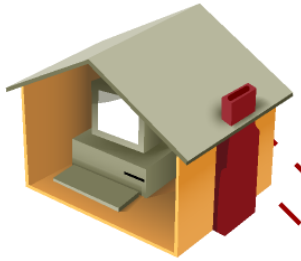
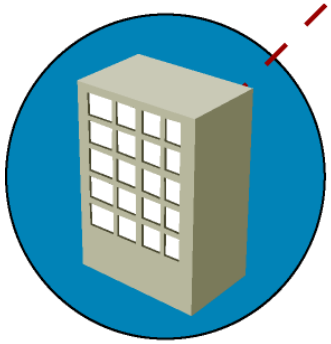
Network Basic

What Is a Network?

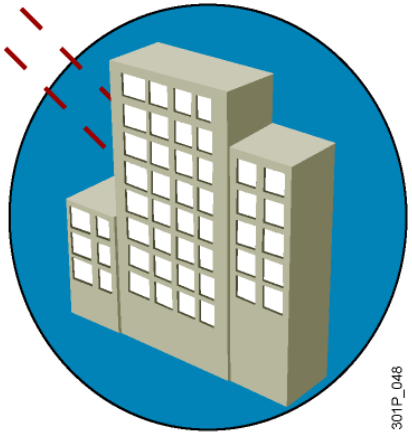
SOHO (**S**mall **O**ffice **H**ome **O**ffice) ~ Home Office



Mobile Users

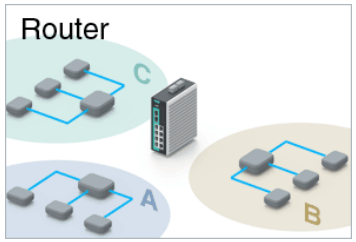


Branch Office



Headquarters

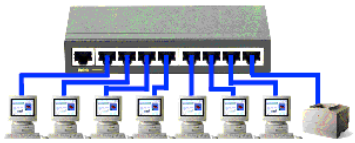
Common Physical Components of a Network



Router

Internet

Switch



Switch

Switch

cable

PC
(**P**ersonal **C**omputer)

PC

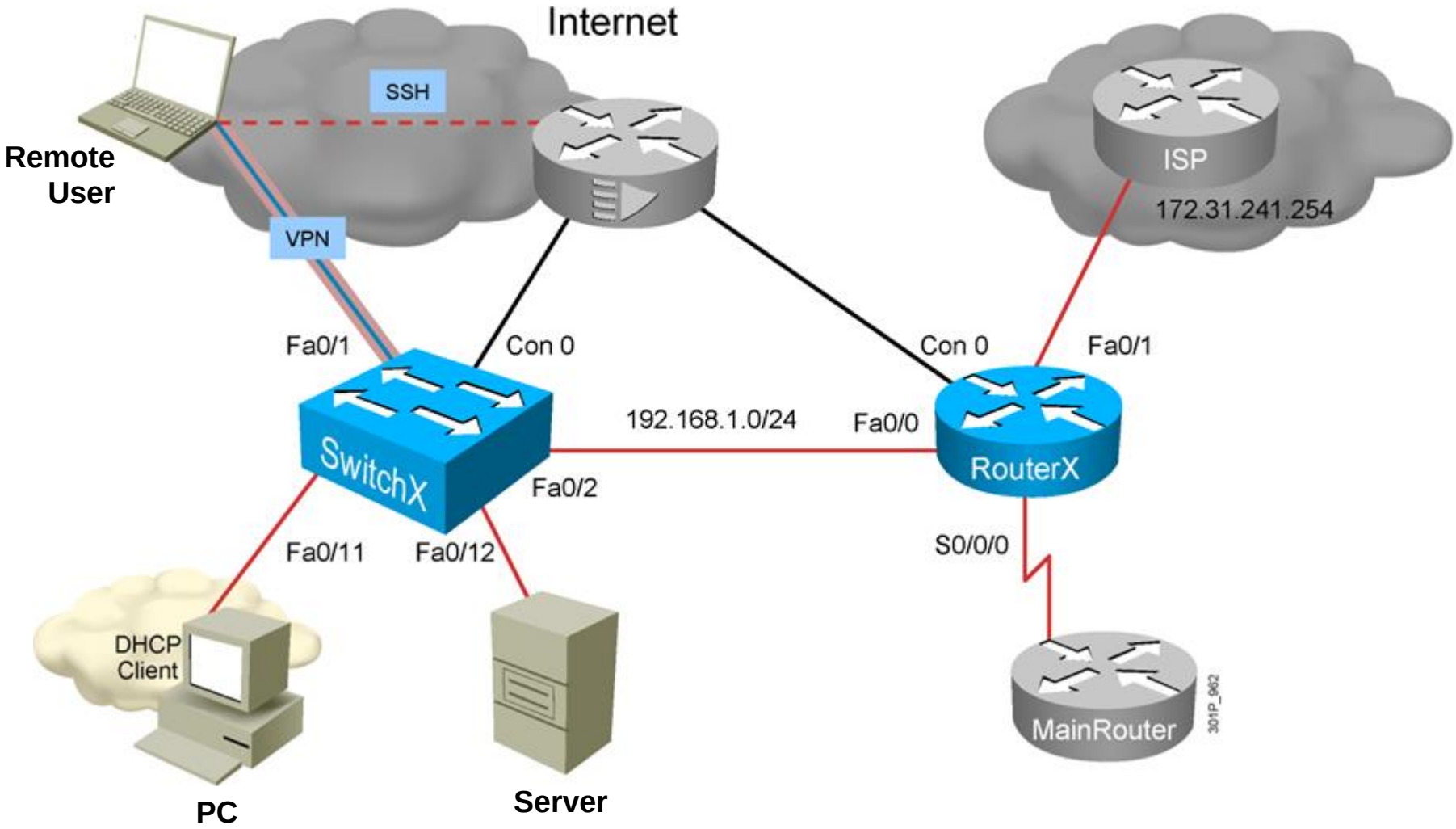
PC

PC

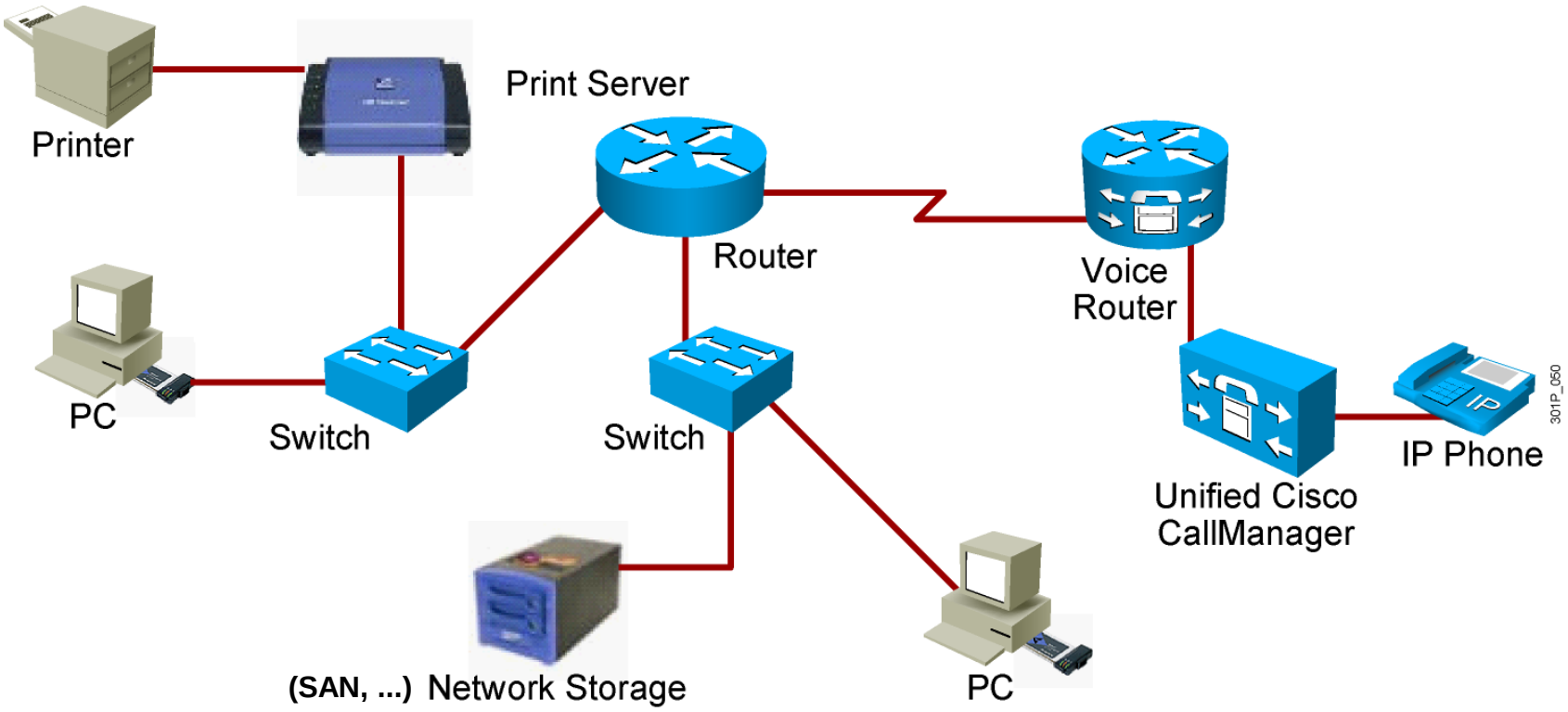
RJ-45 Connector

Network Interface Card (NIC)

Interpreting a Network Diagram



Resource-Sharing Functions and Benefits



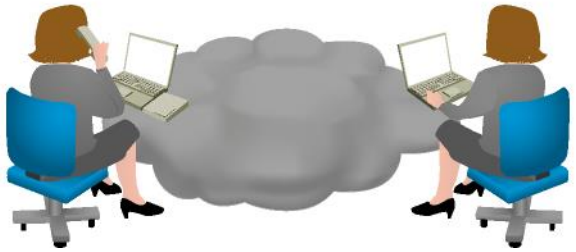
- **Data and applications**
- **Resources**
- **Network storage**
- **Backup devices**

