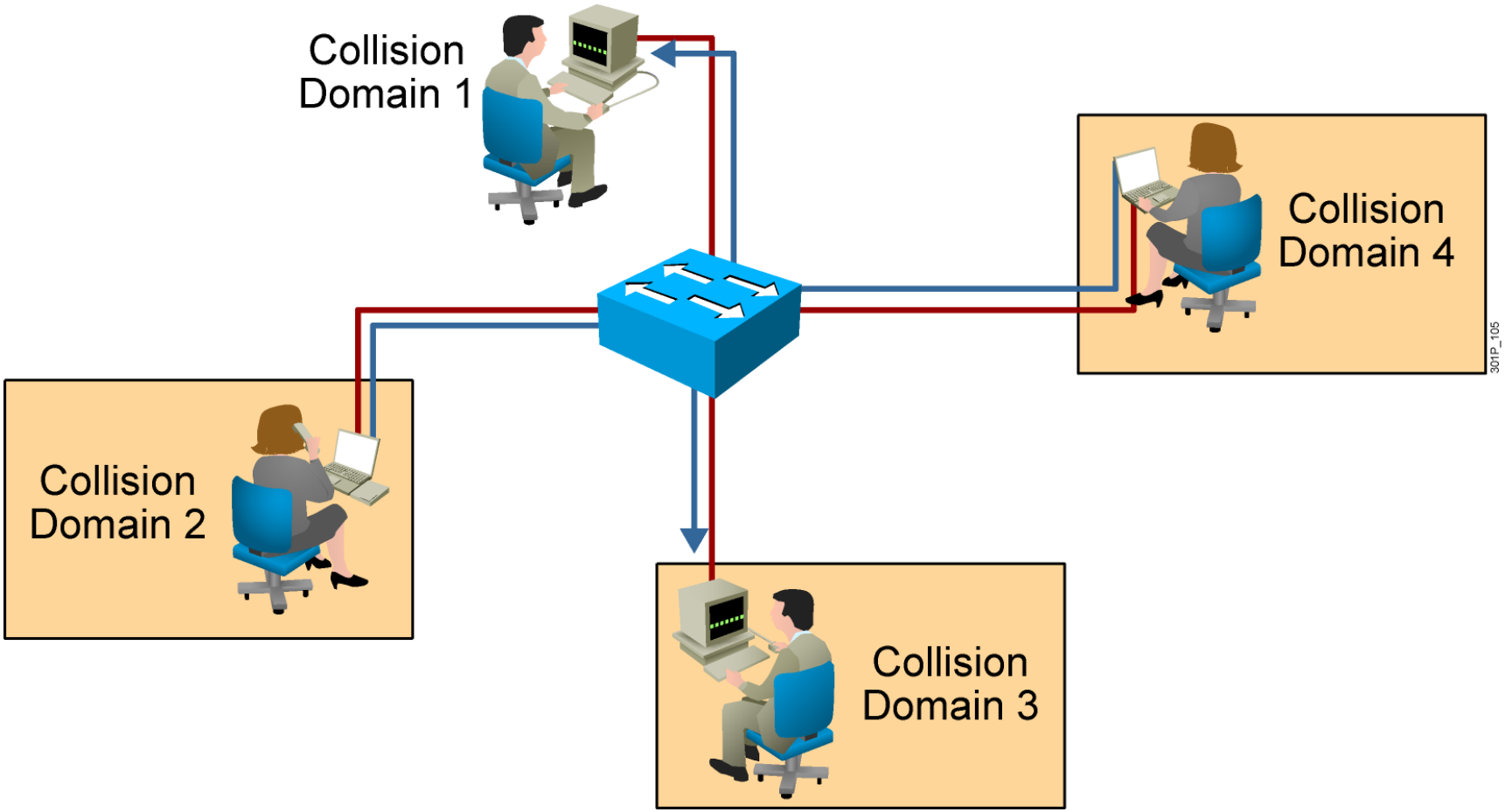



- Shares bandwidth
- Extends cable distances
- Repeats or amplifies signal
- Half-duplex

# Collisions


I cannot get to the payroll server.
Collision
I could have walked to Finance by now.
301P_104

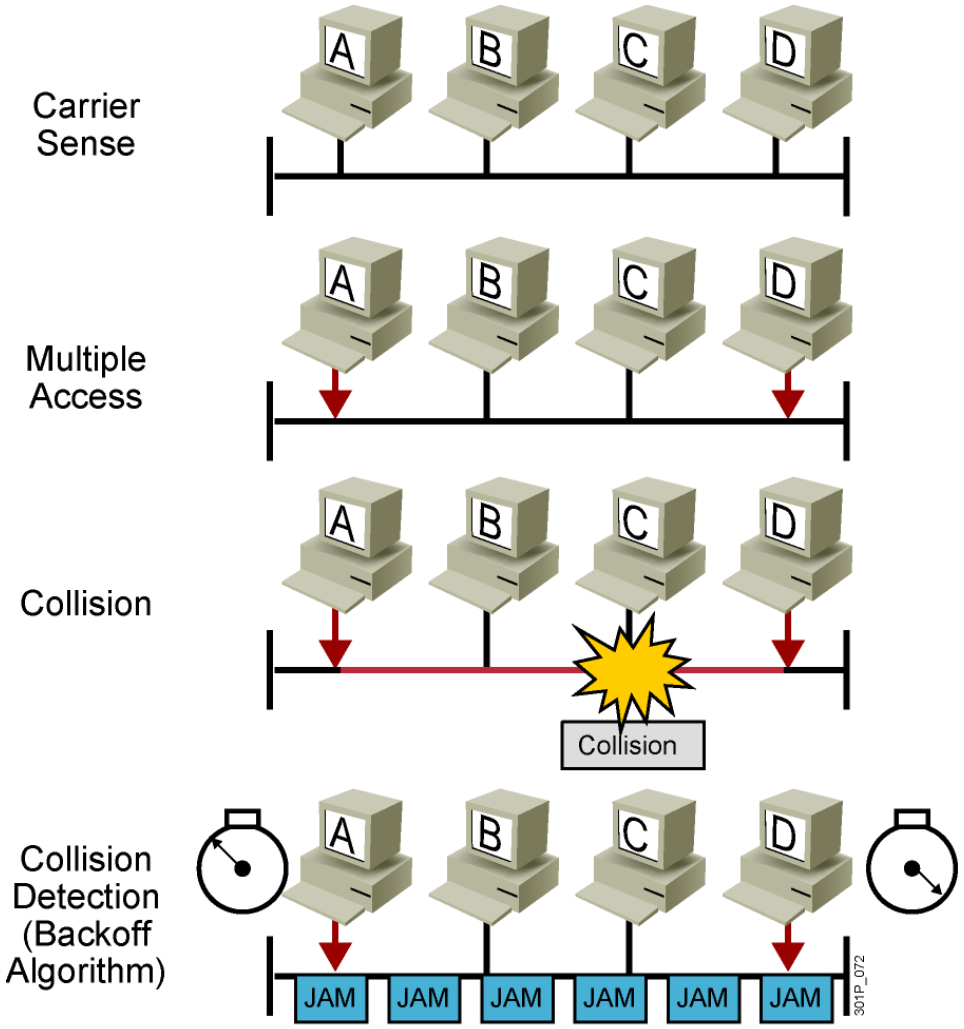
# Multiple Collision Domains



# Collision & Broadcast Domains

- No. of **Broadcast domains** = No. of every active interface of the Routers
- No. of **Collision domains** = No. of every active interface of the Switches & Routers

# CSMA/CD

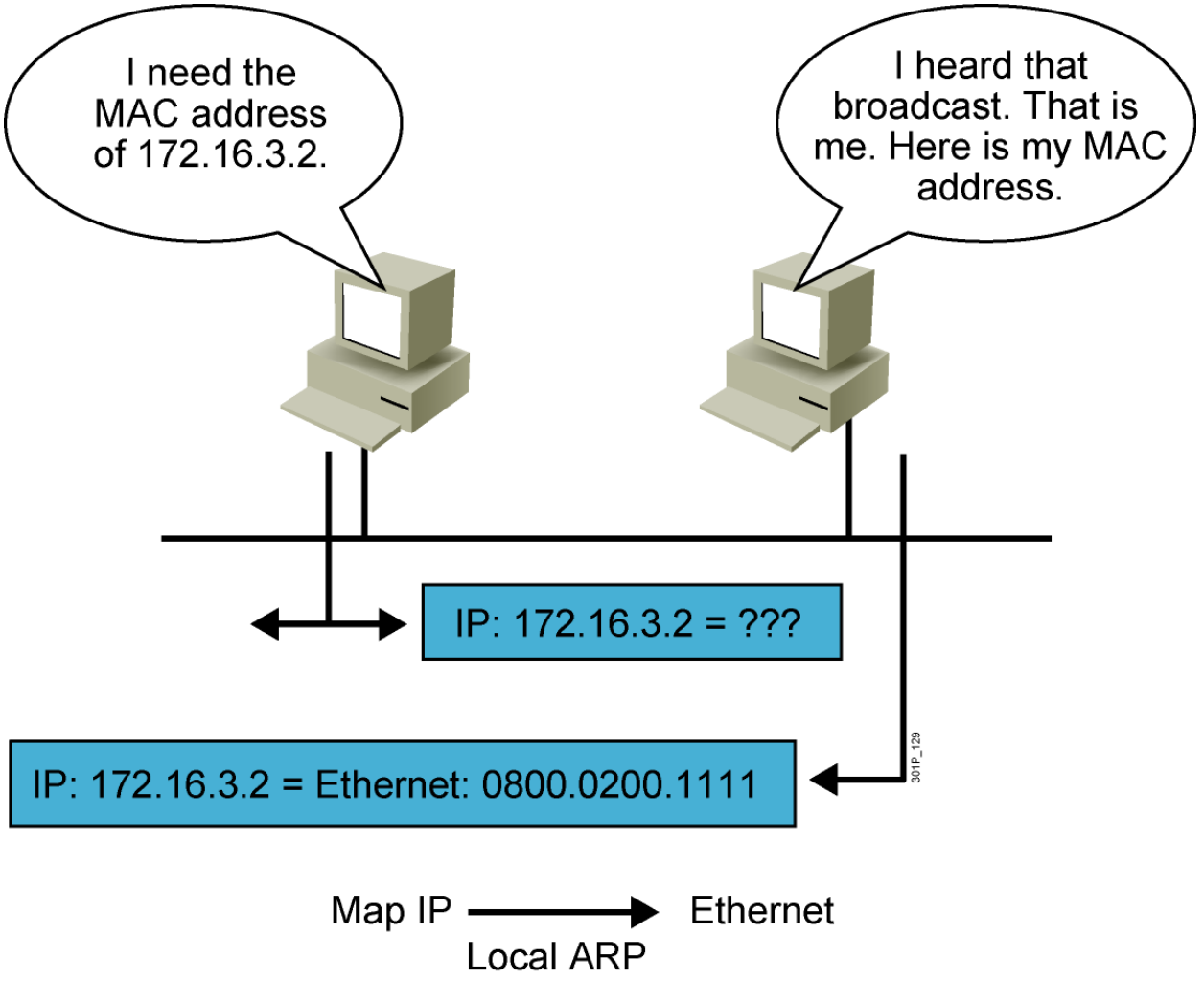



Carrier Sense Multiple Access Collision Detection (CSMA/CD)

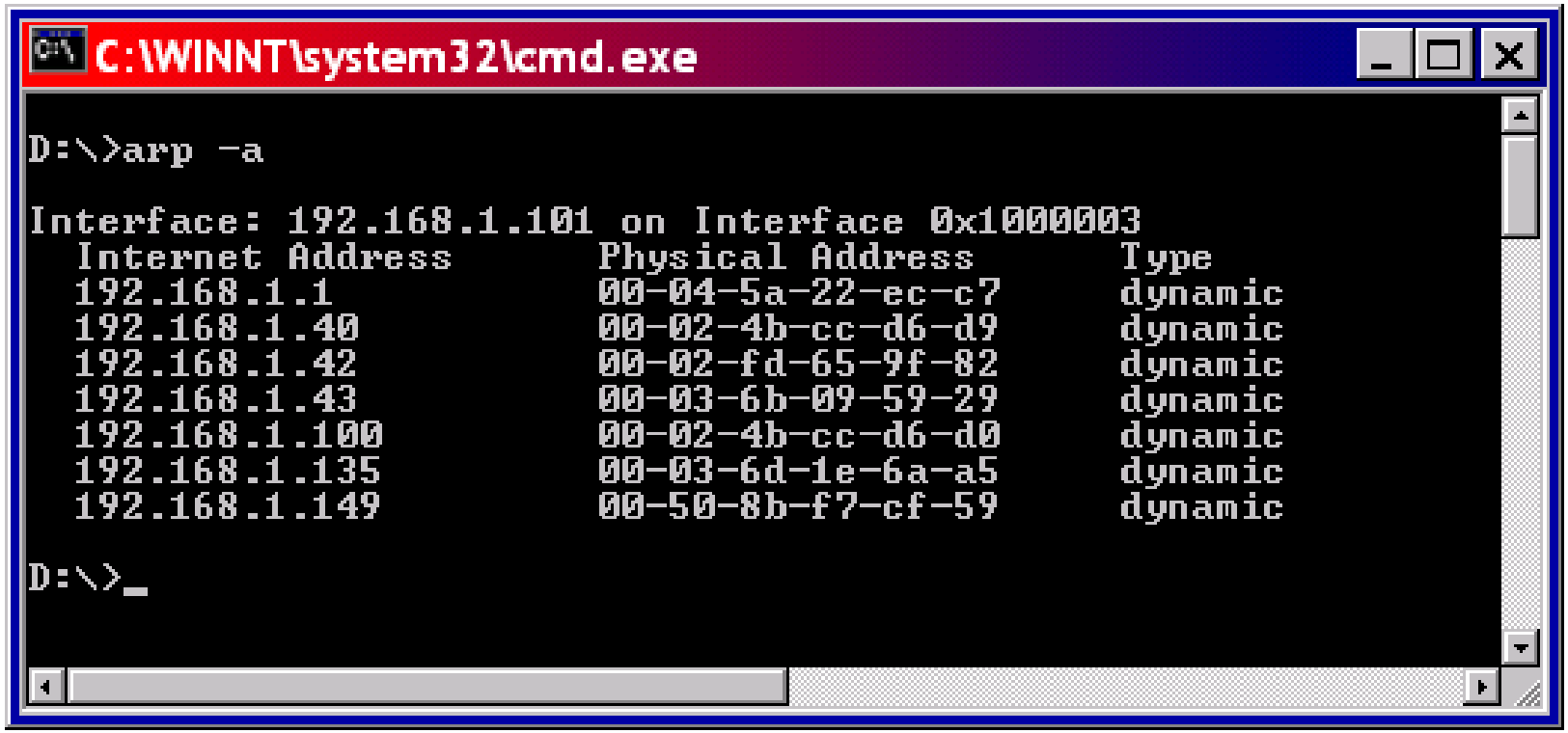
## ARP

# Exploring the Packet Delivery Process

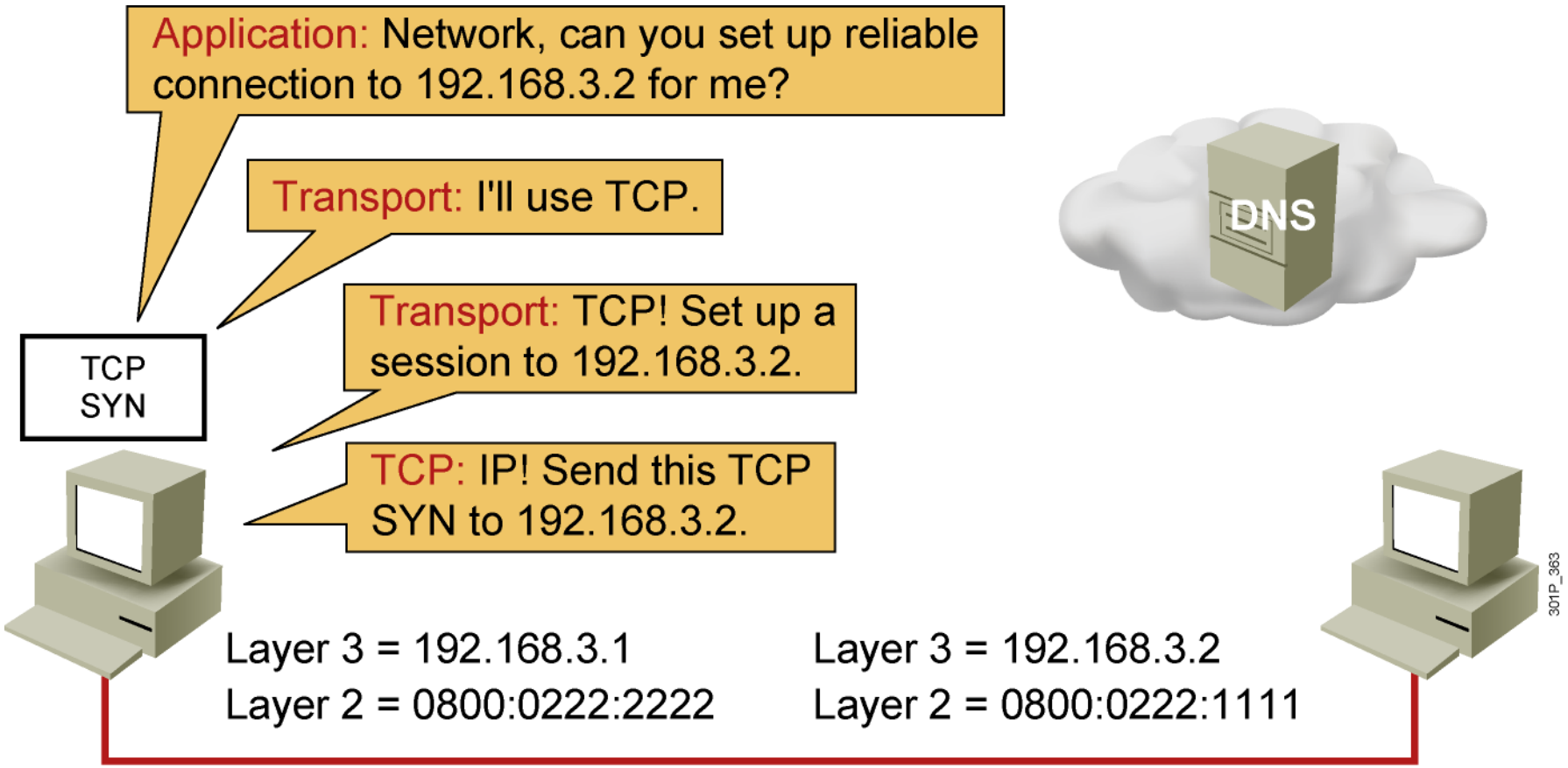
# ARP


I need the MAC address of 172.16.3.2.
I heard that broadcast. That is me. Here is my MAC address.
IP: 172.16.3.2 = ???
IP: 172.16.3.2 = Ethernet: 0800.0200.1111
301P_129
Map IP
Ethernet
Local ARP