Network User Applications

- **E-mail** (Outlook, POP3, Yahoo, and so on)
- **Web browser** (IE, Firefox, Chrome, and so on)
- **Instant messaging** (Yahoo IM, Microsoft Messenger, and so on)
- **Collaboration** (Whiteboard, Netmeeting, WebEx, and so on)
- **Databases** (file servers)

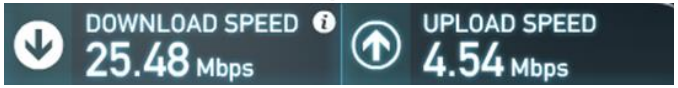
Impact of User Applications on the Network

- **Batch applications**
  - FTP, TFTP, inventory updates
  - No direct human interaction
  - Bandwidth important, but not critical
- **Interactive applications**
  - Inventory inquiries, database updates.
  - Human-to-machine interaction.
  - Because a human is waiting for a response, response time is important but not critical, unless the wait becomes excessive.
- **Real-time applications**
  - VoIP, video
  - Human-to-human interaction
  - End-to-end latency critical



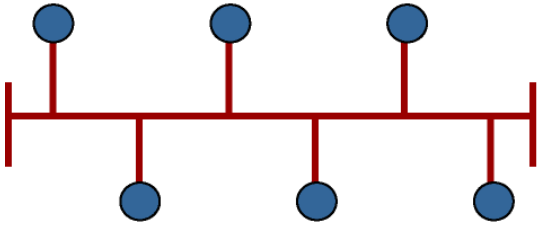
Characteristics of a Network

- **Speed:** fast or slow? → bps (bits per second)

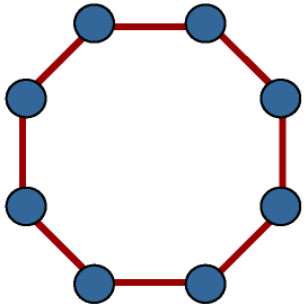


- **Cost:** $$$
- **Security:** secure or not?
- **Availability:** will be available when needed?
- **Scalability:** can be expandable or not?
- **Reliability:** dependability of network components
- **Topology:** both physical and logical

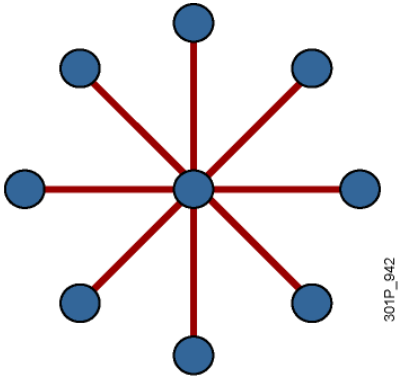
Physical Topology Categories



Bus Topology

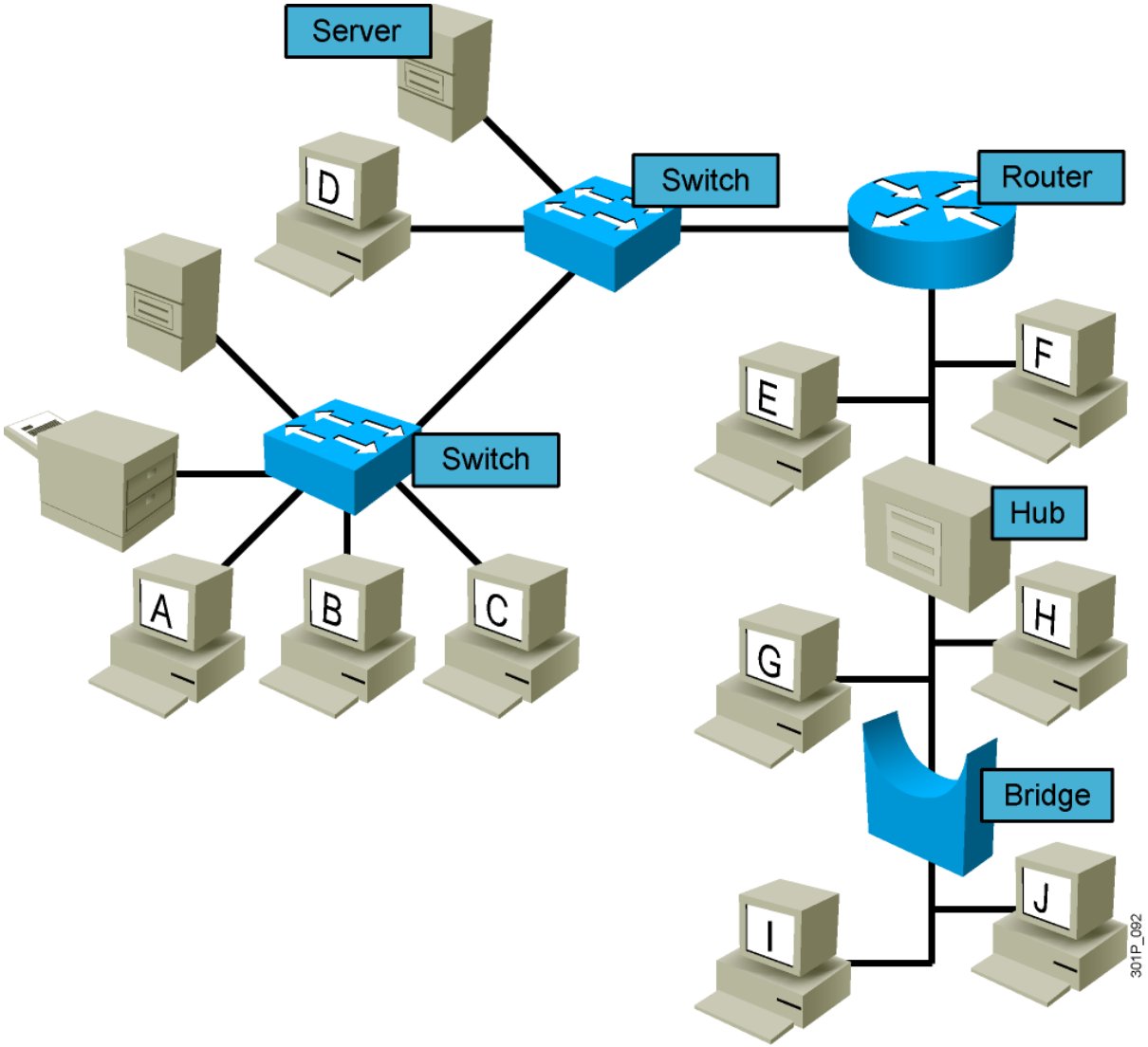


Ring Topology

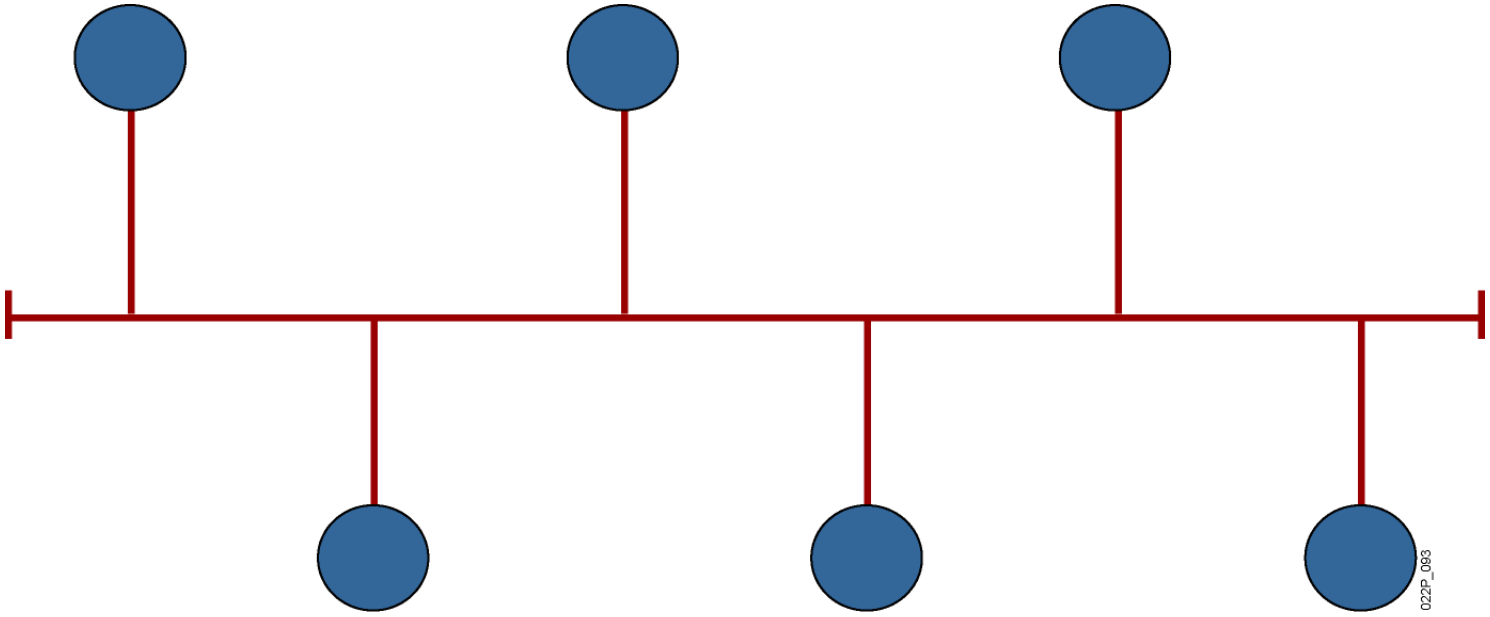


Star Topology

Logical Topologies

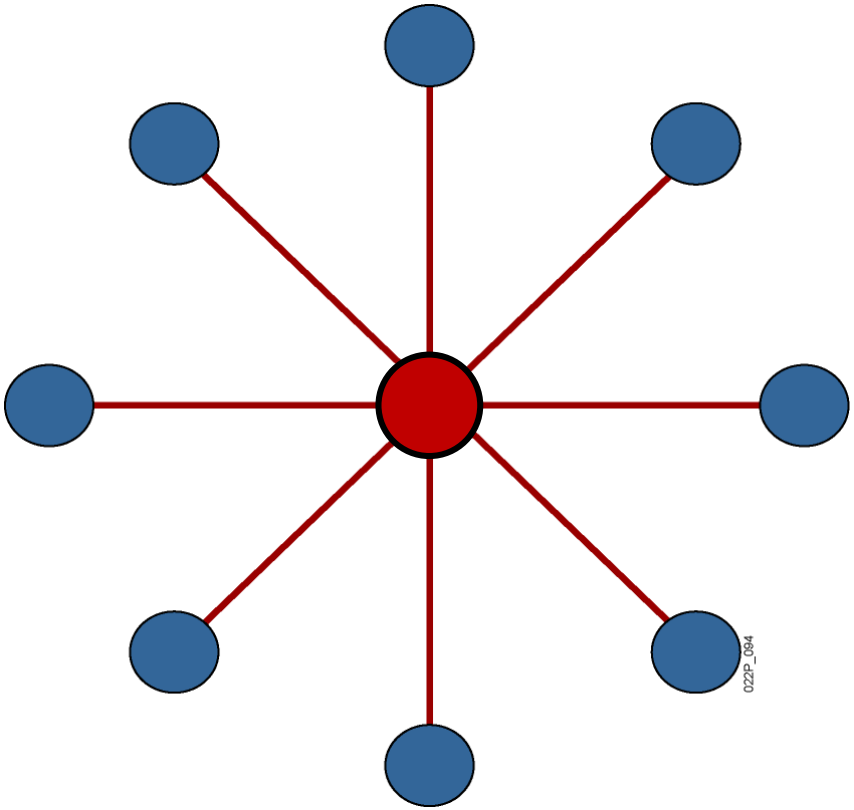


Bus Topology



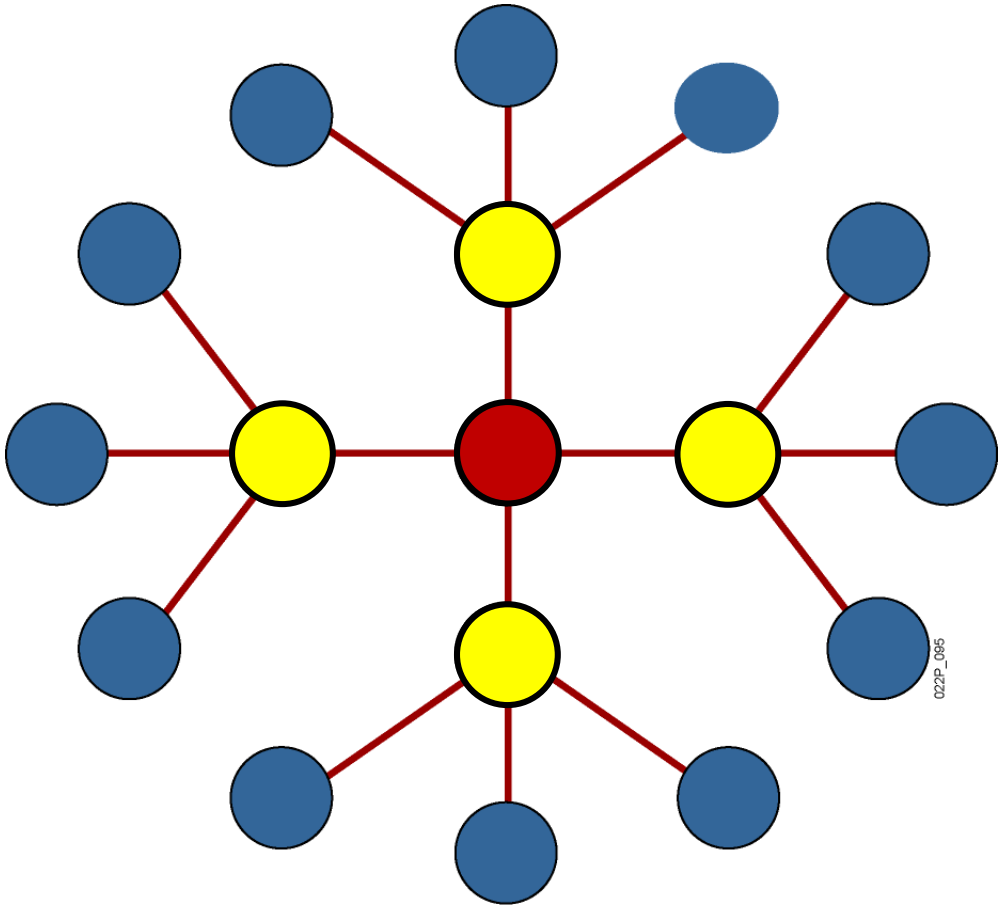
- **All devices (nodes) receive the signal.**
- **Pro: very easy to install, low cost.**
- **Cons: congestion, very low performance.**

Star Topology



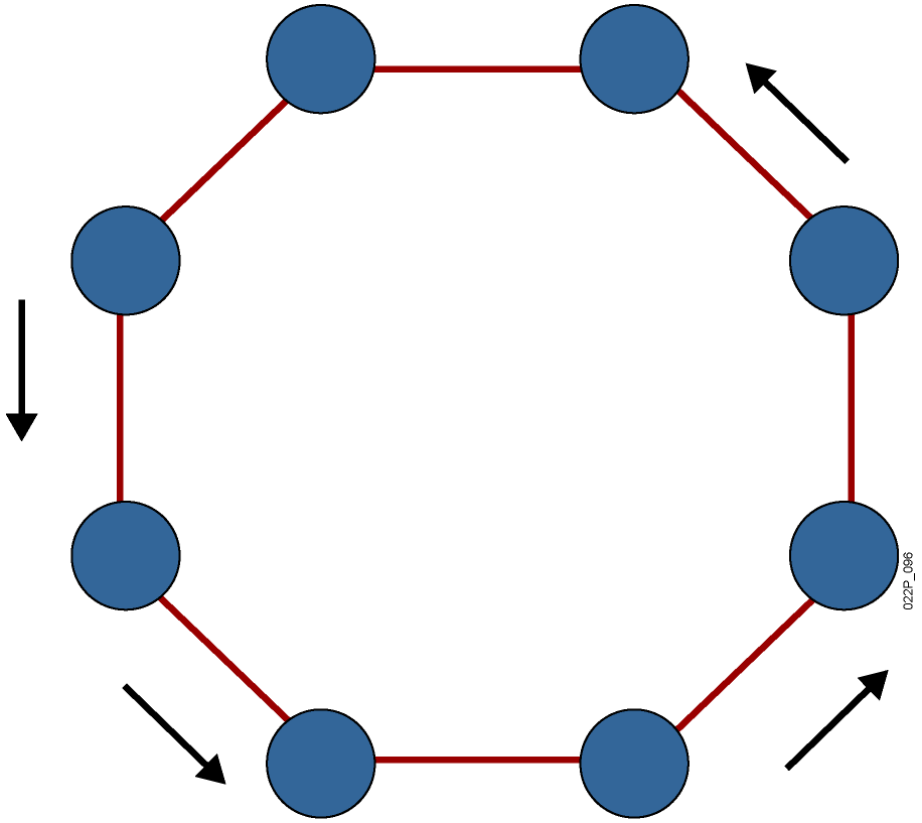
- **Transmission through a central point.**
- **Pro: easy to design and implement.**
- **Cons: single point of failure.**

Extended-Star Topology



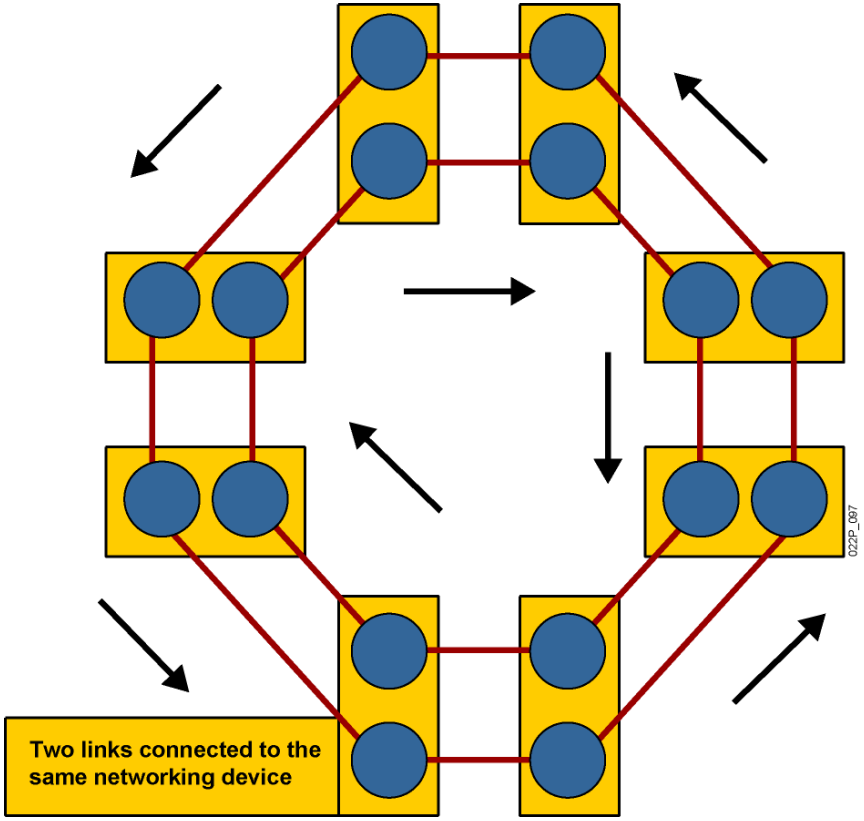
- **Pro: more resilient than star topology.**
- **Cons: still depend on central point for data transmission.**