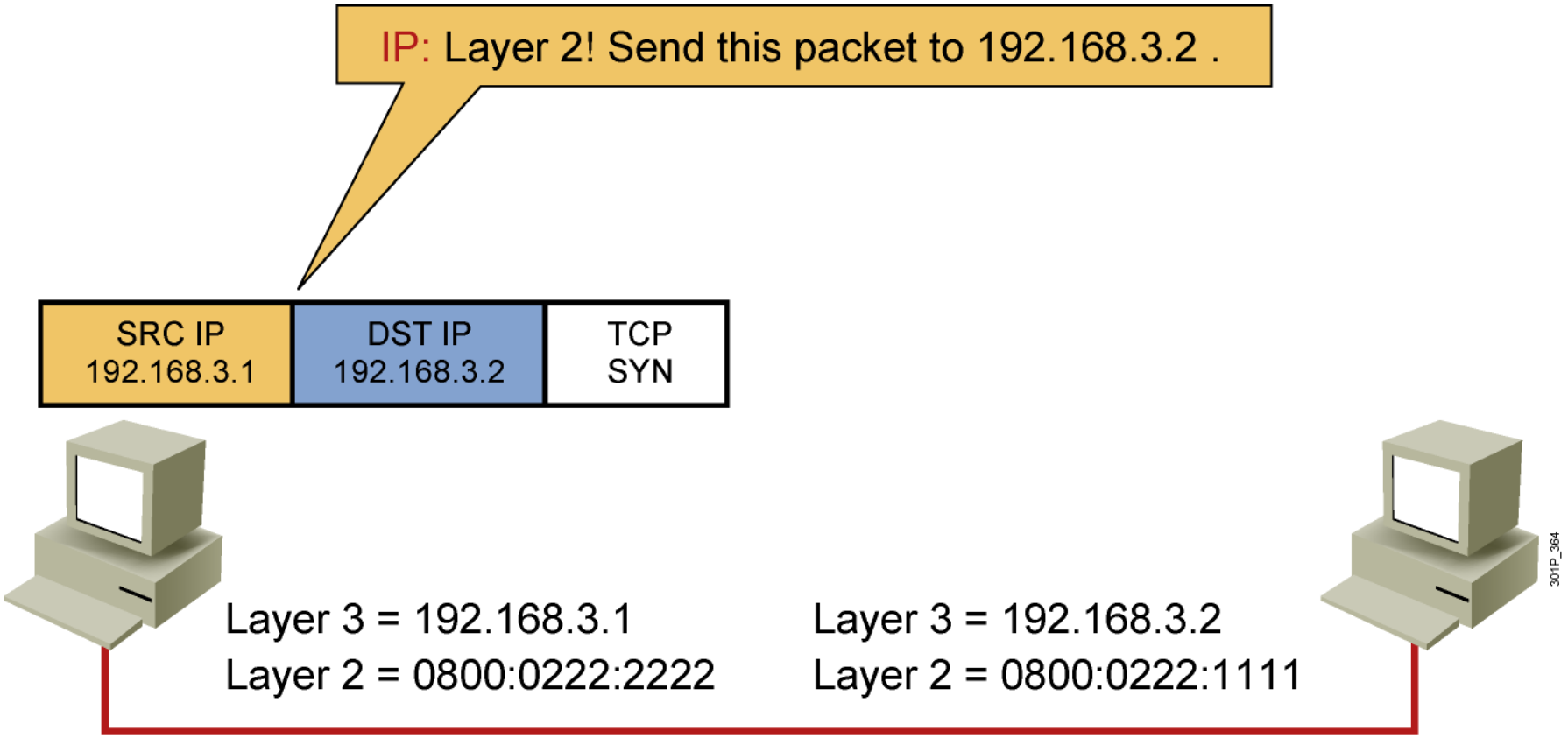
# ARP Table


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:\>

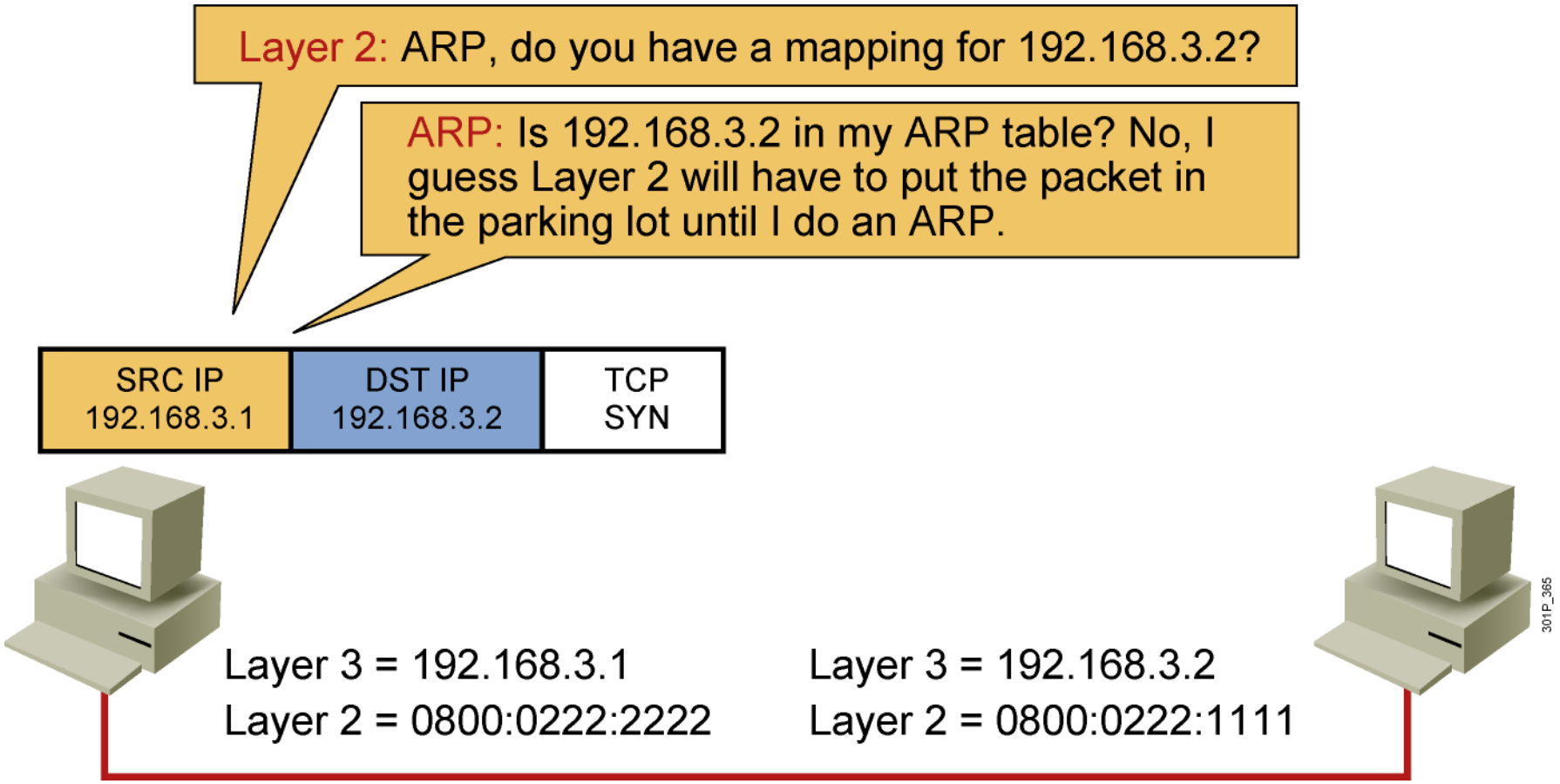
# Host-to-Host Packet Delivery (1 of 22)



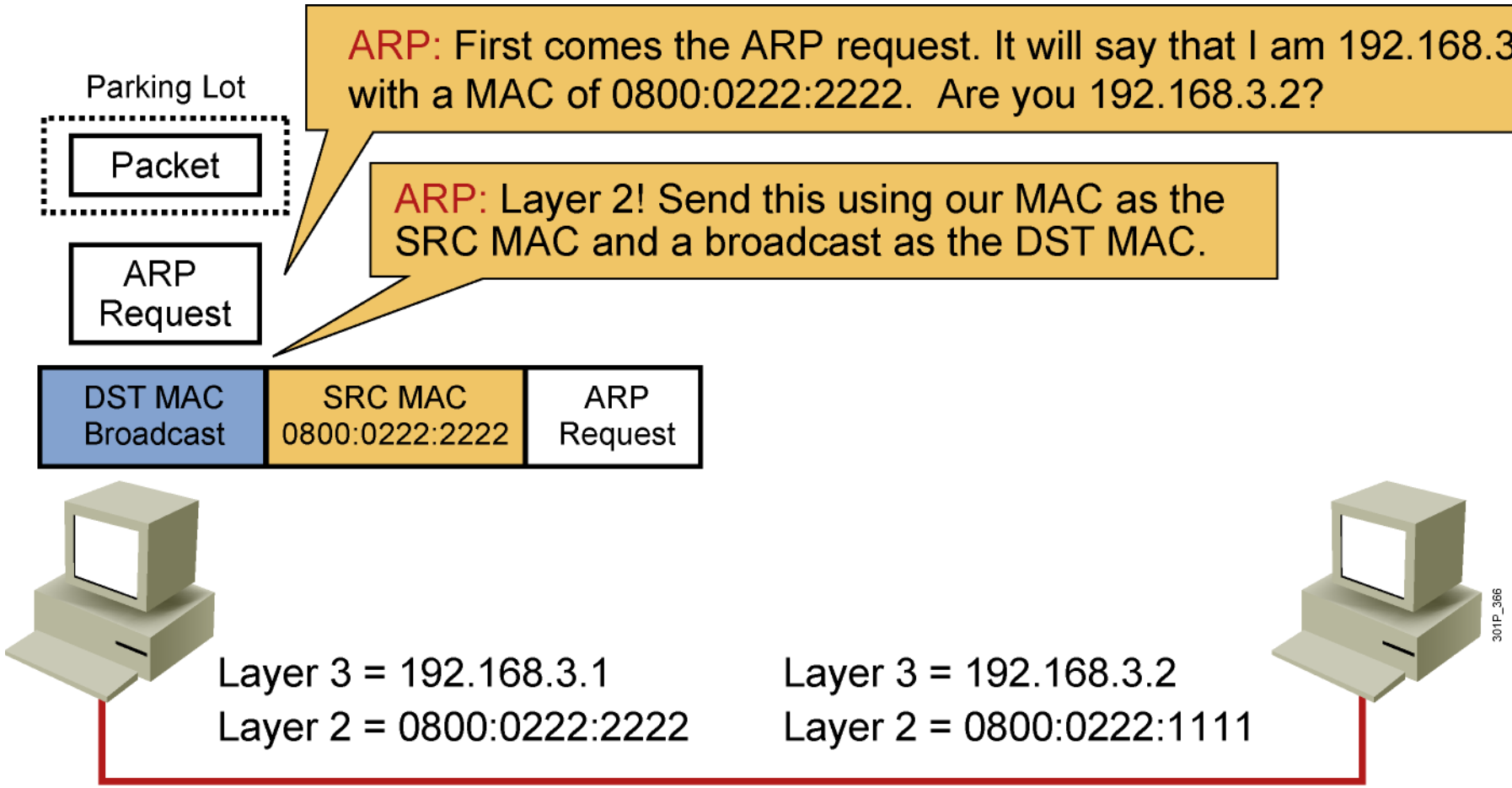
# Host-to-Host Packet Delivery (2 of 22)



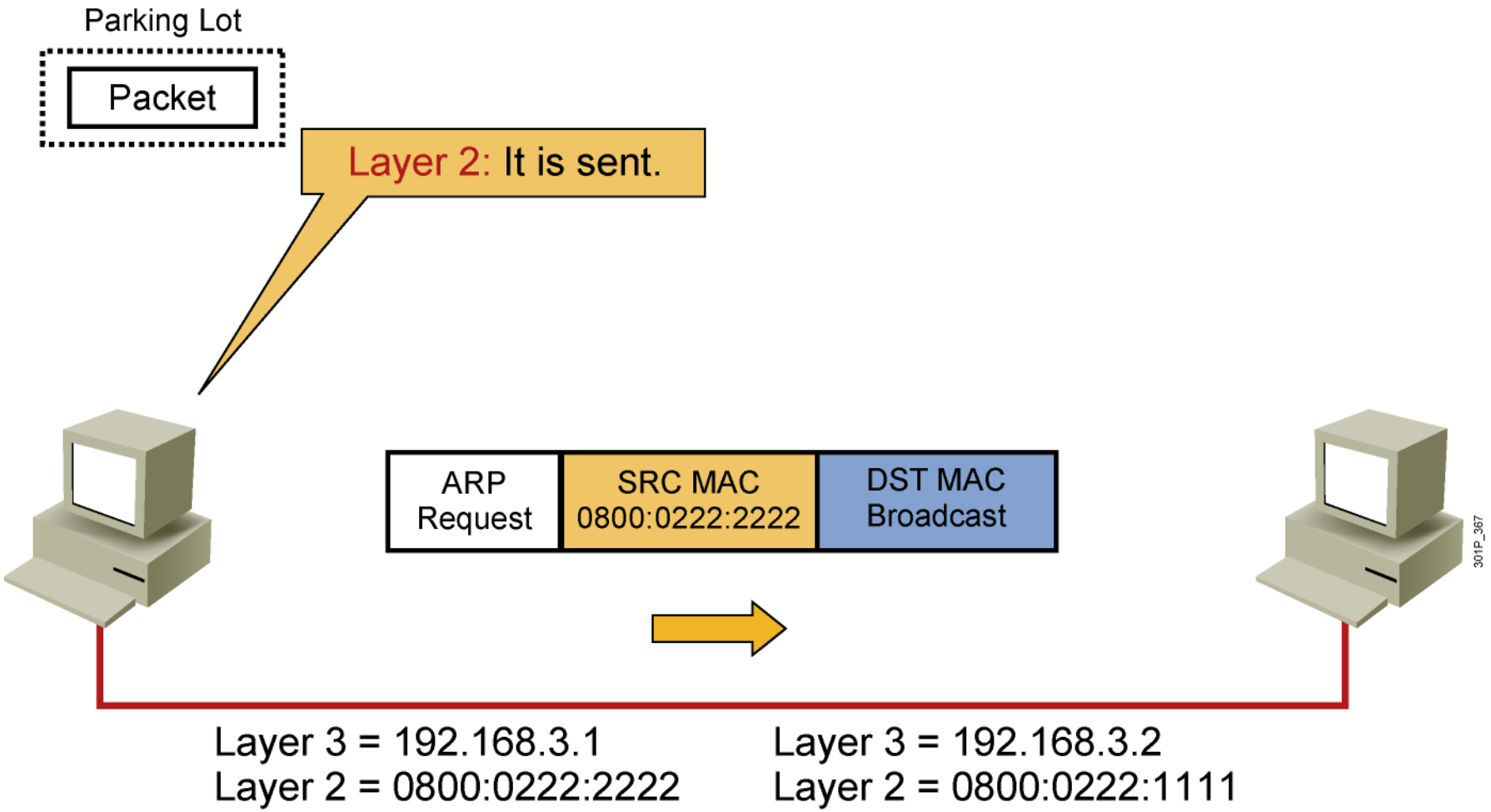
# Host-to-Host Packet Delivery (3 of 22)