Ring Topology



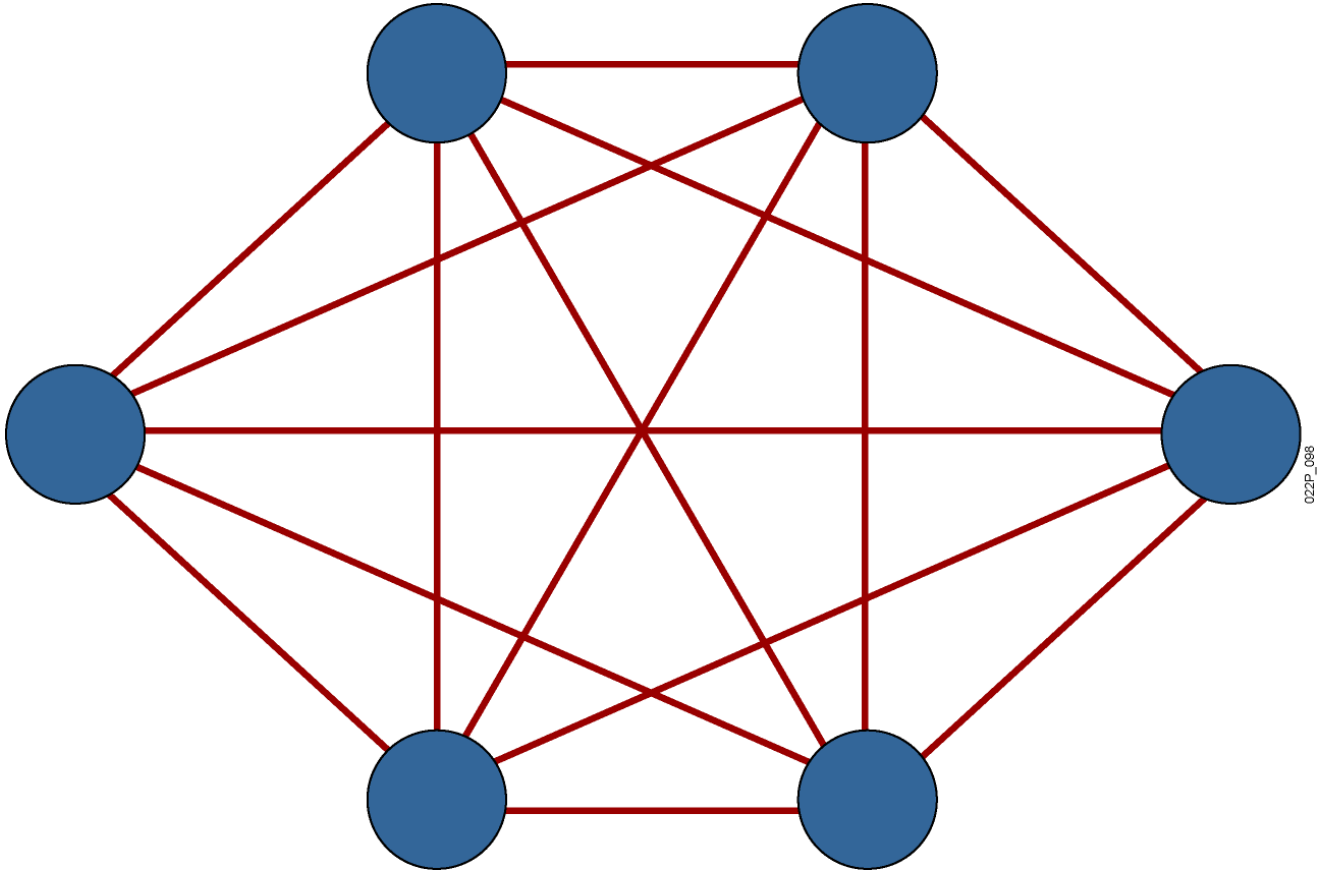
- **Signals travel around ring.**
- **Pro: performs better than bus topology.**
- **Cons: every node is single point of failure.**

Dual-Ring Topology



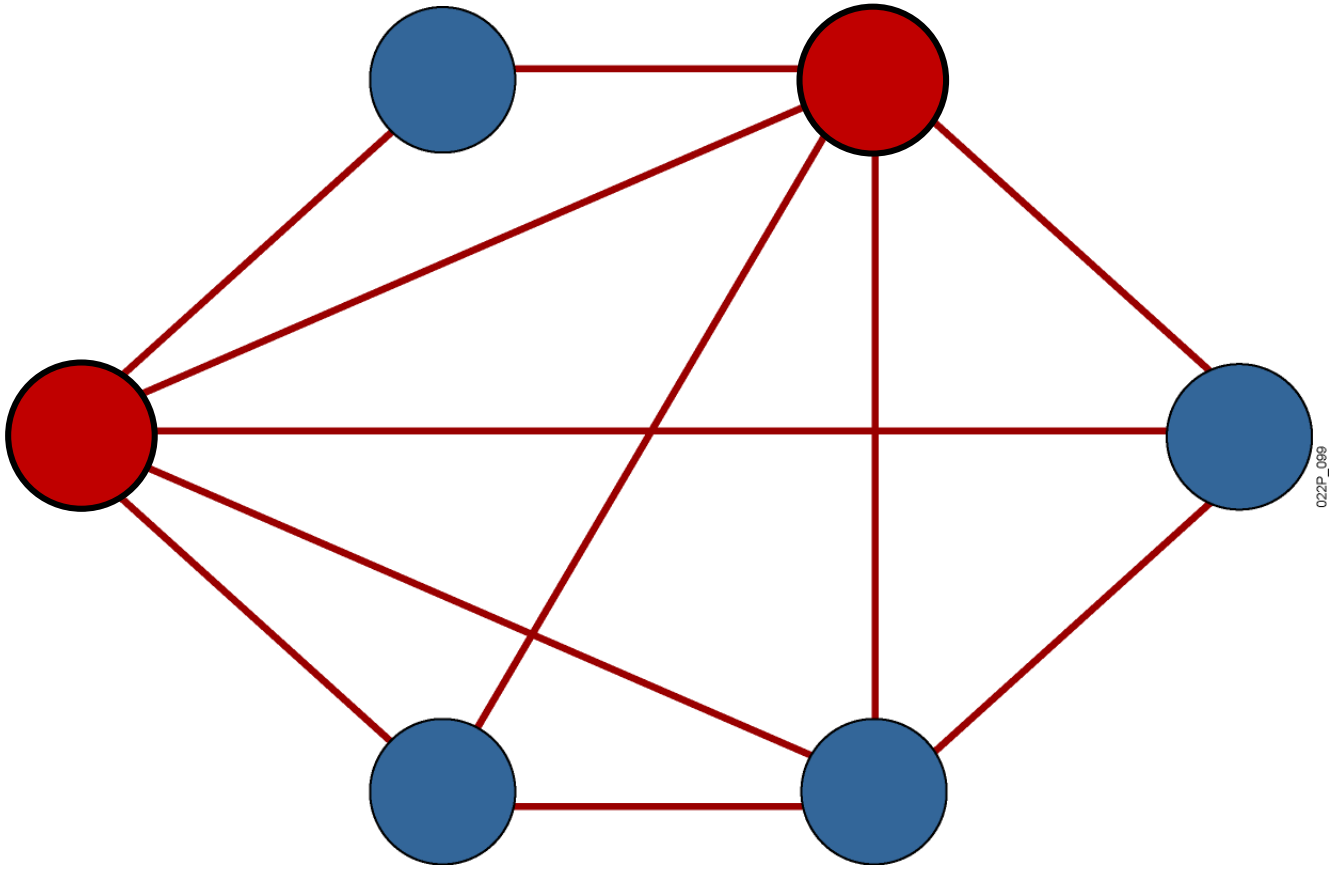
- **Signals travel in opposite directions.**
- **Pro: more resilient than single ring.**
- **Cons: network loop.**

Full-Mesh Topology



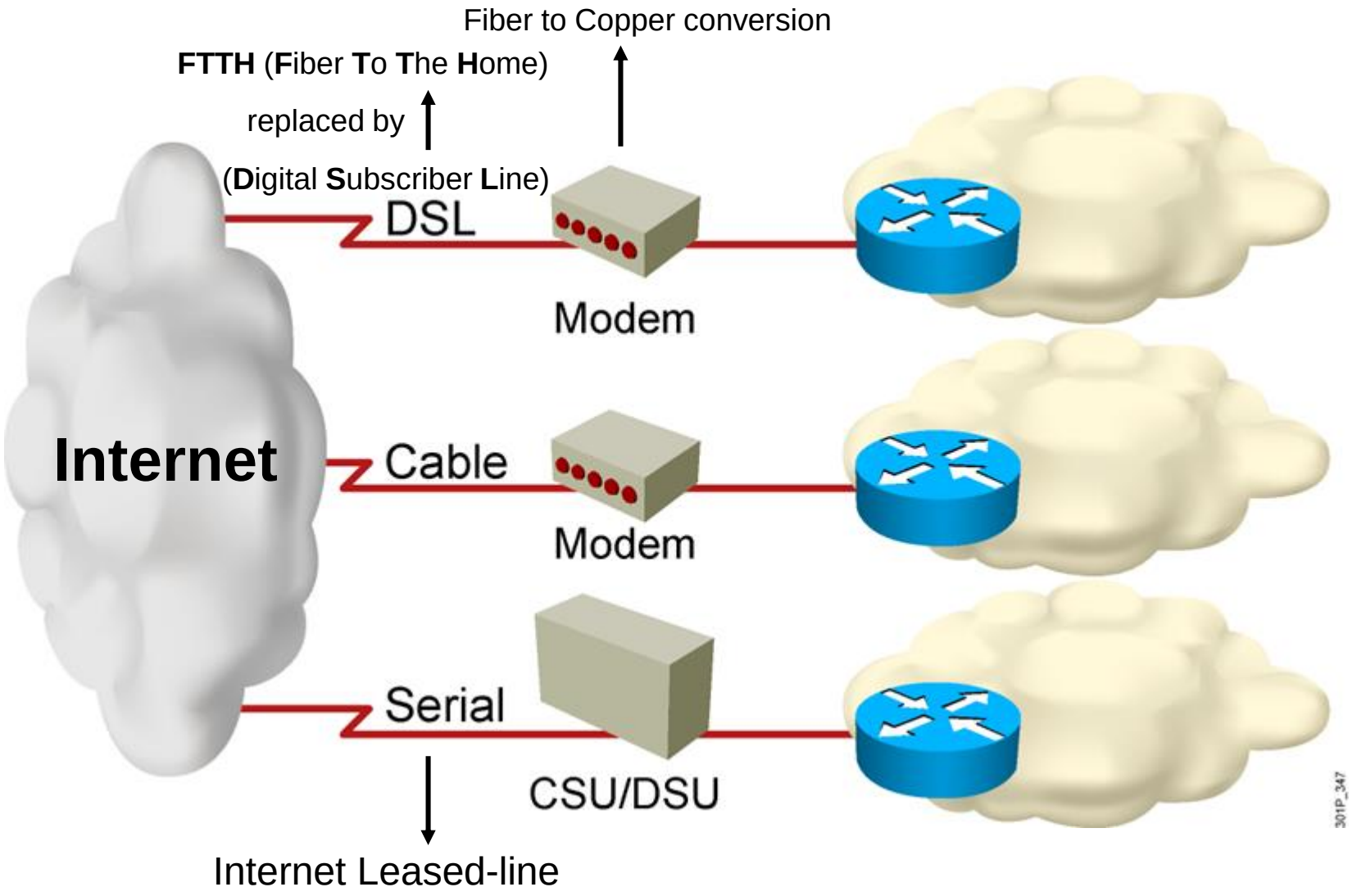
- **Pro: highly fault-tolerant**
- **Cons: expensive to implement**

Partial-Mesh Topology



- **Trade-off between fault tolerance and cost**

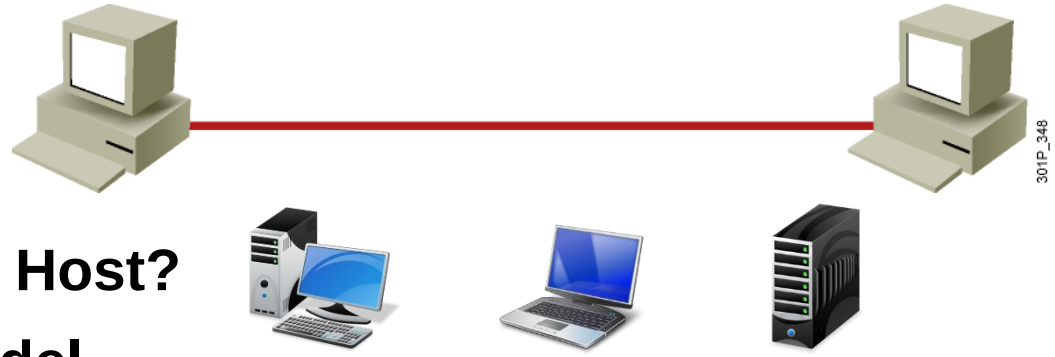
Connection to the Internet



OSI Model

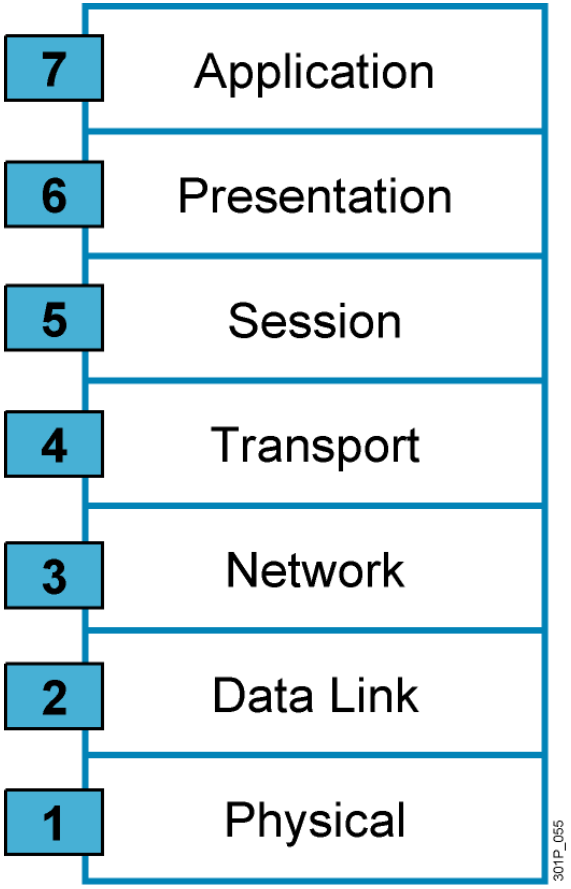
TCP/IP

Understanding Host-to-Host Communications



- **What is a Host?**
- **Older model**
  - Proprietary
  - Application and combinations software controlled by one vendor
- **Standards-based model**
  - Multivendor software
  - Layered approach

Why a Layered Network Model?

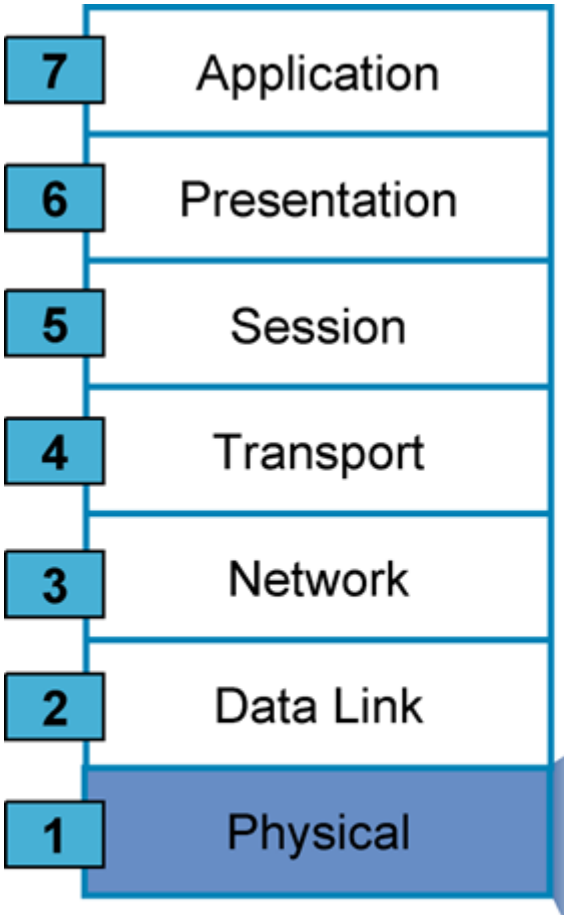


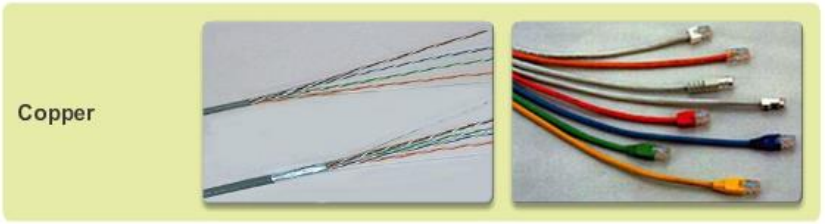
- Reduces complexity
- Standardizes interfaces
- Facilitates modular engineering
- Ensures interoperable technology
- Accelerates evolution
- Simplifies teaching and learning

OSI Model (**O**pen **S**ystems **I**nterconnection)

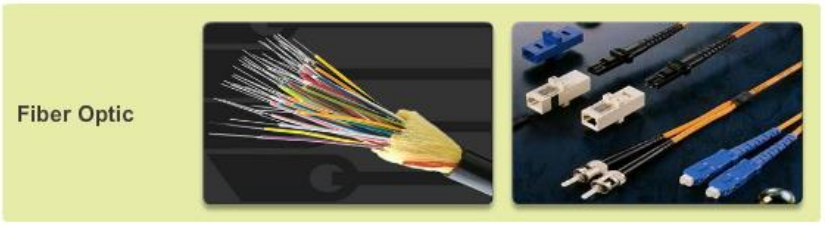
Published in 1984 by **ISO** (International Organization for Standardization)

The Seven Layers of the OSI Model





Cable Type?



Connection Type?

Network Adapter?

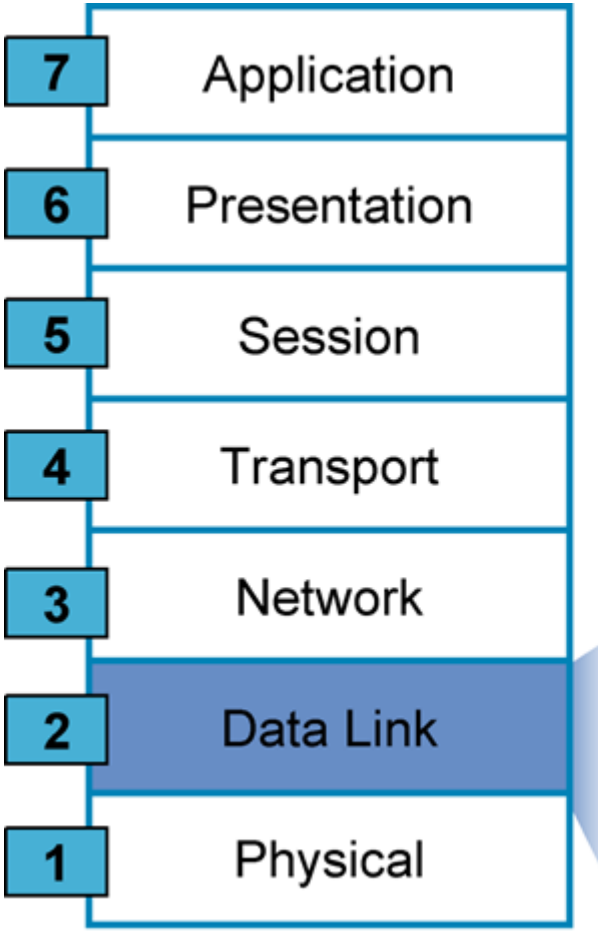
.....

Binary Transmission

- Defines the electrical, mechanical, procedural, and functional specifications for activating, maintaining, and deactivating the physical link

01101111000011000010101010101010101010000101011111000000000110011110000011001100000111101011

The Seven Layers of the OSI Model (Cont.)



MAC
(Physical Addressing)

Access to Media

- Defines how data is formatted for transmission and how access to the network is controlled
- Provides error detection

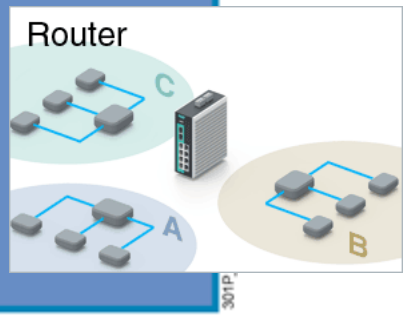
The Seven Layers of the OSI Model (Cont.)