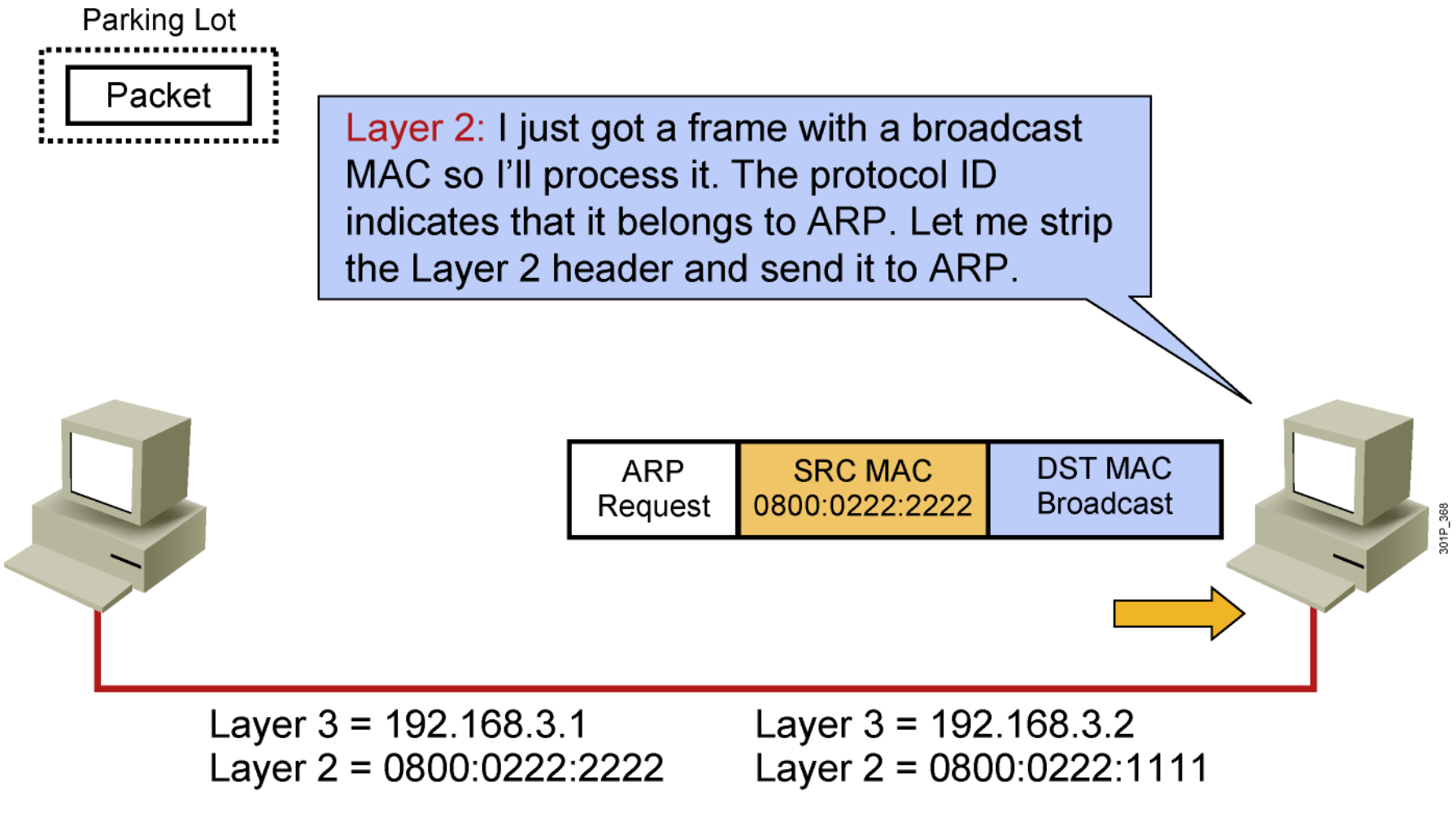
# Host-to-Host Packet Delivery (4 of 22)



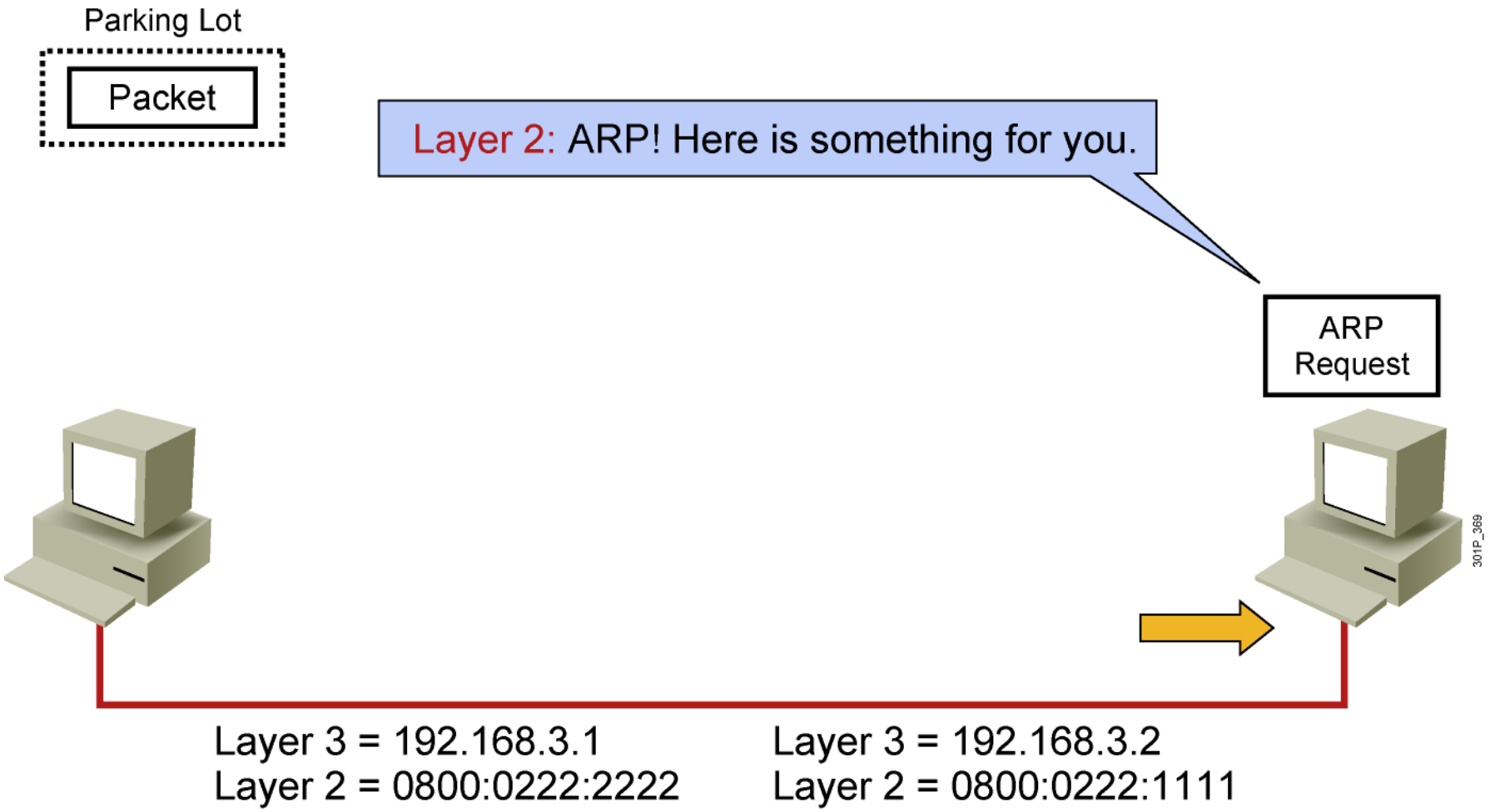
# Host-to-Host Packet Delivery (5 of 22)



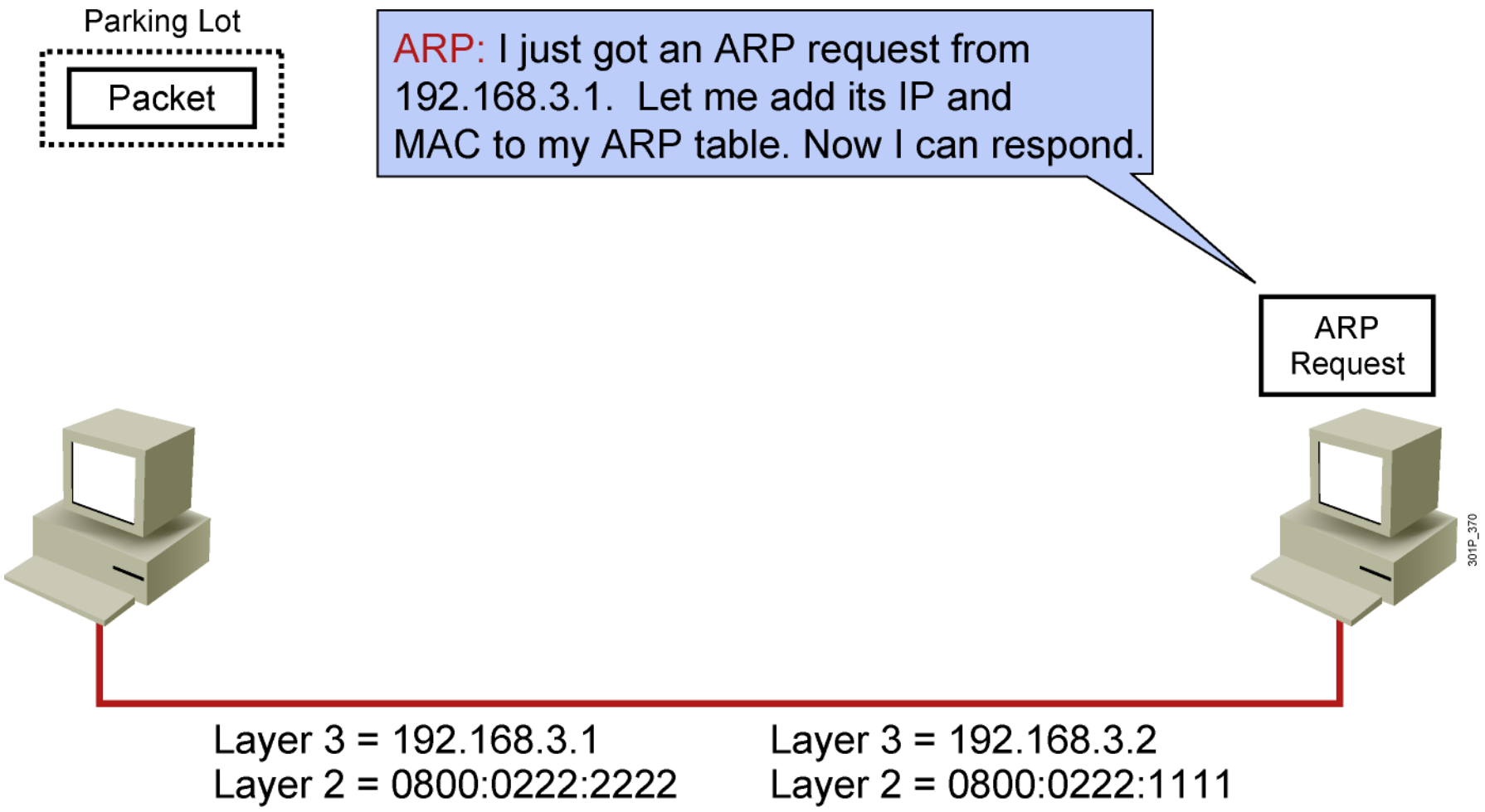
# Host-to-Host Packet Delivery (6 of 22)



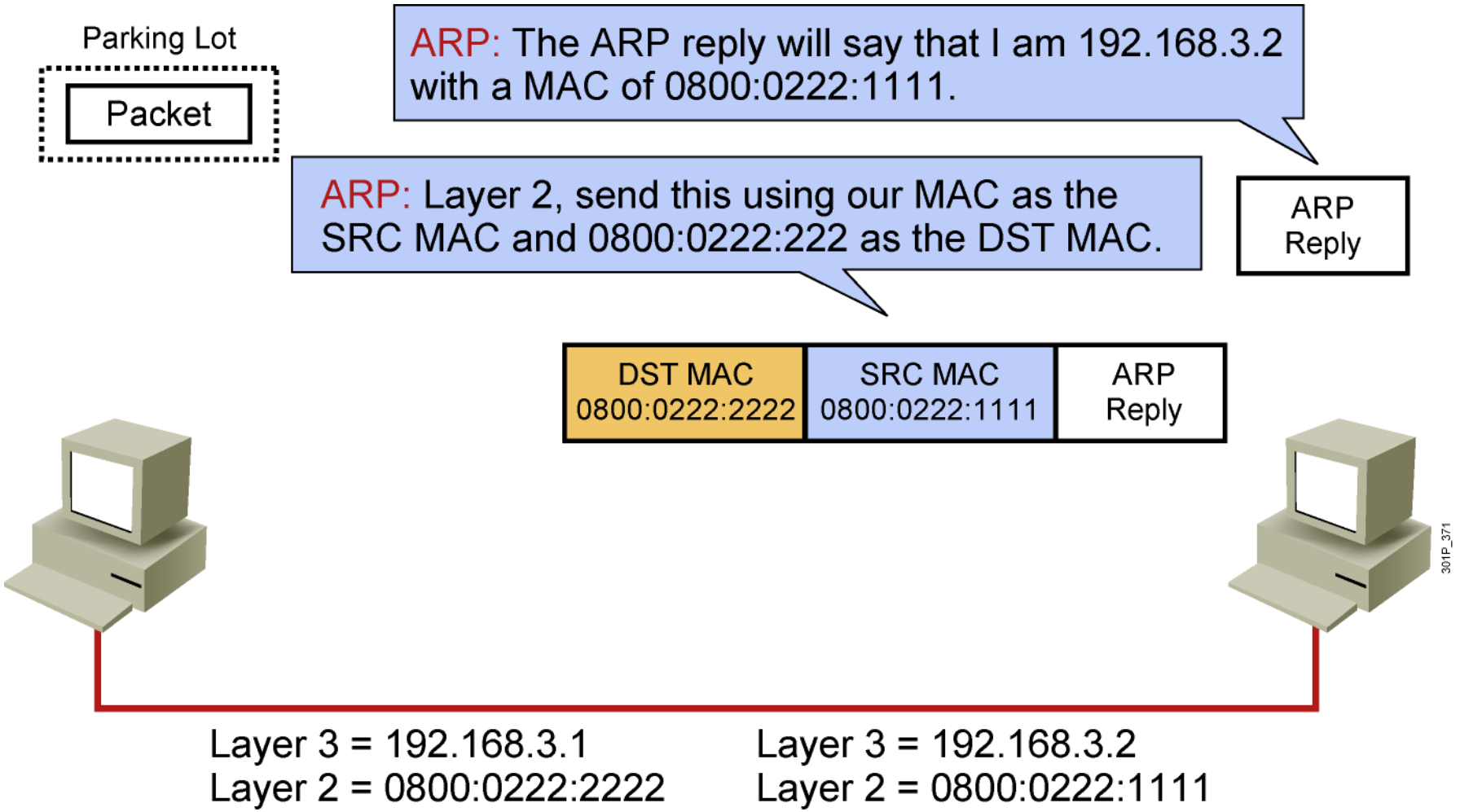
# Host-to-Host Packet Delivery (7 of 22)