IP
(Logical Addressing)

7	Application
6	Presentation
5	Session
4	Transport
3	Network
2	Data Link
1	Physical

Data Delivery

- Routes data packets
- Selects best path to deliver data
- Provides logical addressing and path selection



The Seven Layers of the OSI Model (Cont.)

TCP/
UDP

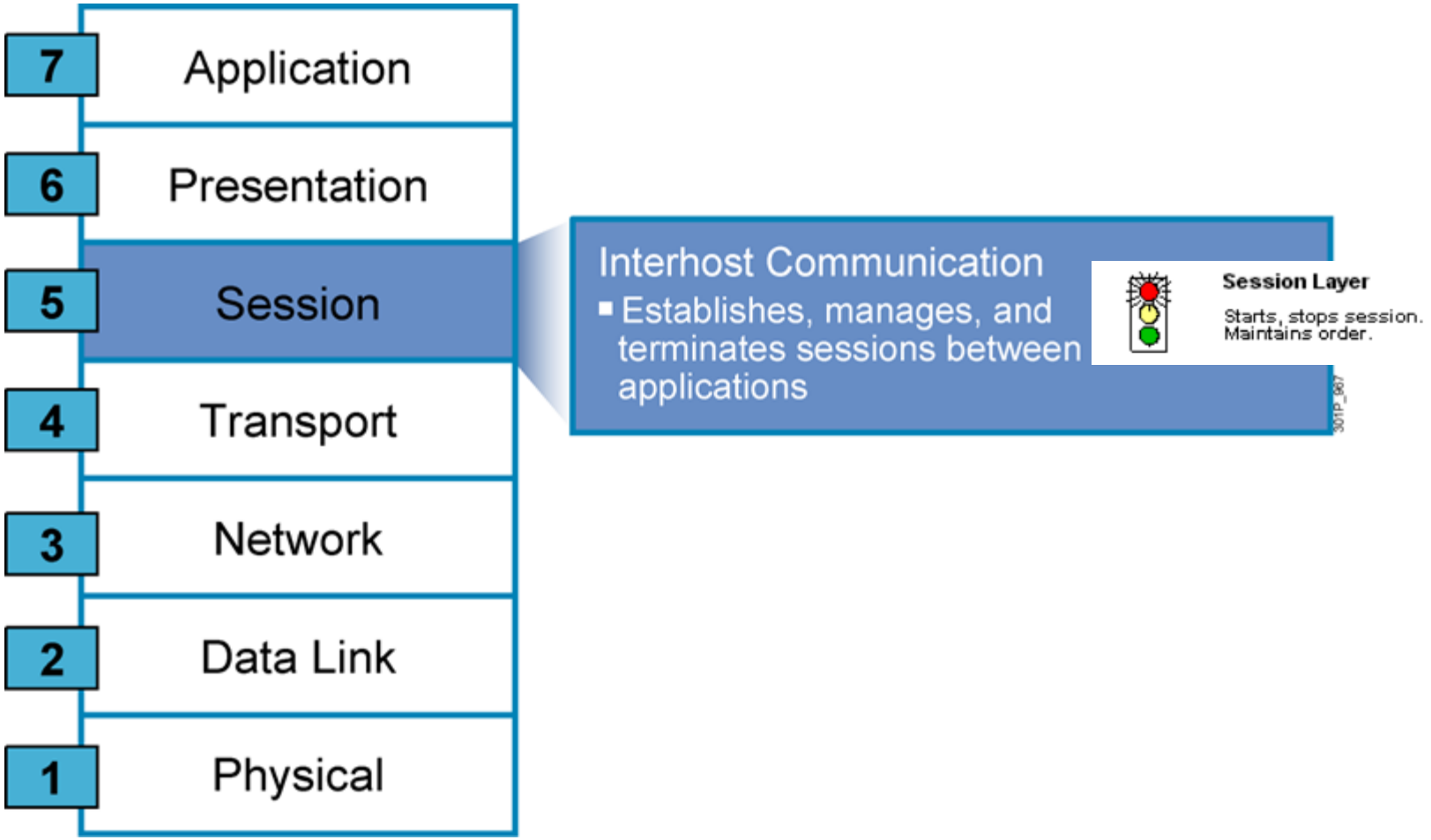
7	Application
6	Presentation
5	Session
4	Transport
3	Network
2	Data Link
1	Physical

End-to-End Connections

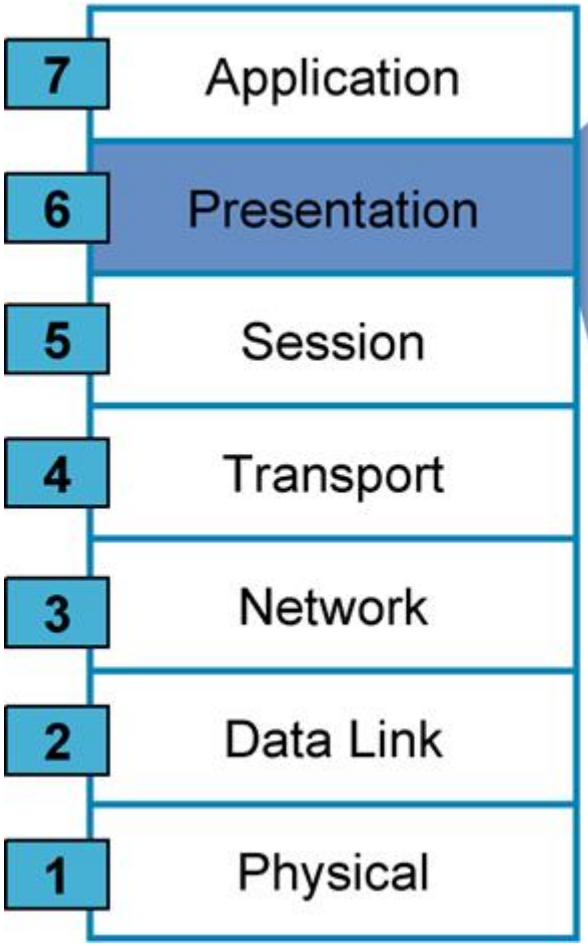
- Handles transportation issues between hosts
- Ensures data transport reliability
- Establishes, maintains, and terminates virtual circuits
- Provides reliability through fault detection and recovery information flow control

301P_059

The Seven Layers of the OSI Model (Cont.)

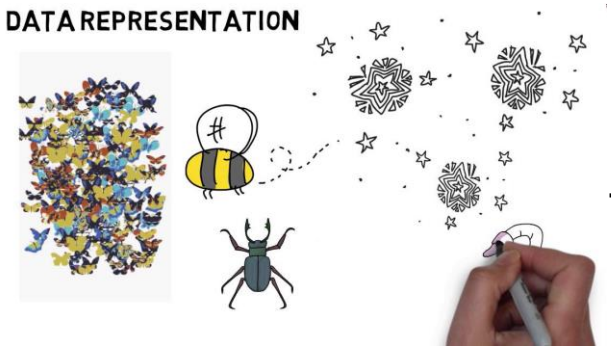


The Seven Layers of the OSI Model (Cont.)



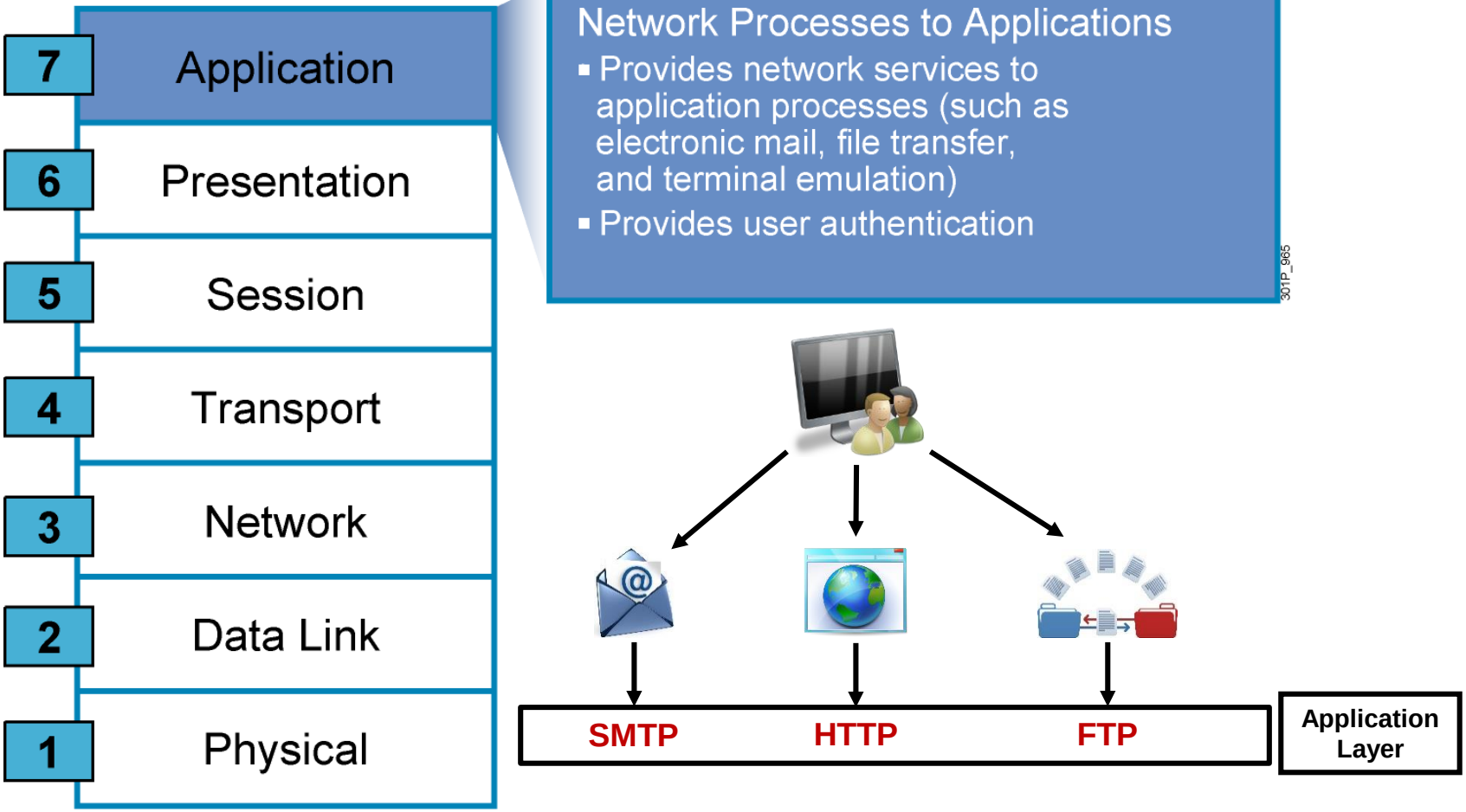
Data Representation

- Ensures that data is readable by receiving system
- Formats data
- Structures data
- Negotiates data transfer syntax for application layer
- Provides encryption

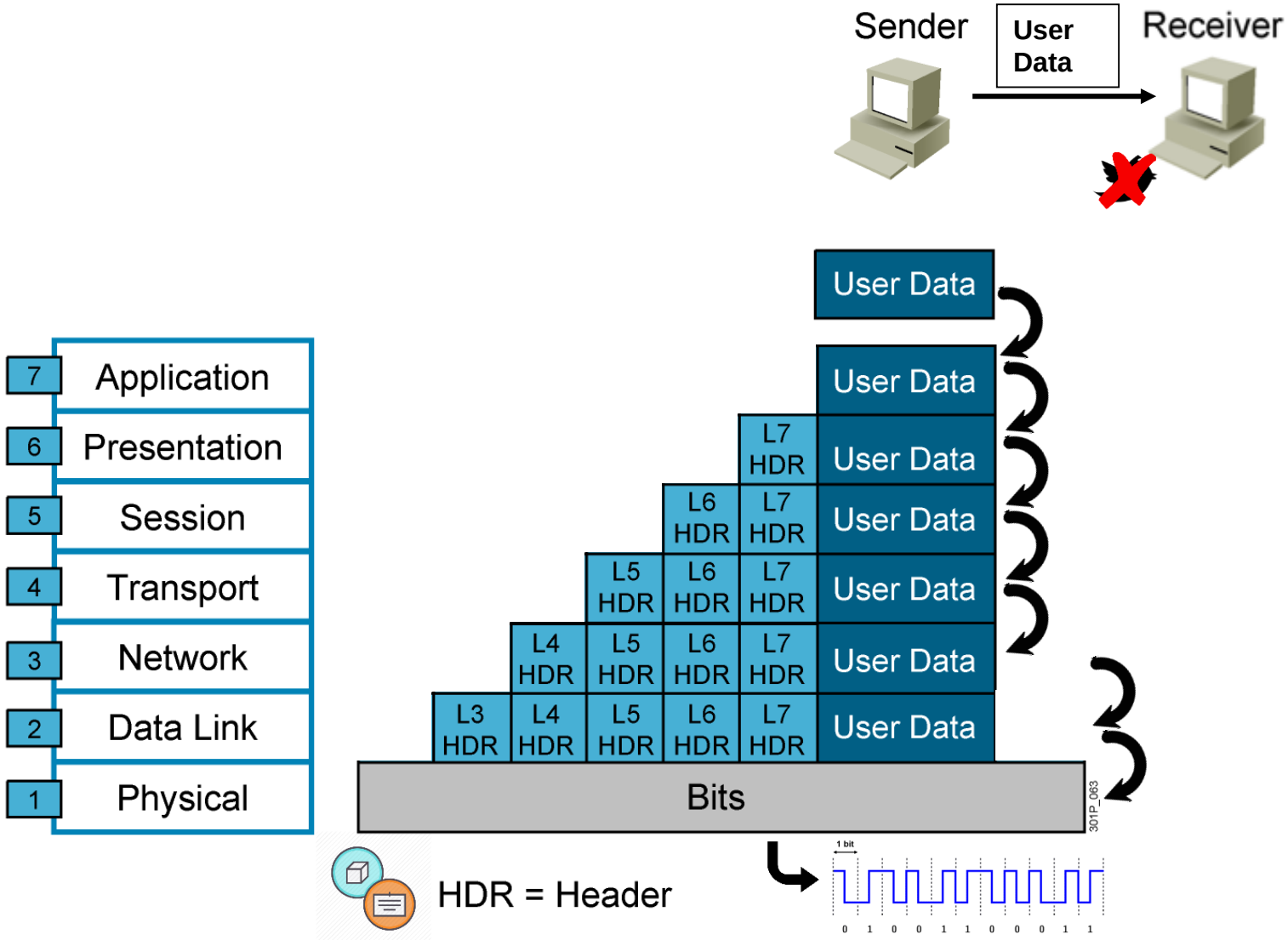


+

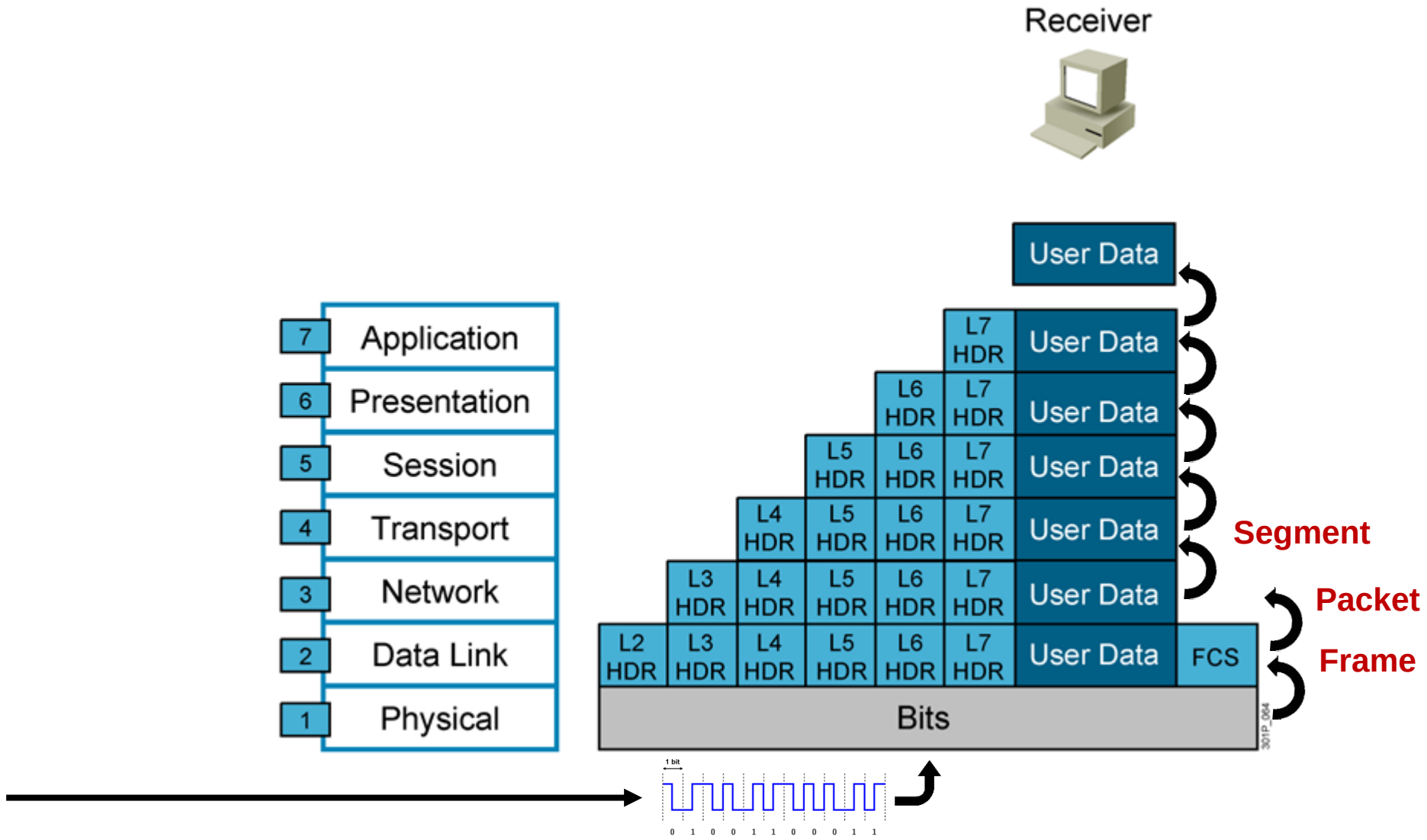
The Seven Layers of the OSI Model (Cont.)