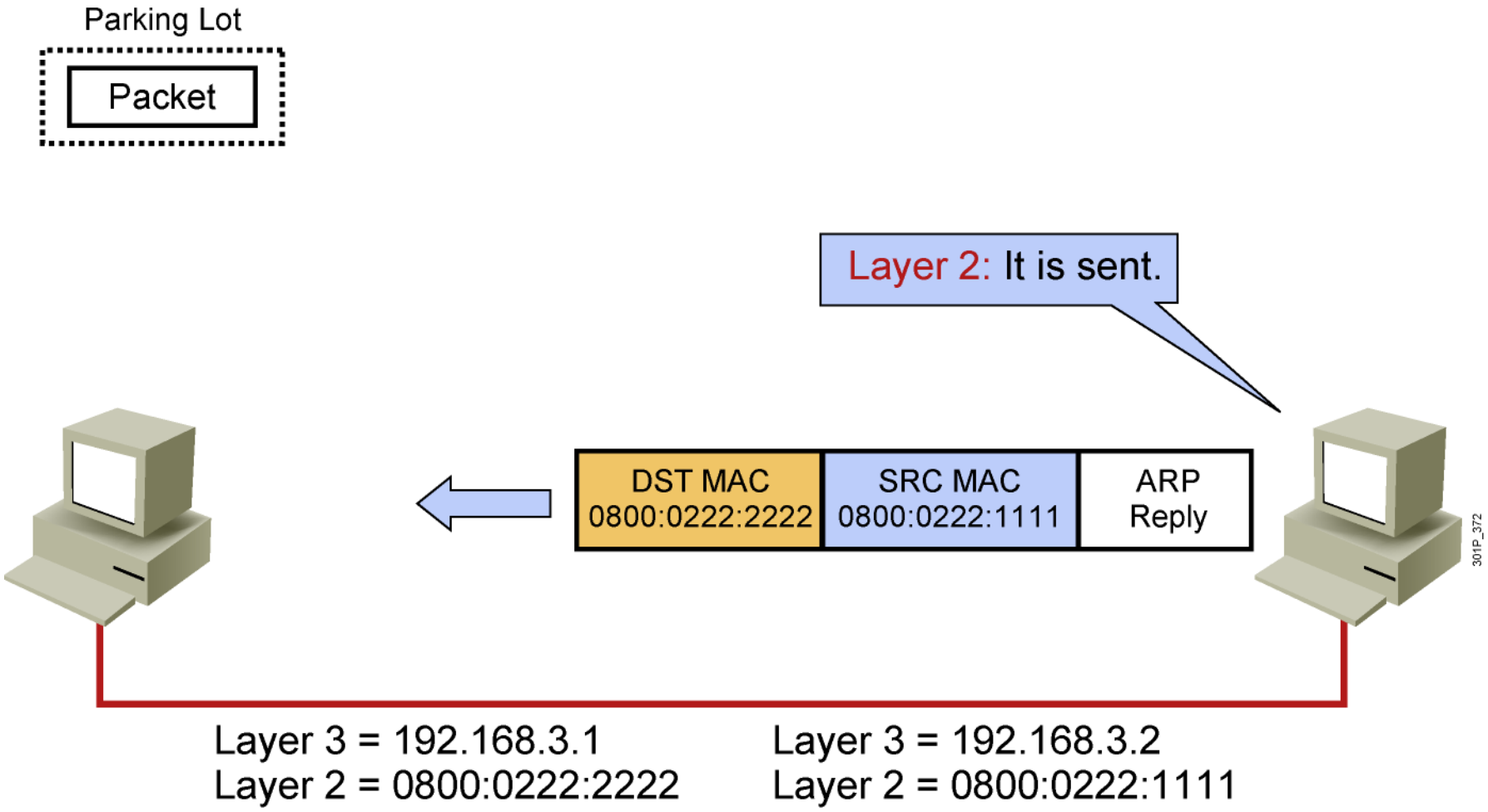
# Host-to-Host Packet Delivery (8 of 22)



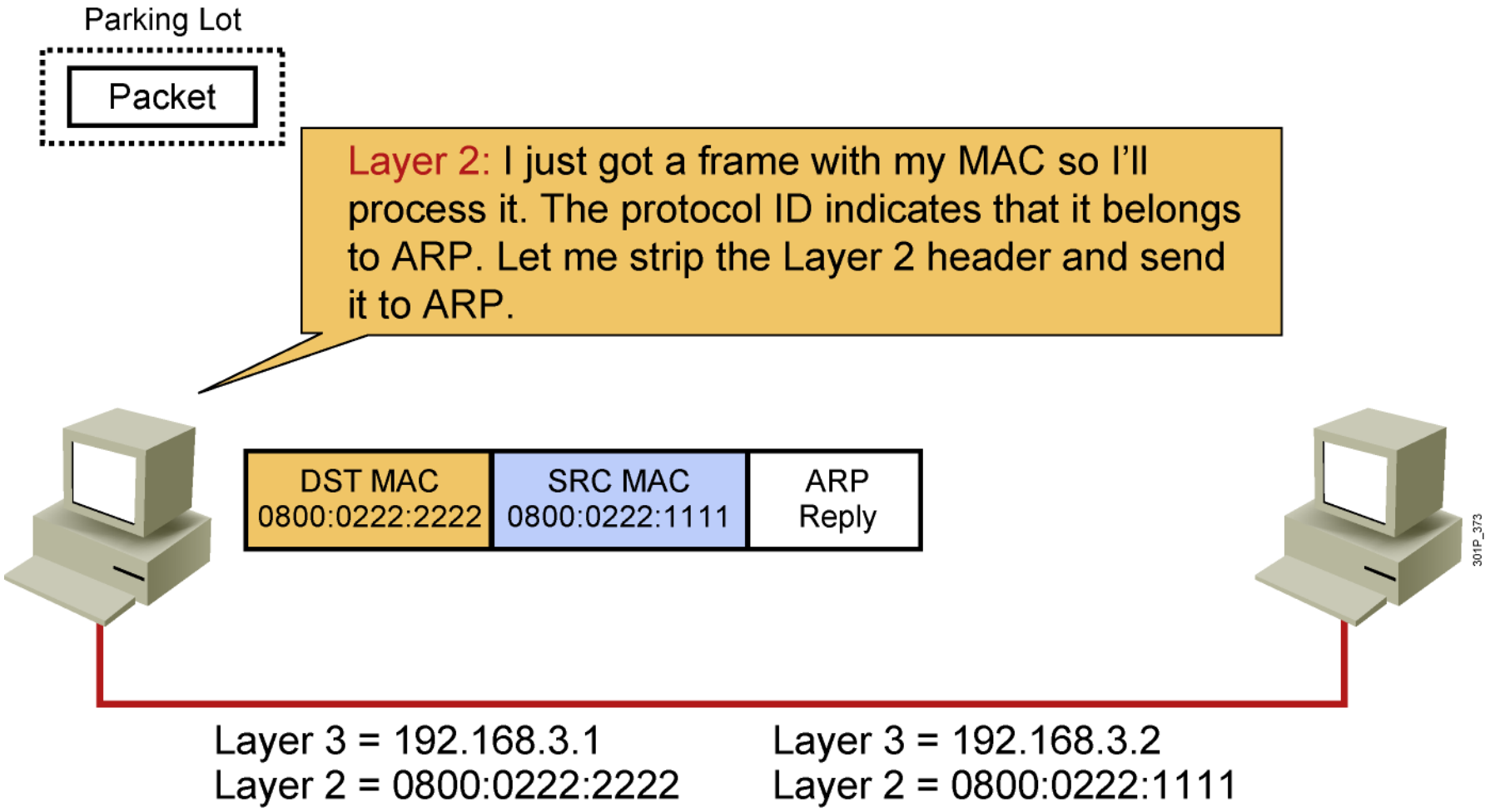
# Host-to-Host Packet Delivery (9 of 22)



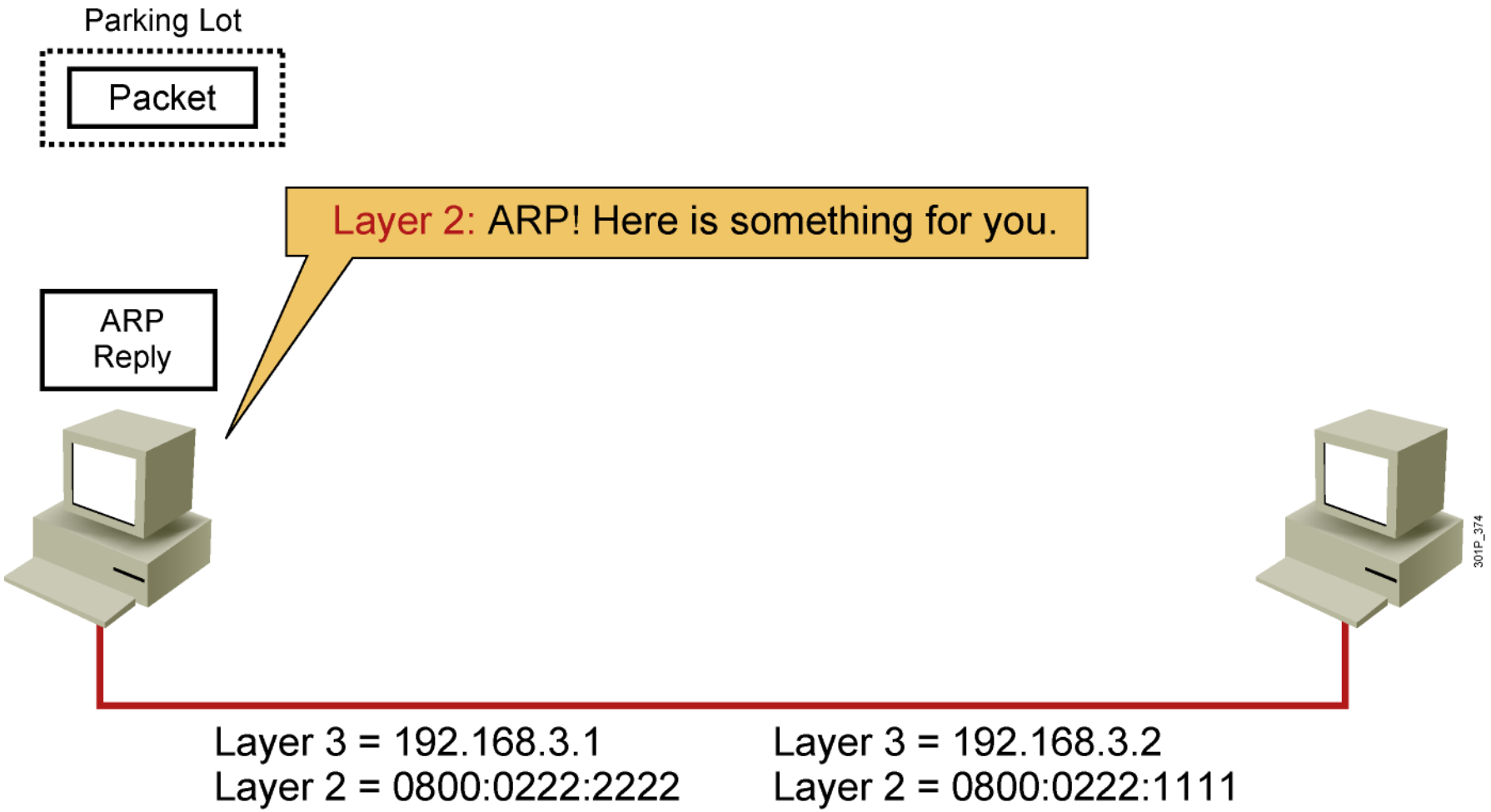
# Host-to-Host Packet Delivery (10 of 22)



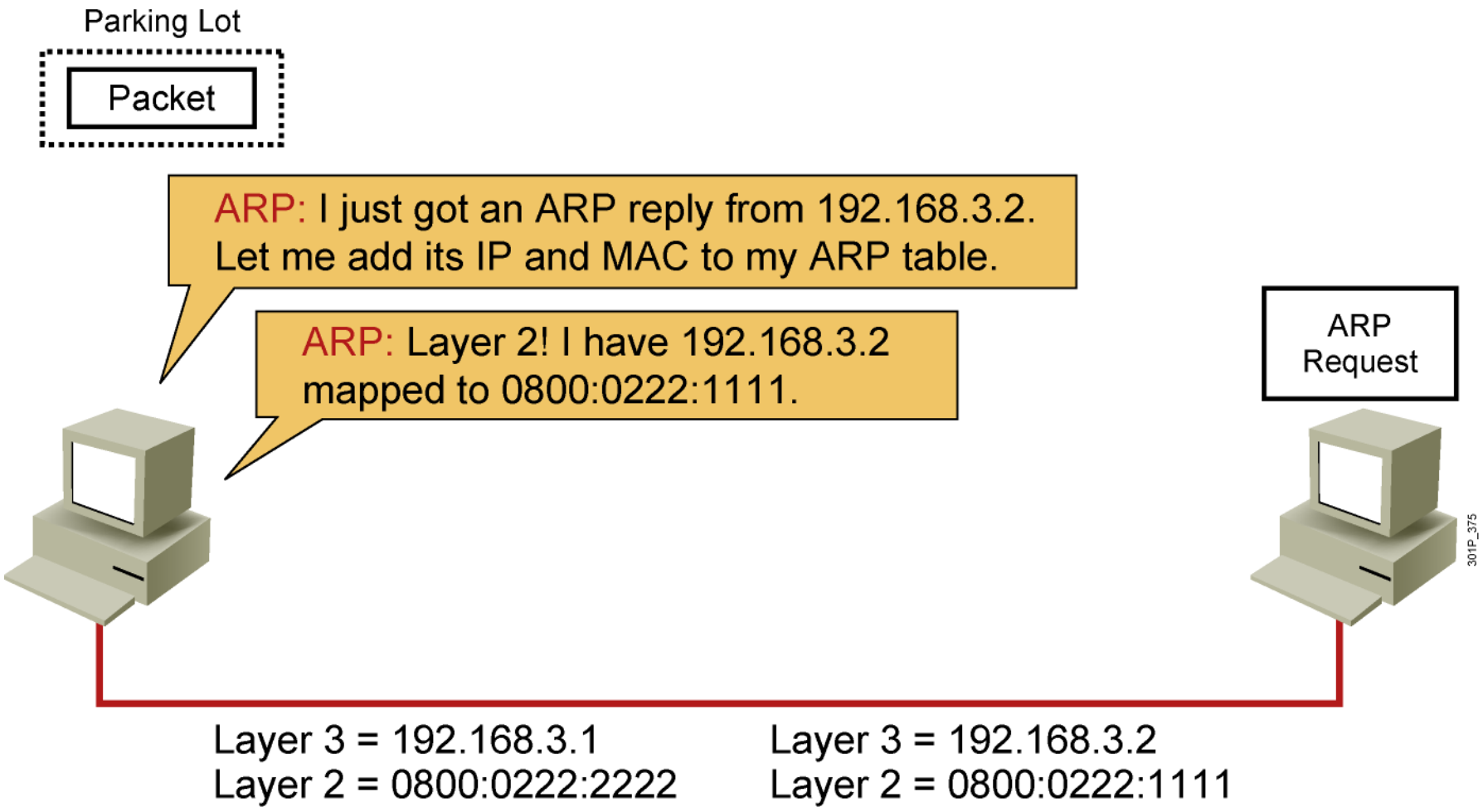
# Host-to-Host Packet Delivery (11 of 22)



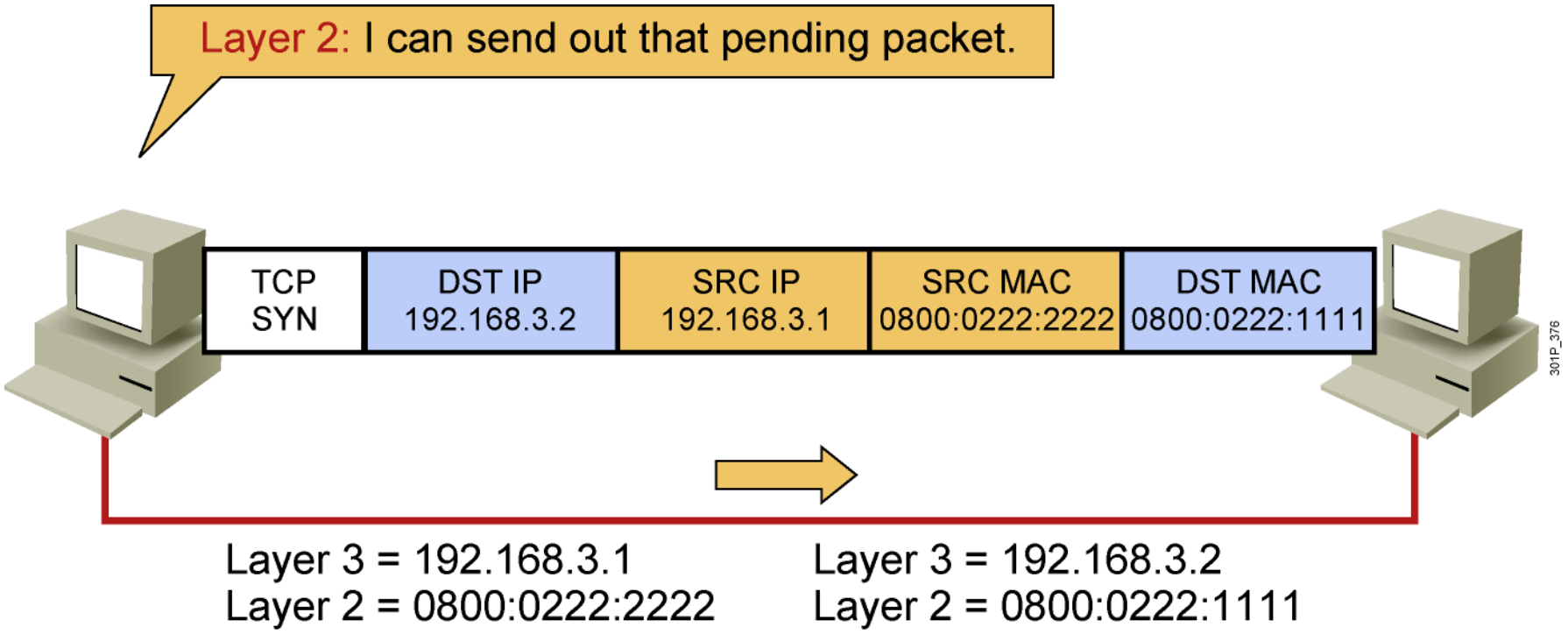
# Host-to-Host Packet Delivery (12 of 22)



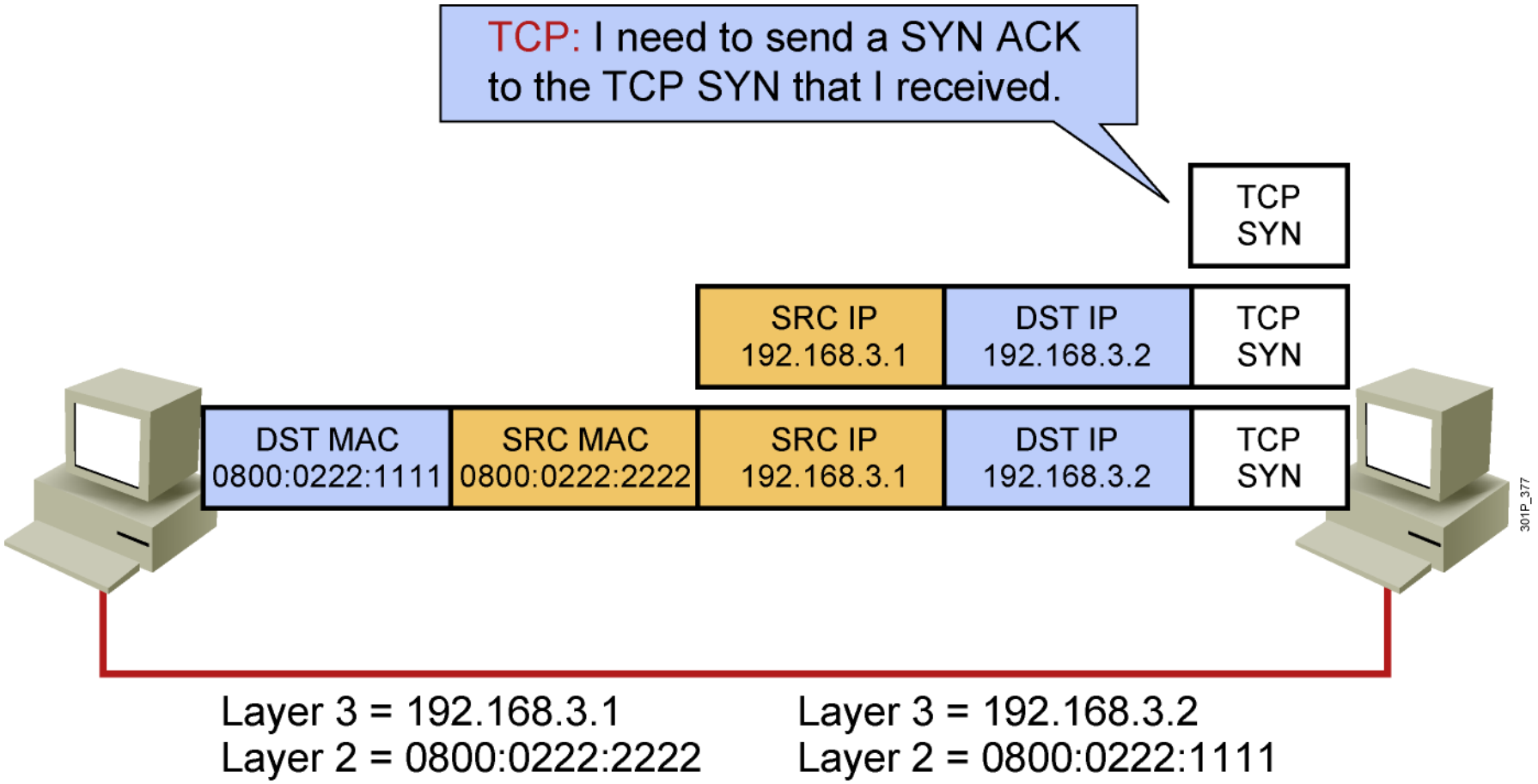
# Host-to-Host Packet Delivery (13 of 22)



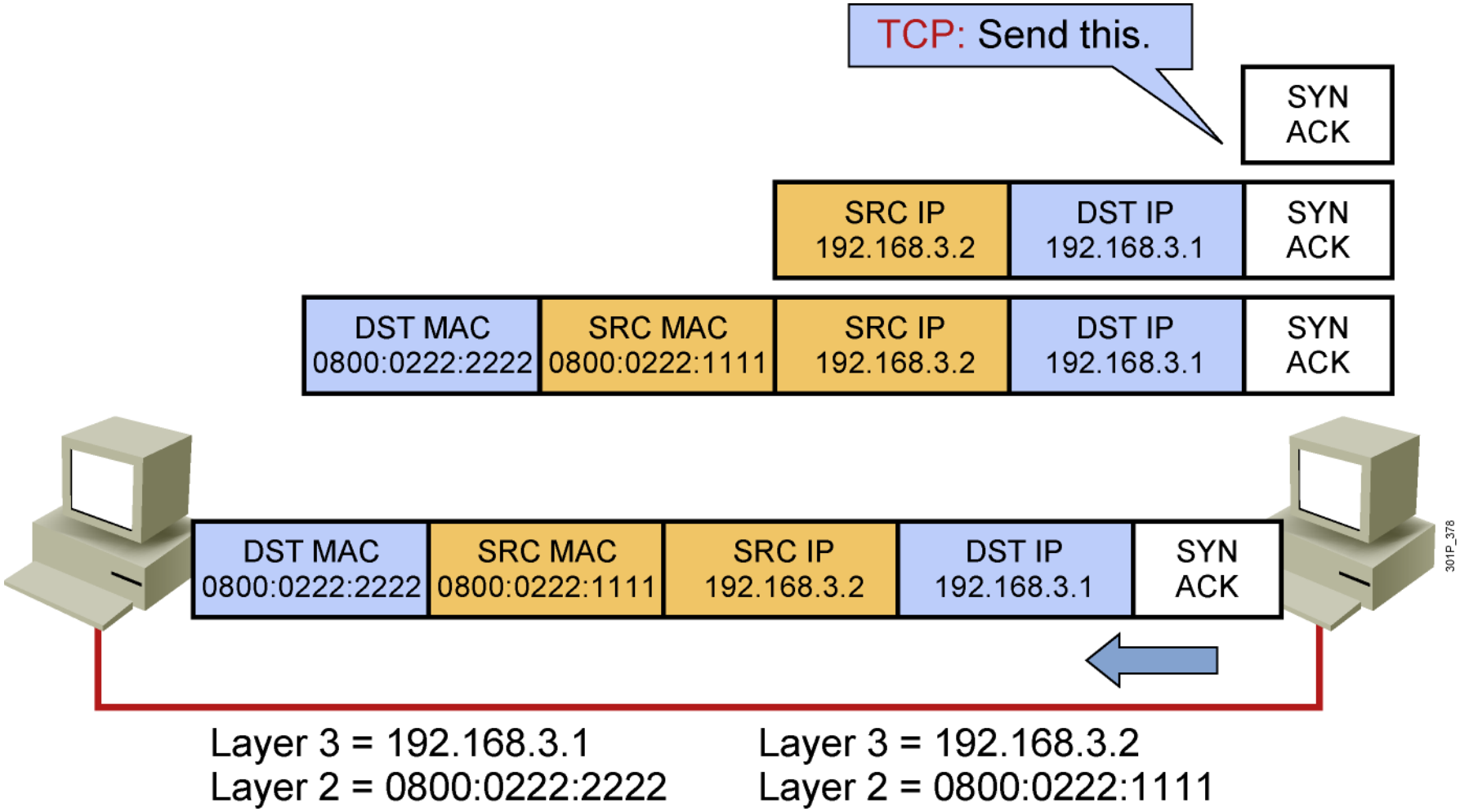
# Host-to-Host Packet Delivery (14 of 22)



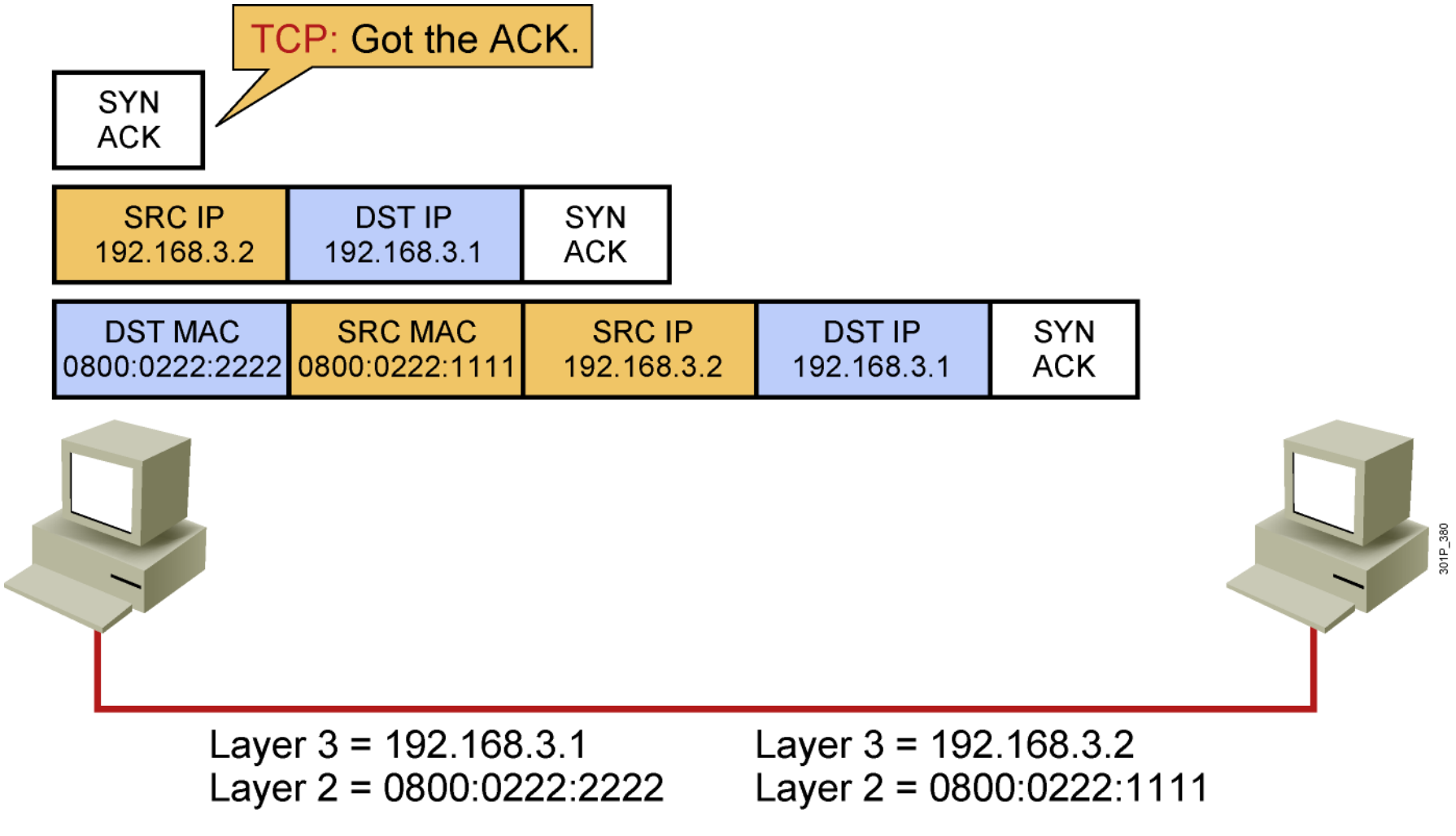
# Host-to-Host Packet Delivery (15 of 22)



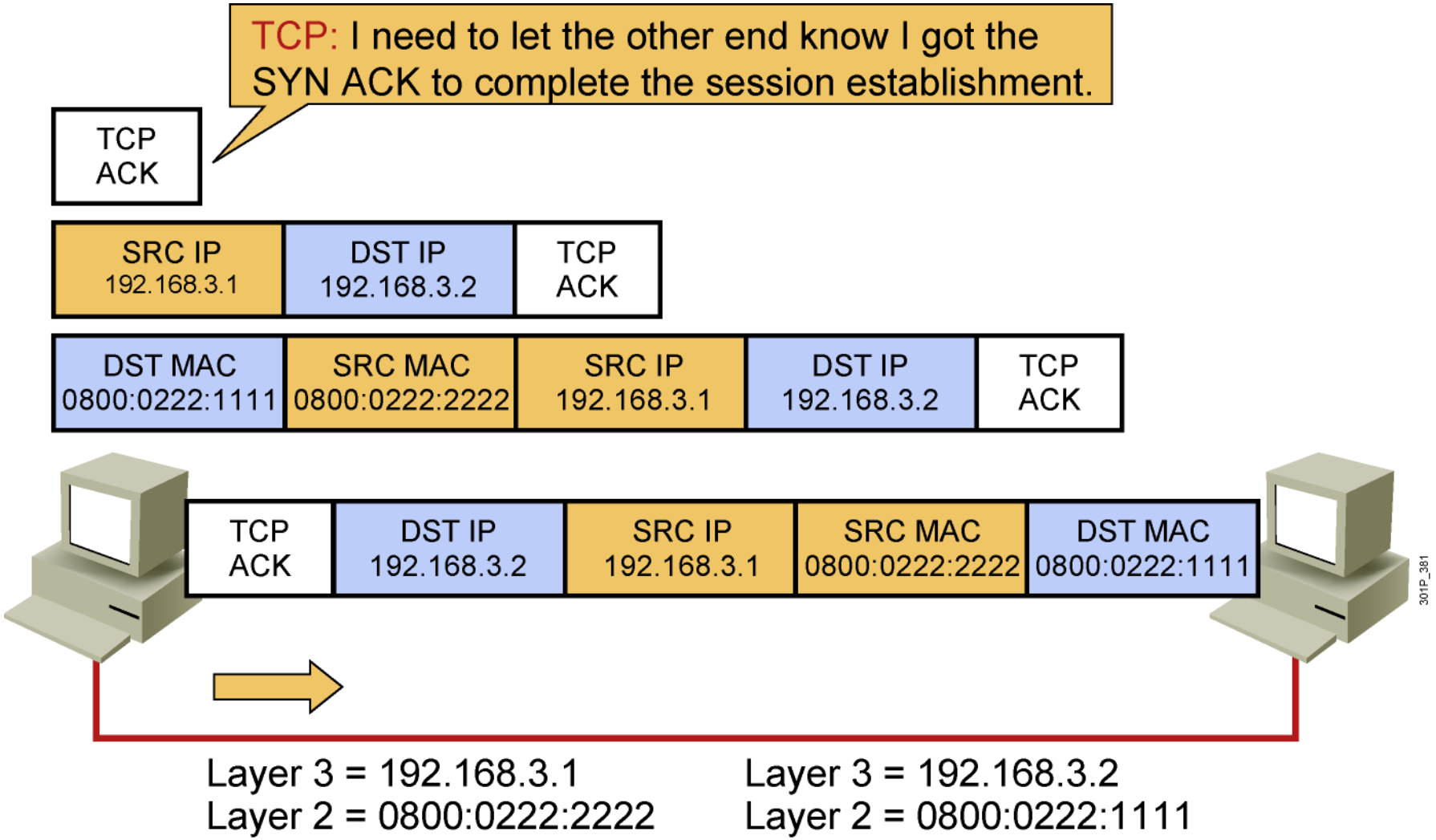
# Host-to-Host Packet Delivery (16 of 22)



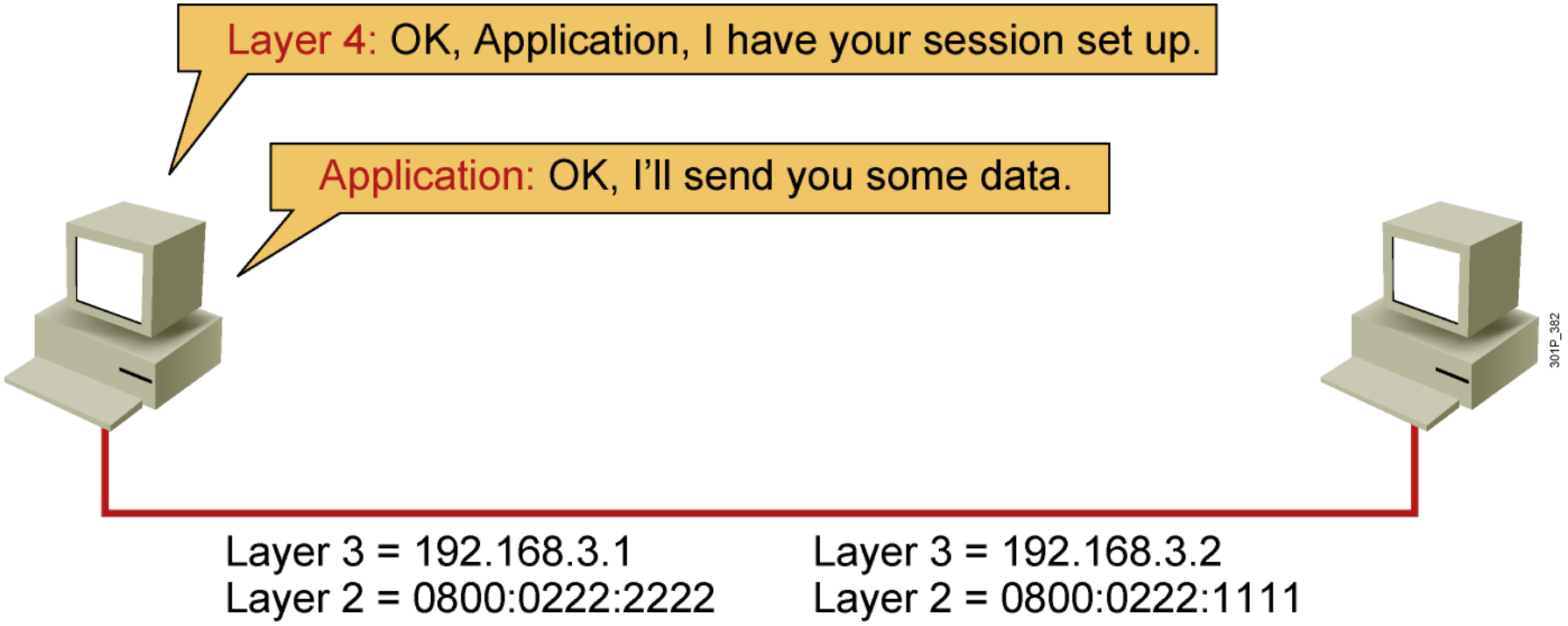
# Host-to-Host Packet Delivery (17 of 22)



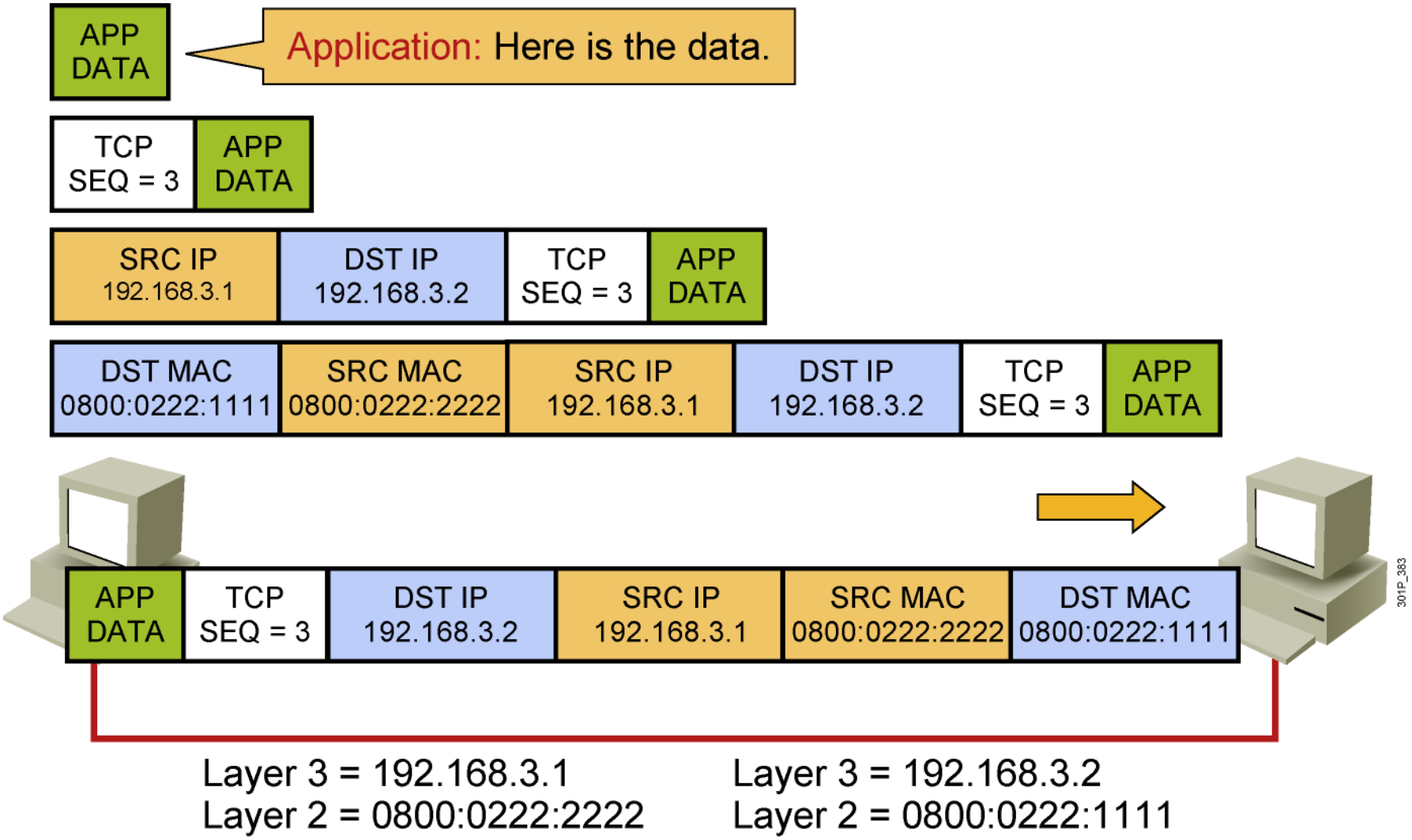
# Host-to-Host Packet Delivery (18 of 22)



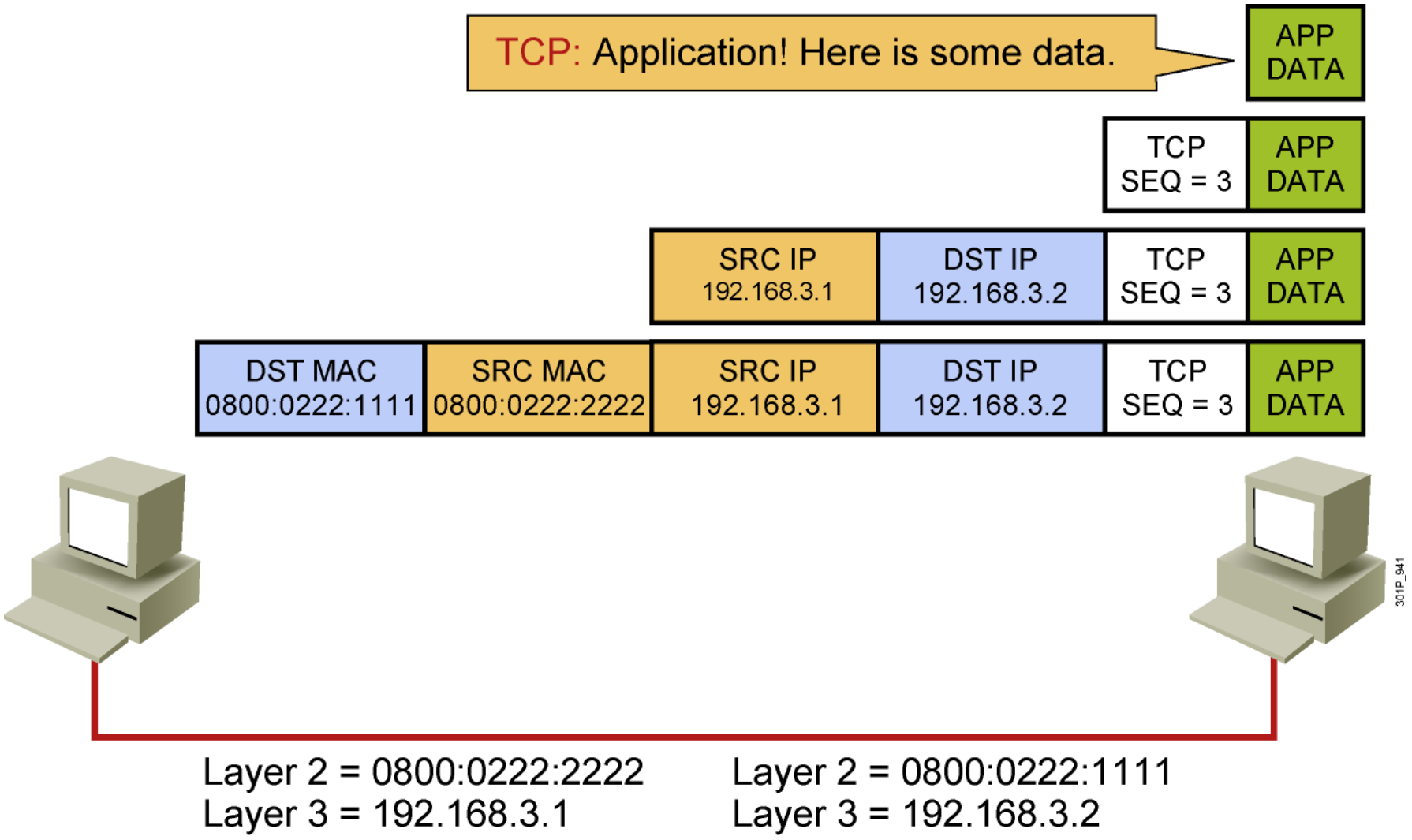
# Host-to-Host Packet Delivery (19 of 22)



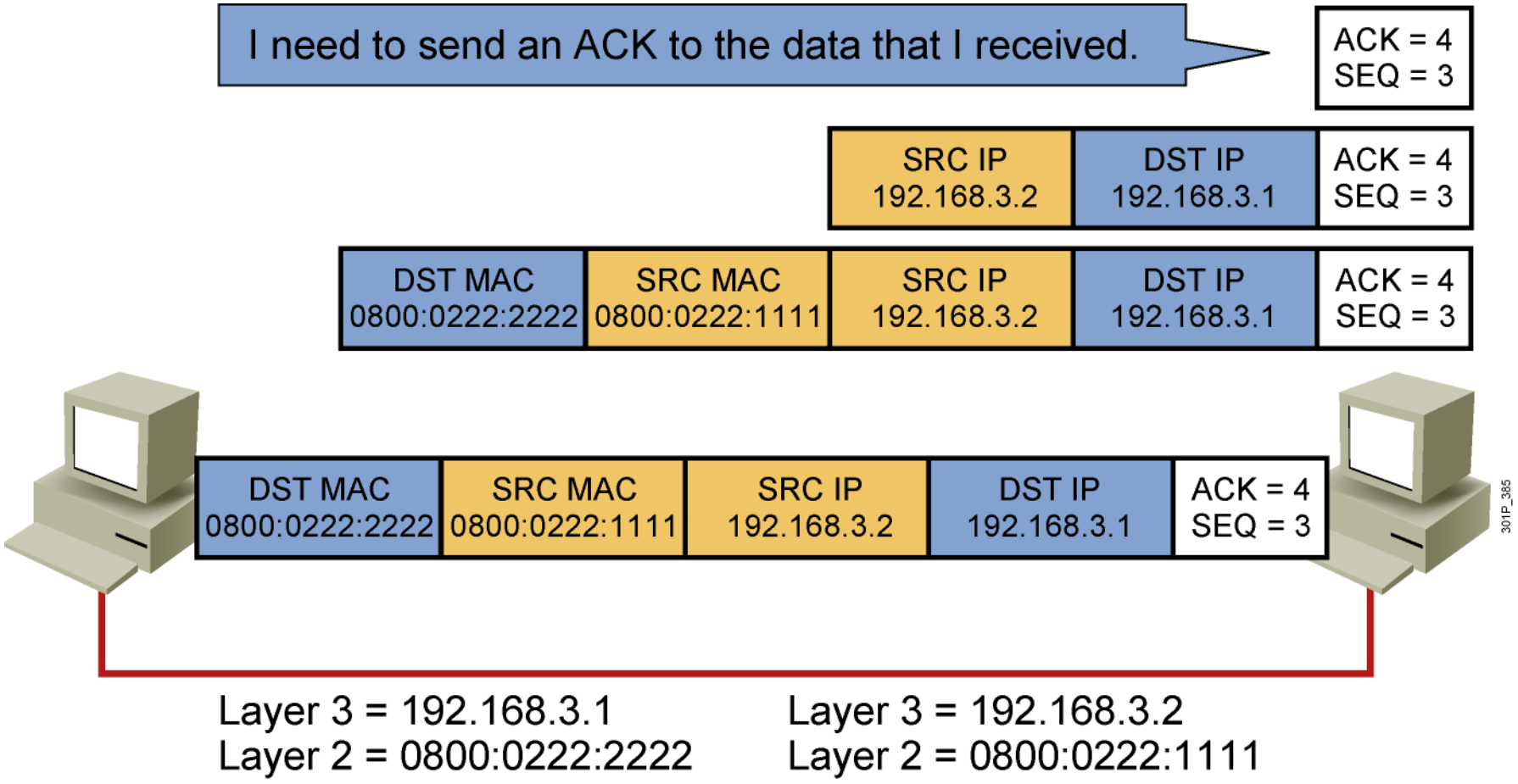
# Host-to-Host Packet Delivery (20 of 22)



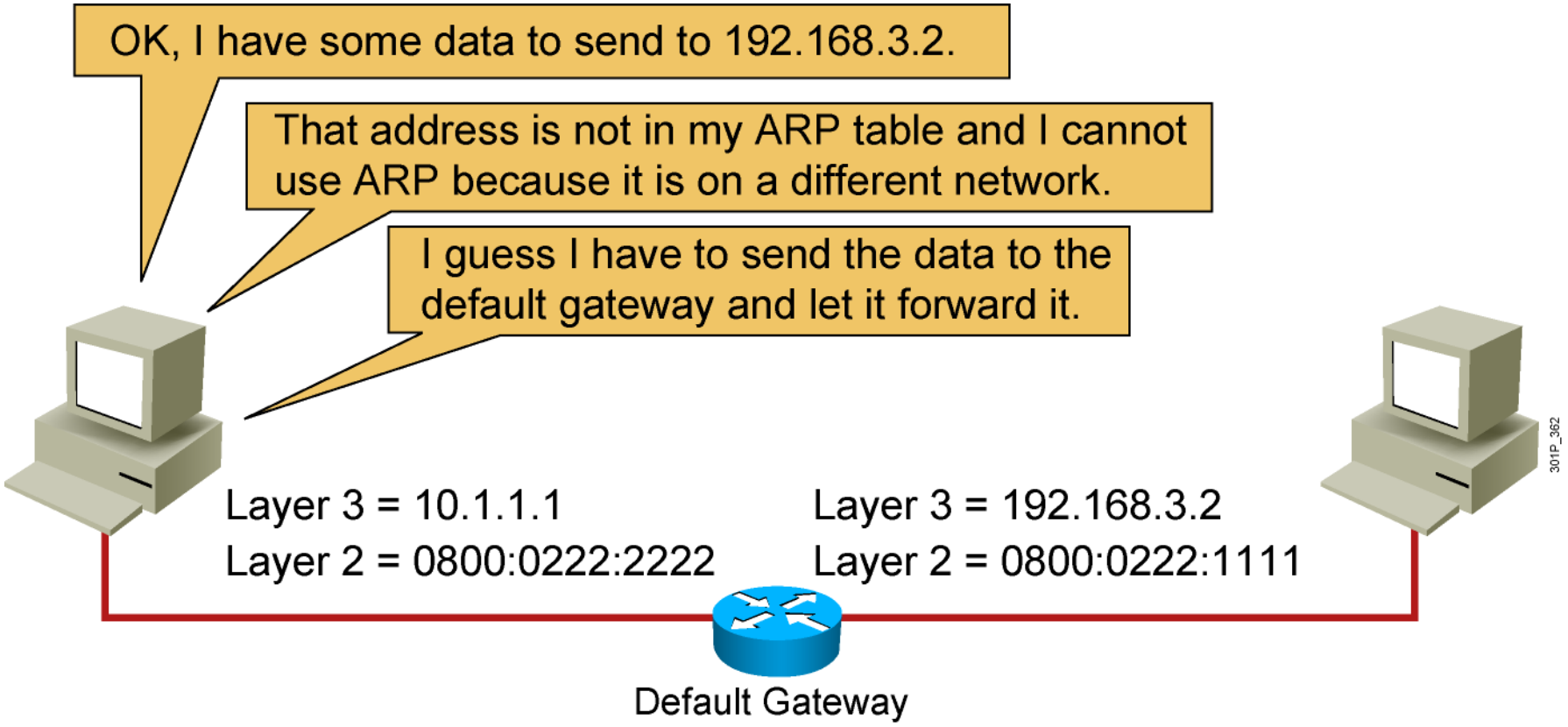
# Host-to-Host Packet Delivery (21 of 22)



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



# Default Gateway

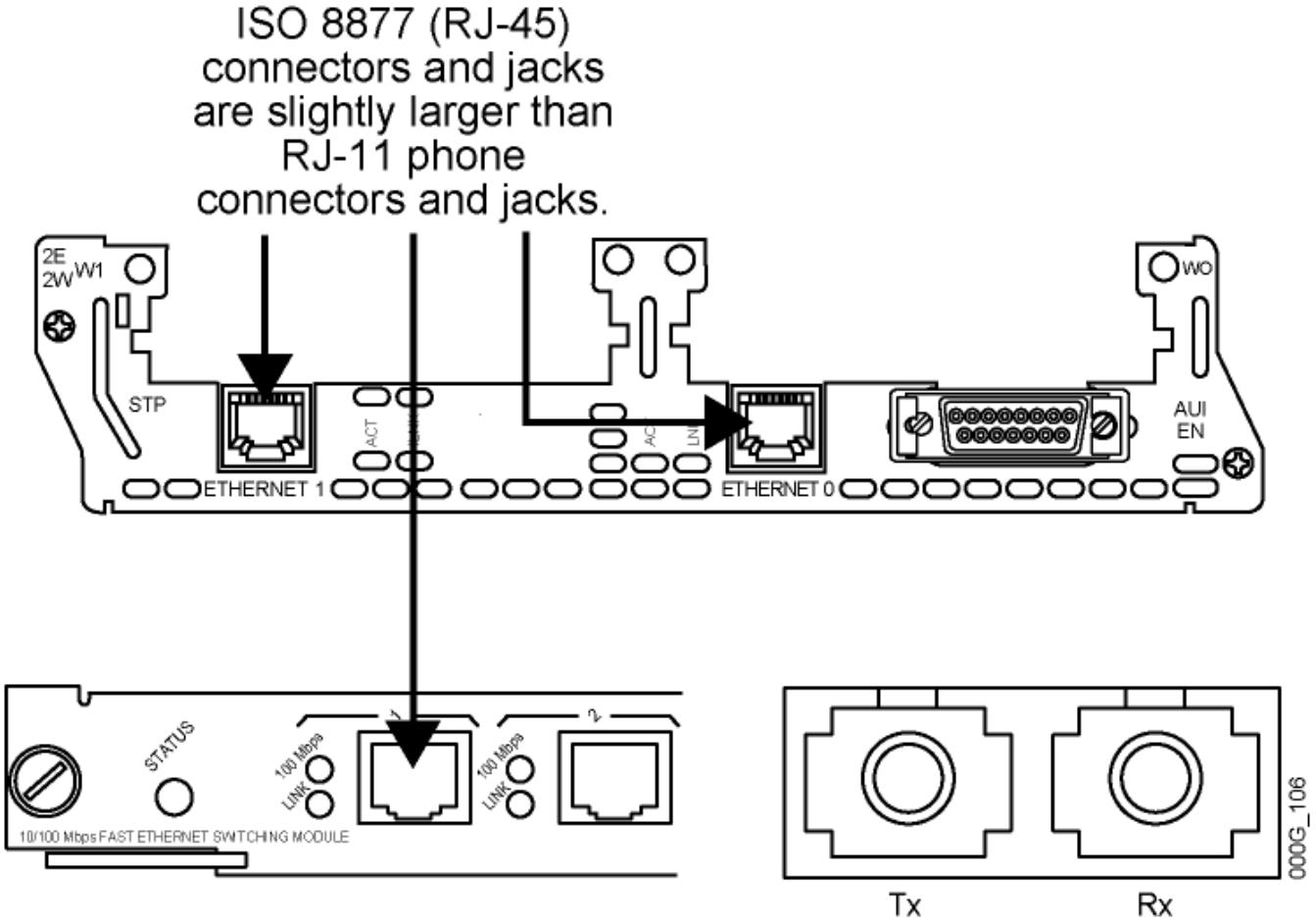


# Cabling in Internetwork

# Comparing Ethernet Media Requirements

| Requirement | 10 BASE-T | 100 BASE-TX | 100 BASE-FX | 1000 BASE-CX | 1000 BASE-T | 1000 BASE-SX | 1000 BASE-LX |
|---|---|---|---|---|---|---|---|
| Media | EIA/TIA Category 3, 4, 5 UTP 2 pair | EIA/TIA Category 5 UTP 2 pair | 62.5/125 micron multimode fiber | STP | EIA/TIA Category 5 UTP 4 pair | 62.5/50 micron multimode fiber | 9 micron single-mode fiber |
| Maximum Segment Length | 100 m (328 ft) | 100 m (328 ft) | 400 m (1312.3 ft) | 25 m (82 ft) | 100 m (328 ft) | 275 m (62.5 micron) 550 m (50 micron) | 3-10 km (1.86-6.2 miles) |
| Connector | ISO 8877 (RJ-45) | ISO 8877 (RJ-45) | Duplex media interface connector (MIC) ST | ISO 8877 (RJ-45) | ISO 8877 (RJ-45) | — | — |

# Differentiating Between Connections



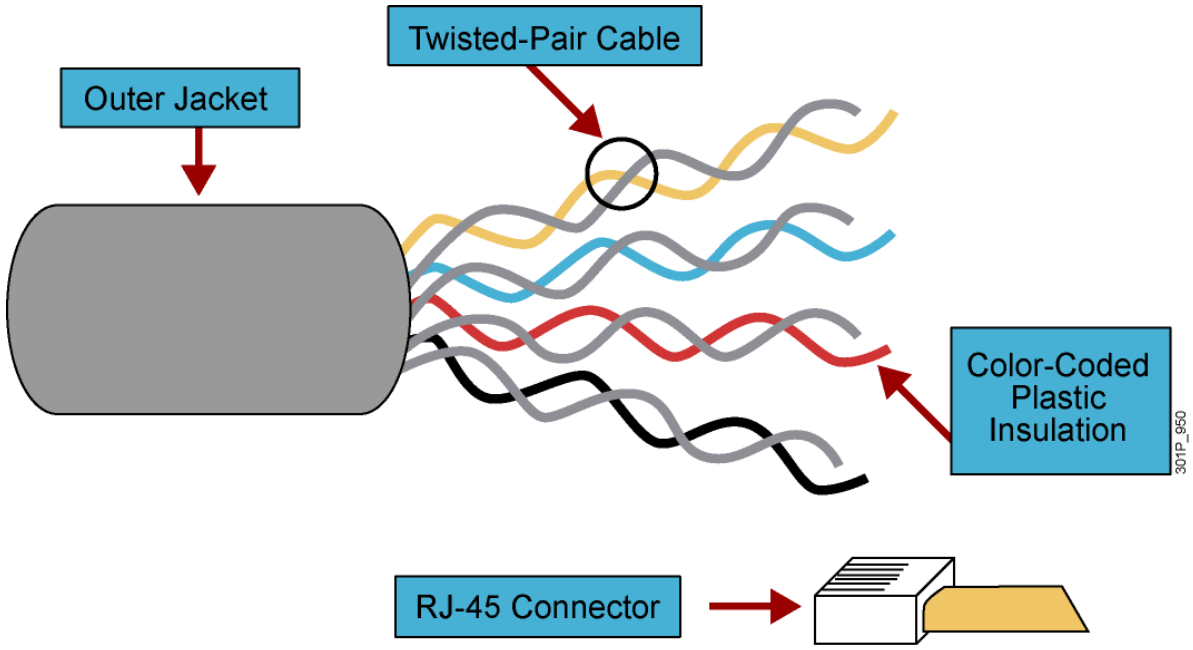

ISO = International Organization for Standardization

# 1000BASE-T GBIC

# Cisco Fiber-Optic GBICs

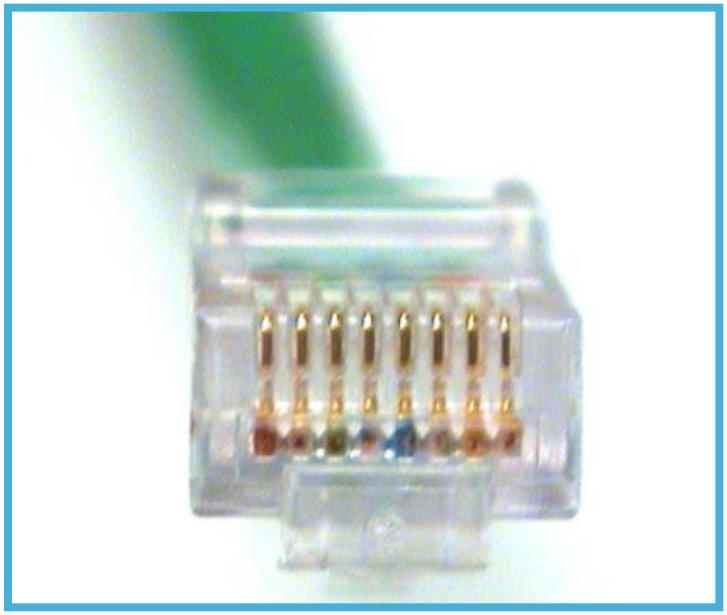
- Short wavelength (1000BASE-SX)
- Long wavelength/long haul (1000BASE-LX/LH)
- Extended distance (1000BASE-ZX)


# Unshielded Twisted-Pair Cable

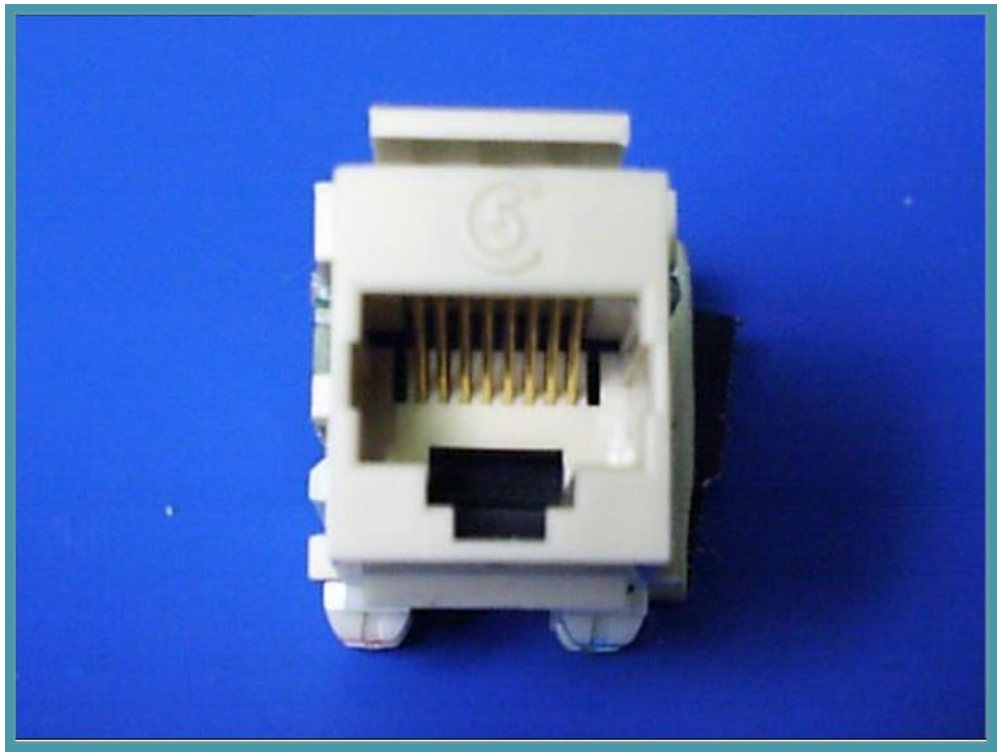



- Speed and throughput: 10 to 1000 Mb/s
- Average cost per node: Least expensive
- Media and connector size: Small
- Maximum cable length: Varies

# RJ-45 Connector

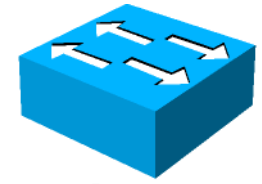


# RJ-45 Jack

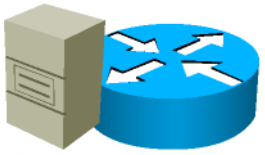


# UTP Implementation (Straight-Through)

## Cable 10BASE-T/ 100BASE-TX Straight-Through



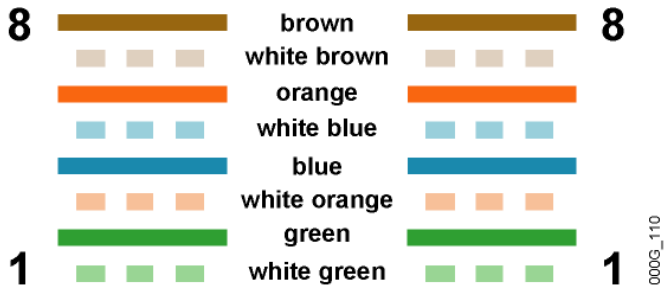
Hub/Switch




Server/Router

| Pin Label | | | Pin Label |
|---|---|---|---|
| 1 | TX+ ⟷ | 1 | TX+ |
| 2 | TX- ⟷ | 2 | TX- |
| 3 | RX+ ⟷ | 3 | RX+ |
| 4 | NC | 4 | NC |
| 5 | NC | 5 | NC |
| 6 | RX- ⟷ | 6 | RX- |
| 7 | NC | 7 | NC |
| 8 | NC | 8 | NC |

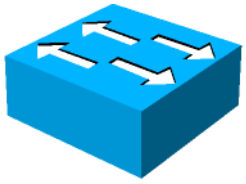
## Straight-Through Cable



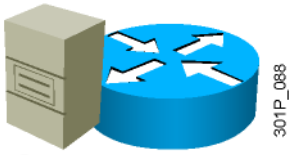

Wires on cable ends are in same order.

# UTP Implementation (Crossover)

Cable 10BASE-T or
100BASE-TX Straight-Through



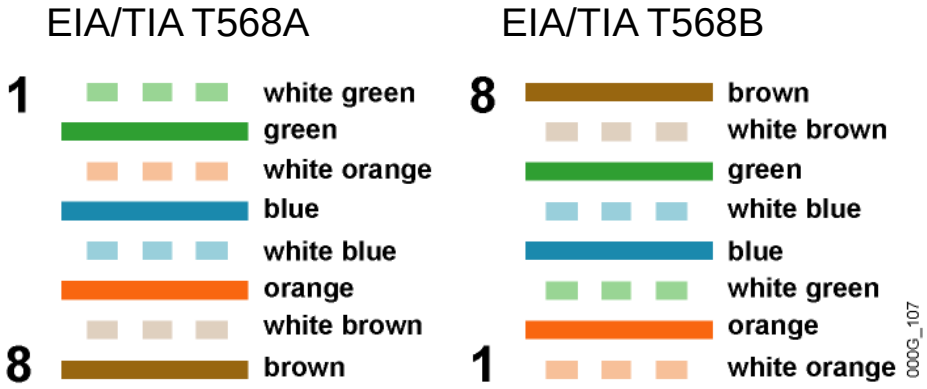
Hub/Switch




Server/Router

| Pin Label | | Pin Label | |
|---|---|---|---|
| 1 | TX+ | 1 | TX+ |
| 2 | TX- | 2 | TX- |
| 3 | RX+ | 3 | RX+ |
| 4 | NC | 4 | NC |
| 5 | NC | 5 | NC |
| 6 | RX- | 6 | RX- |
| 7 | NC | 7 | NC |
| 8 | NC | 8 | NC |

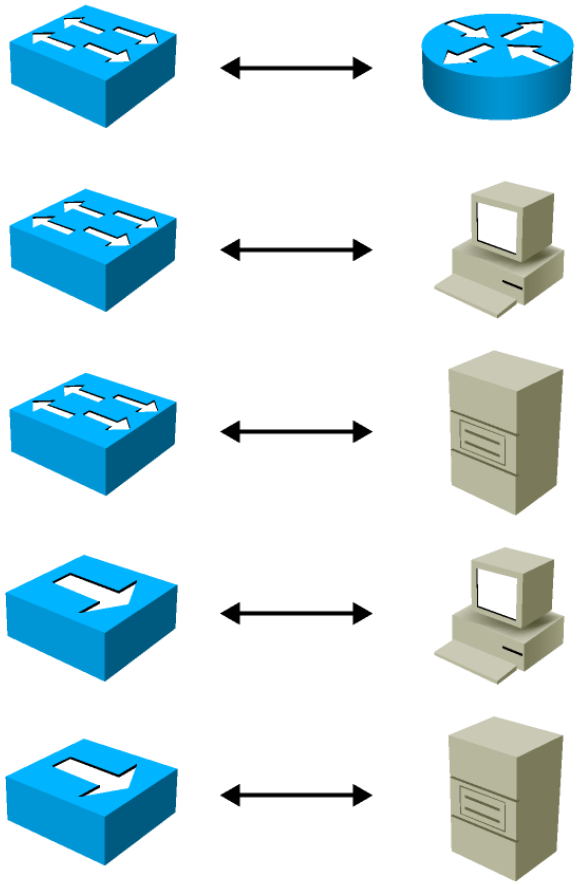
Crossover Cable



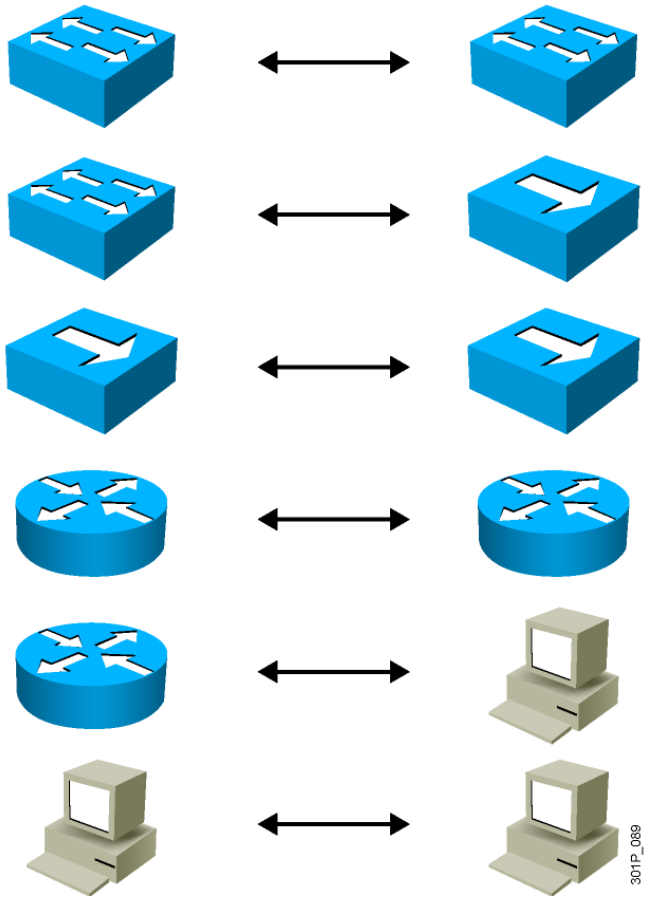

Some wires on cable ends are crossed.

# UTP Implementation: Straight-Through vs. Crossover

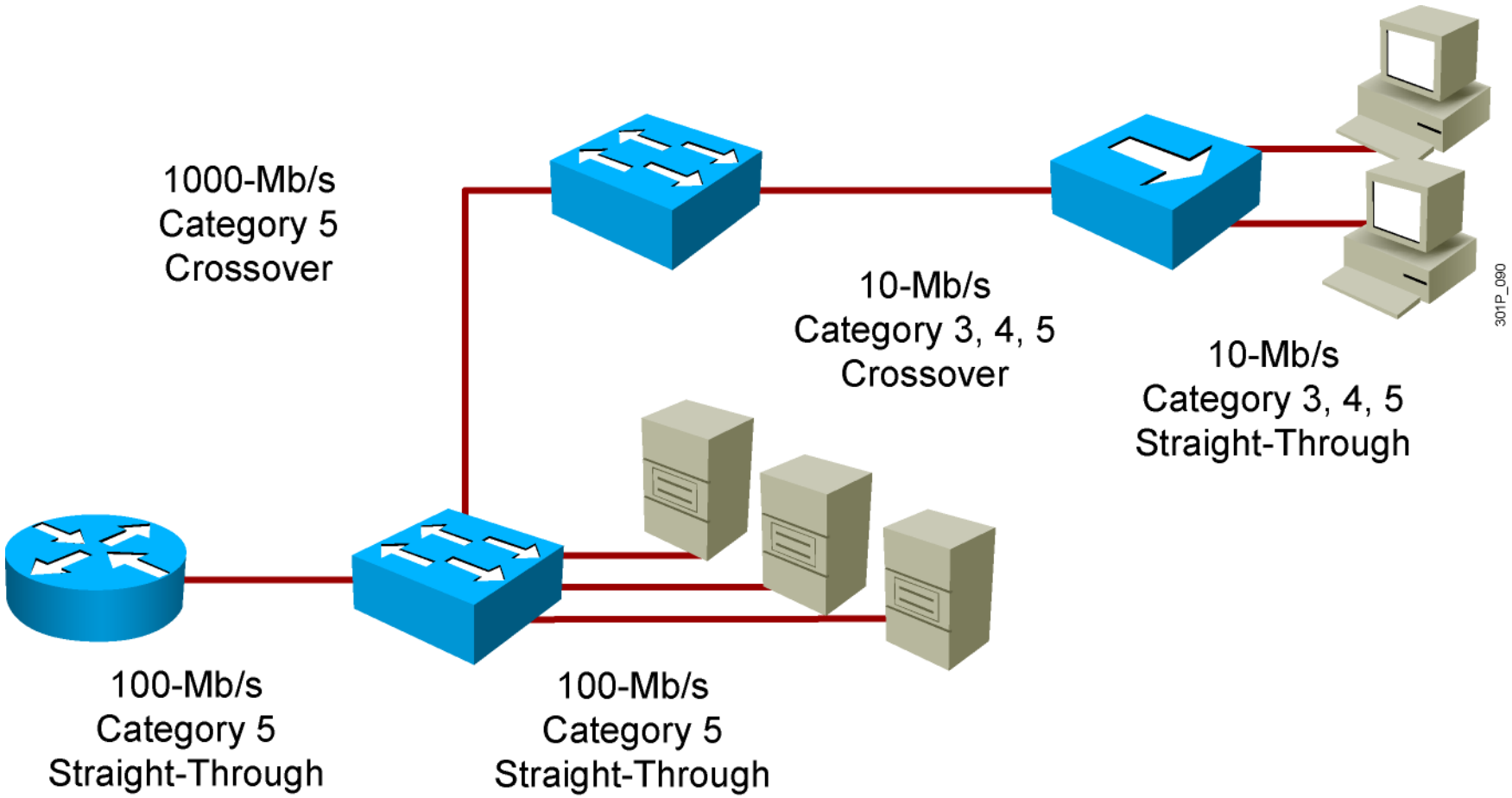
## Straight-Through Cable



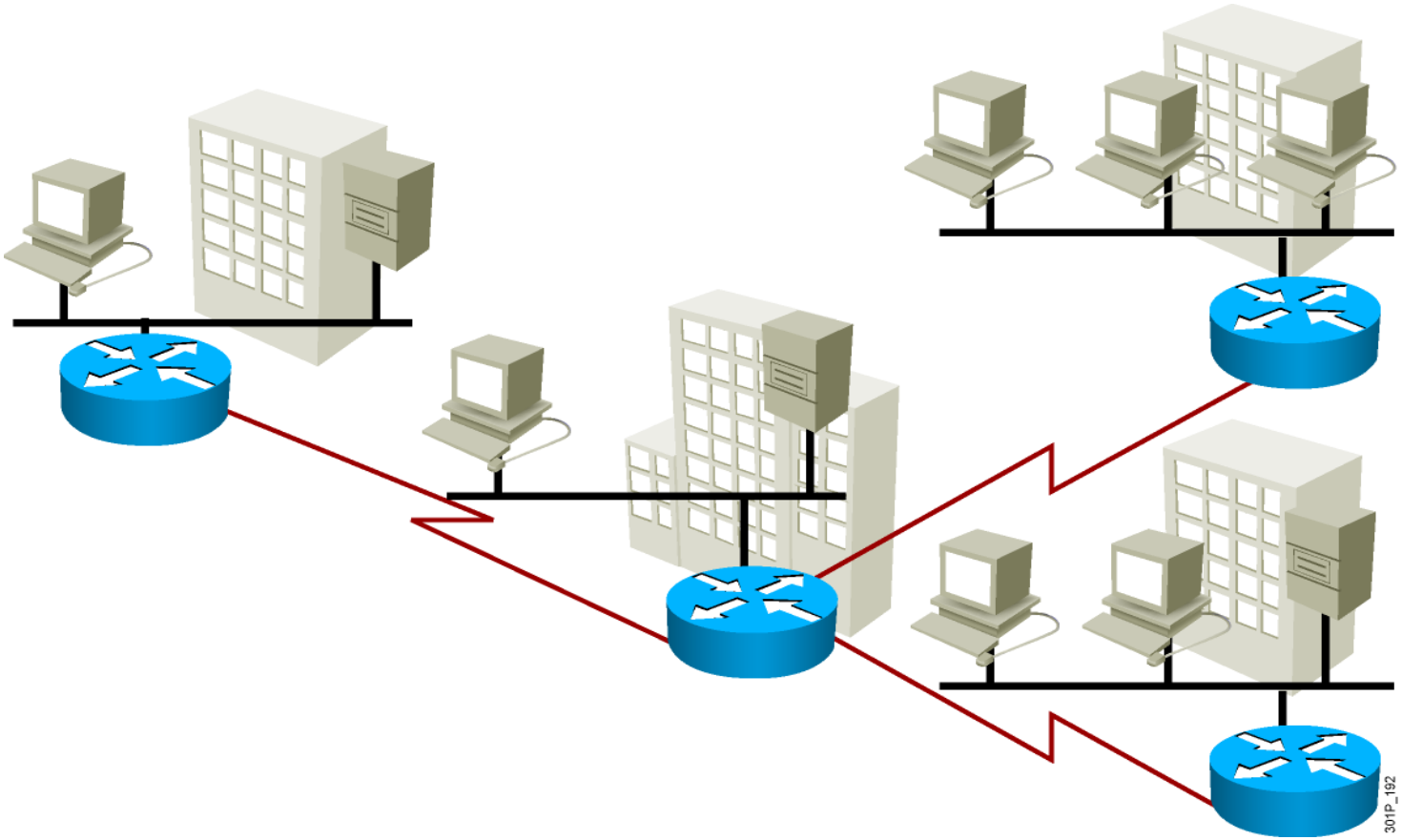
## Crossover Cable



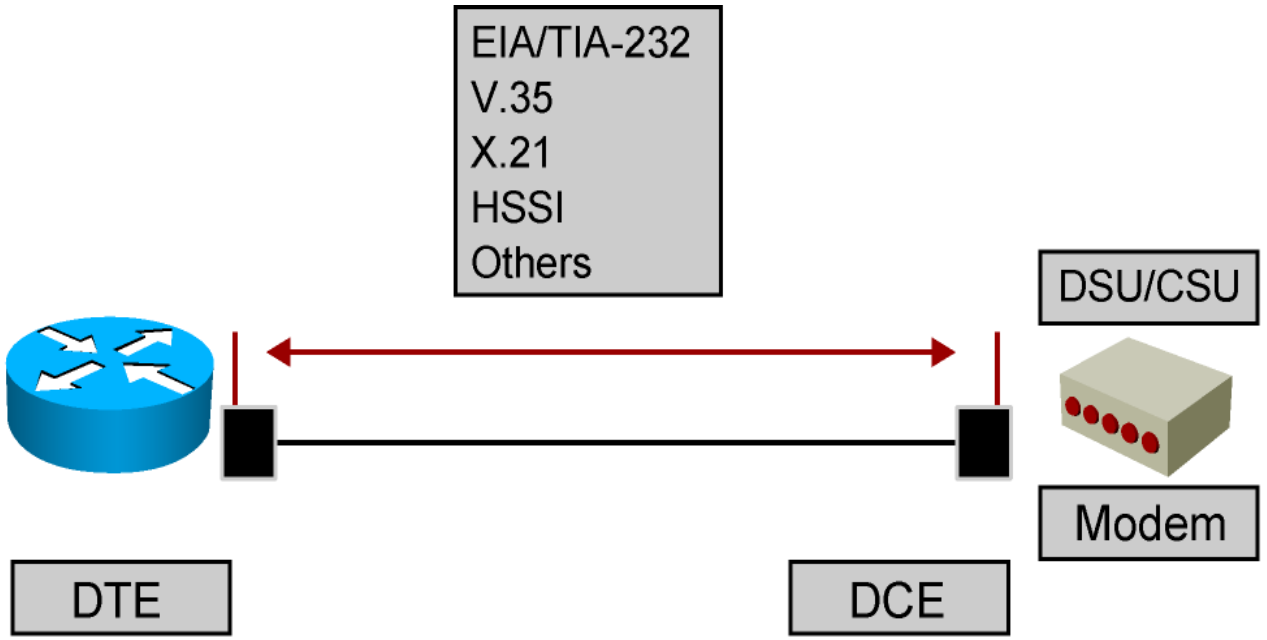
# Using Varieties of UTP



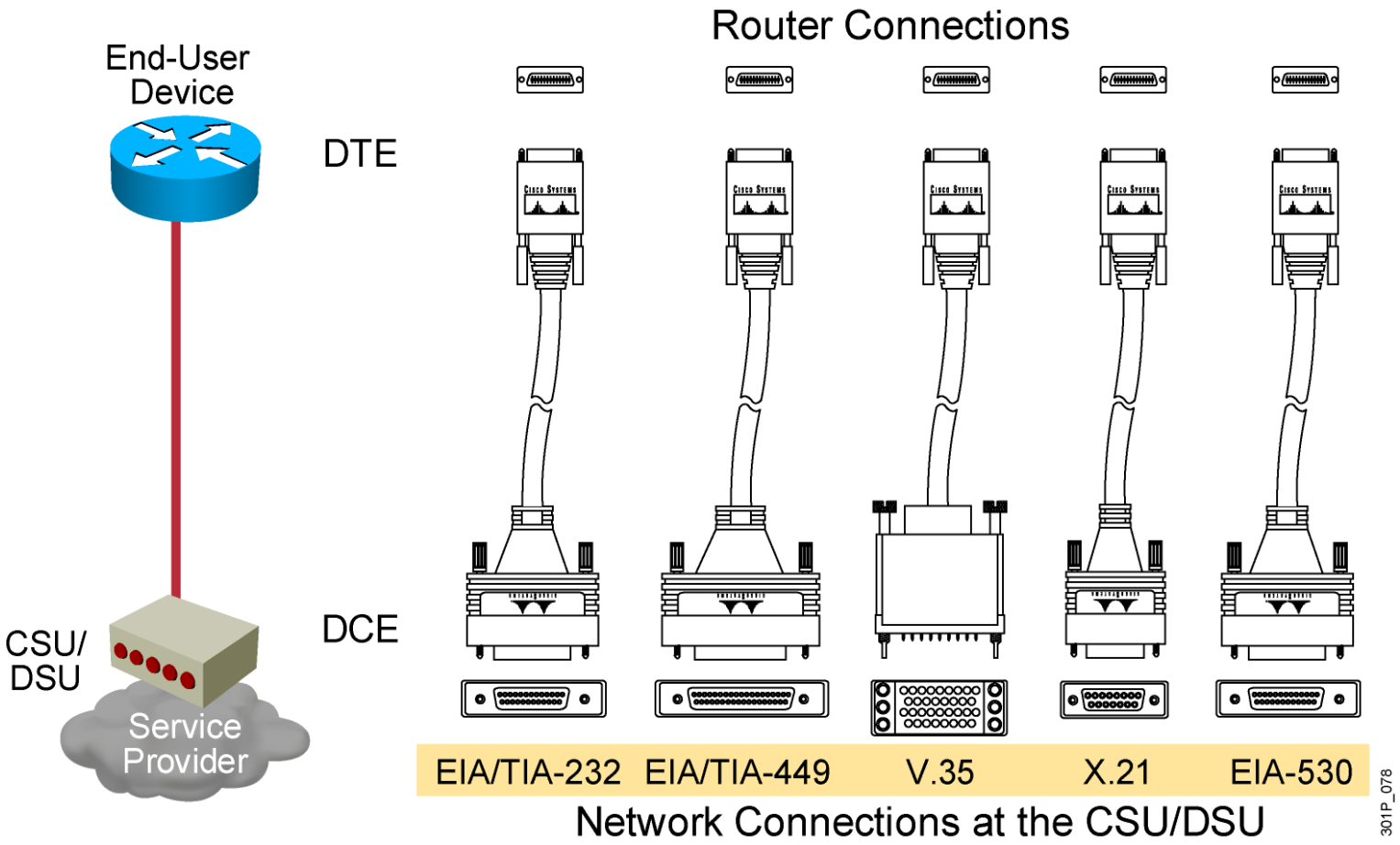
# WAN—Multiple LANs



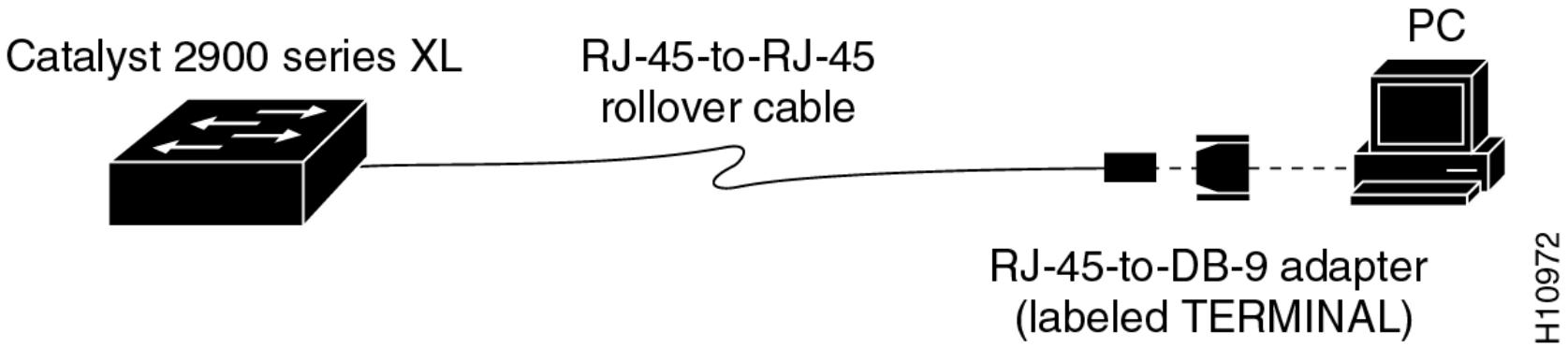
# Physical Layer: WANs



# Serial Point-to-Point Connections



# Setting up a Console Connection

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