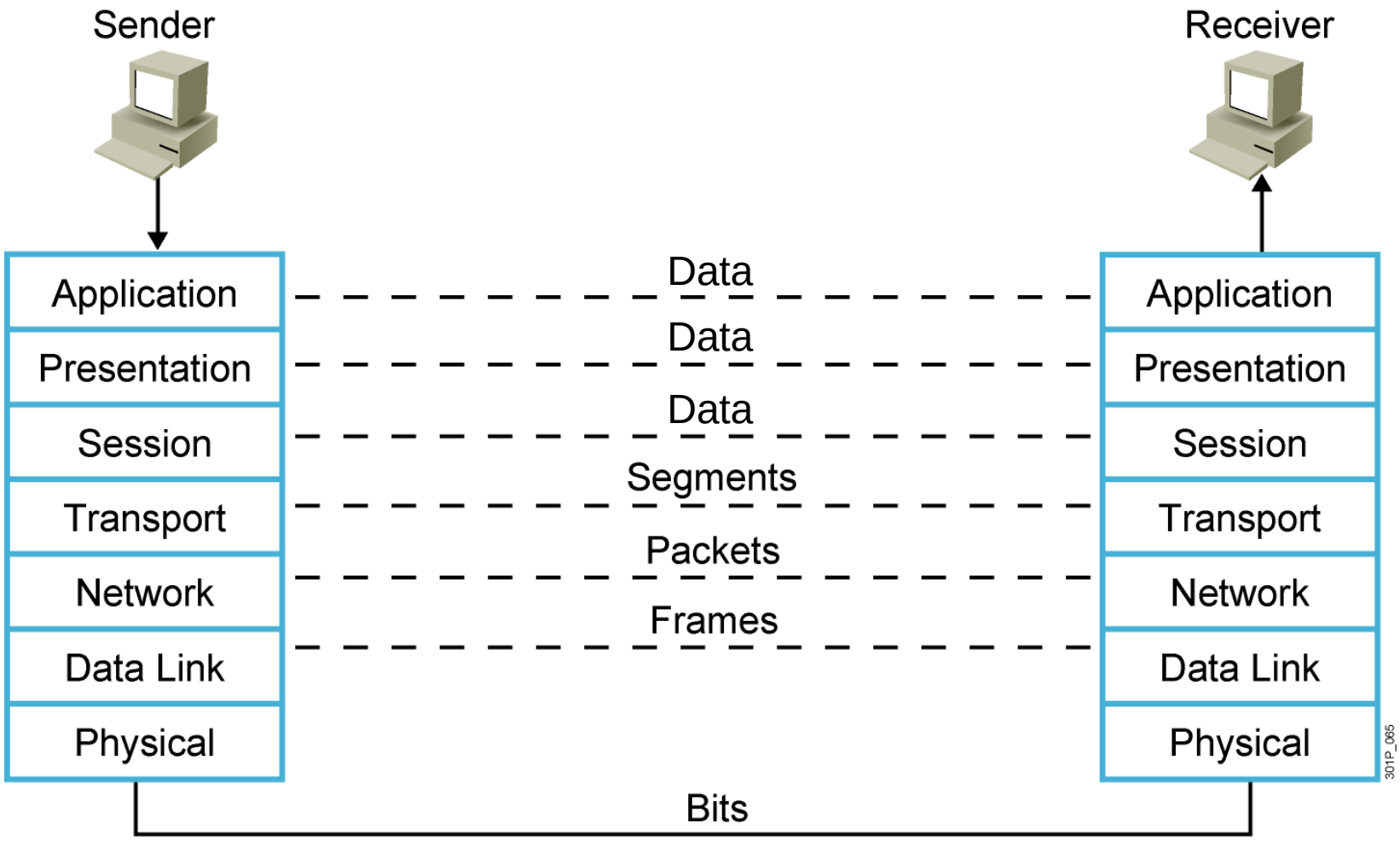
Data Encapsulation



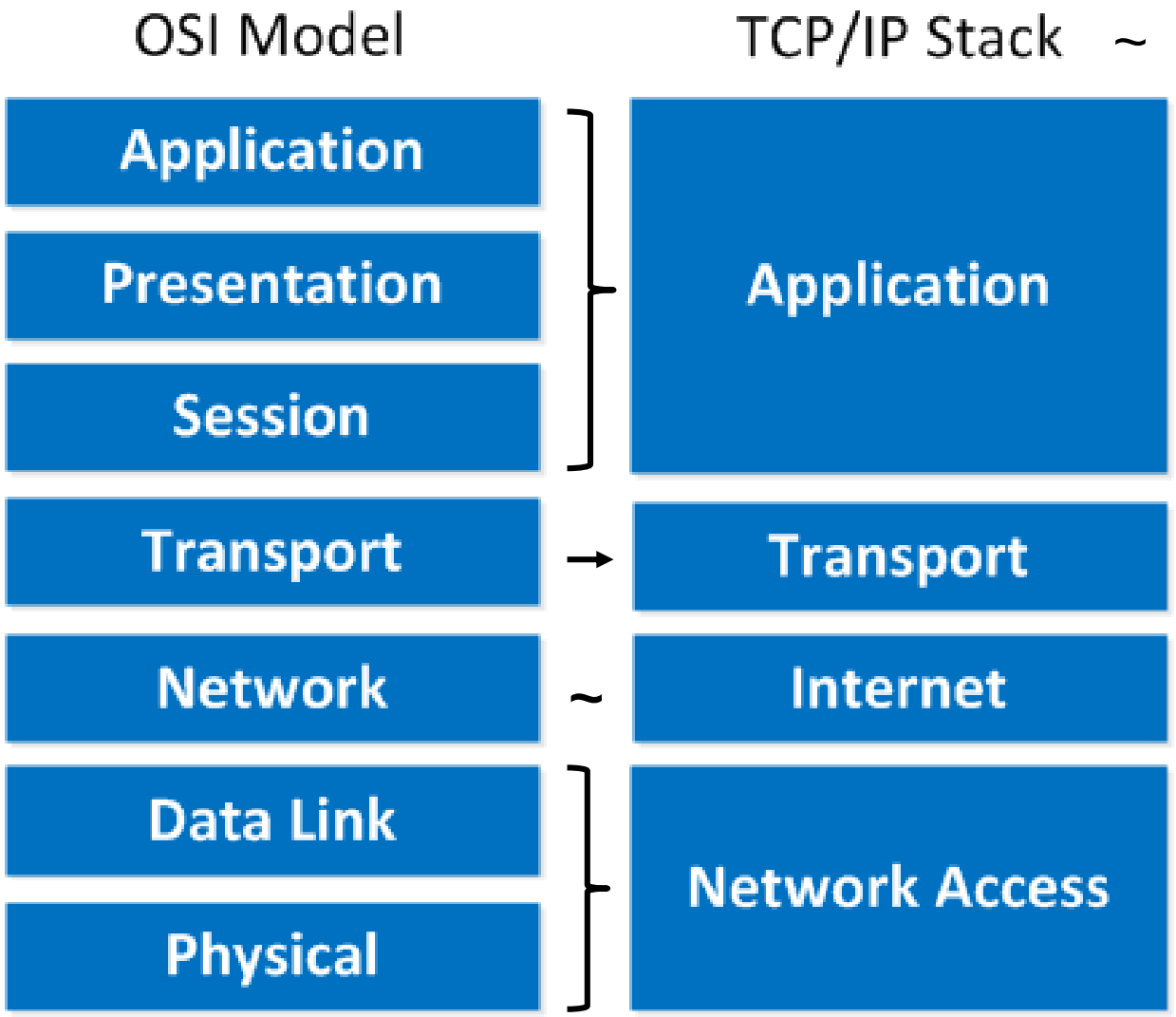
Data De-Encapsulation



Peer-to-Peer Communication



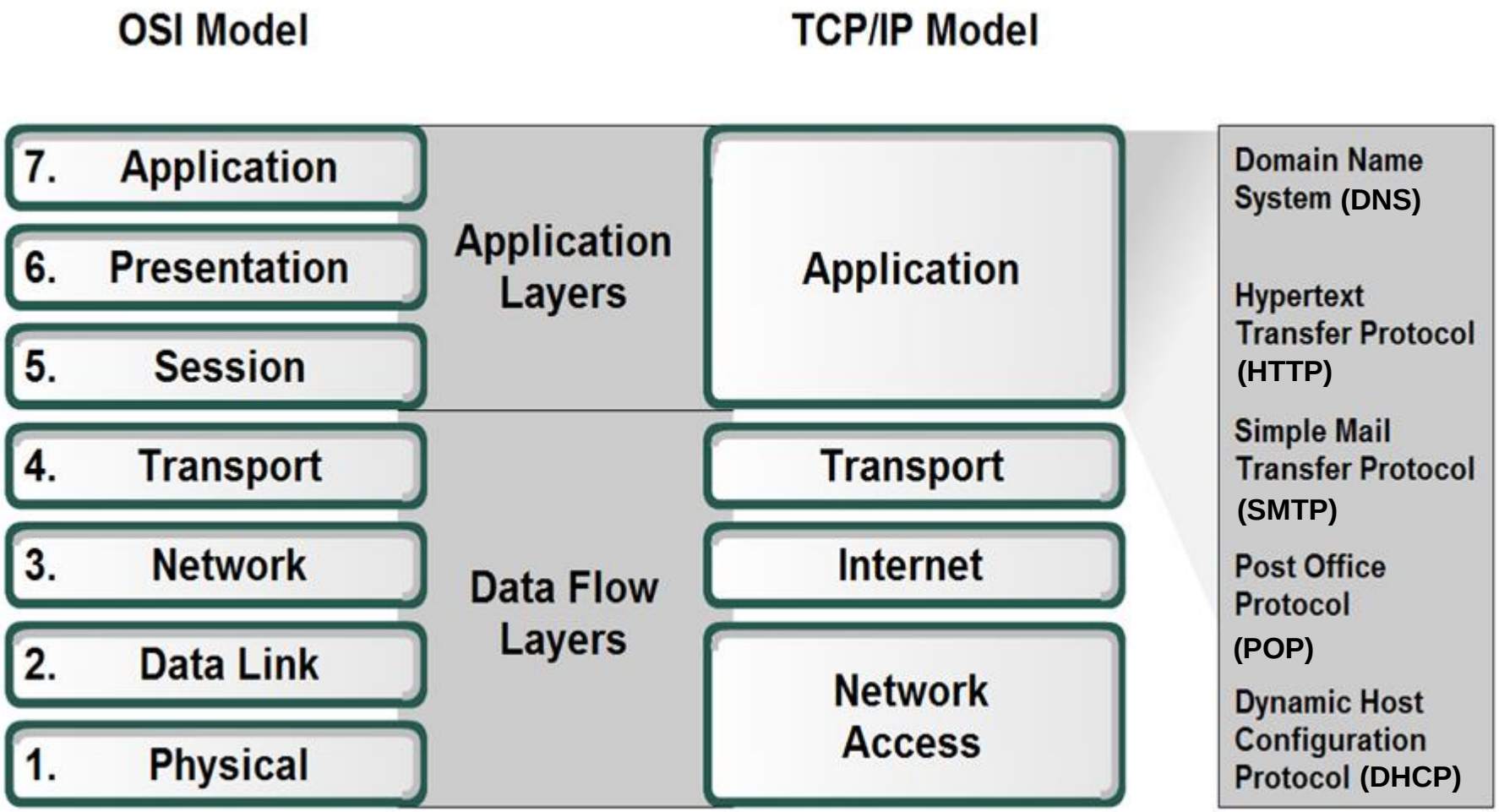
TCP/IP Stack vs. the OSI Model



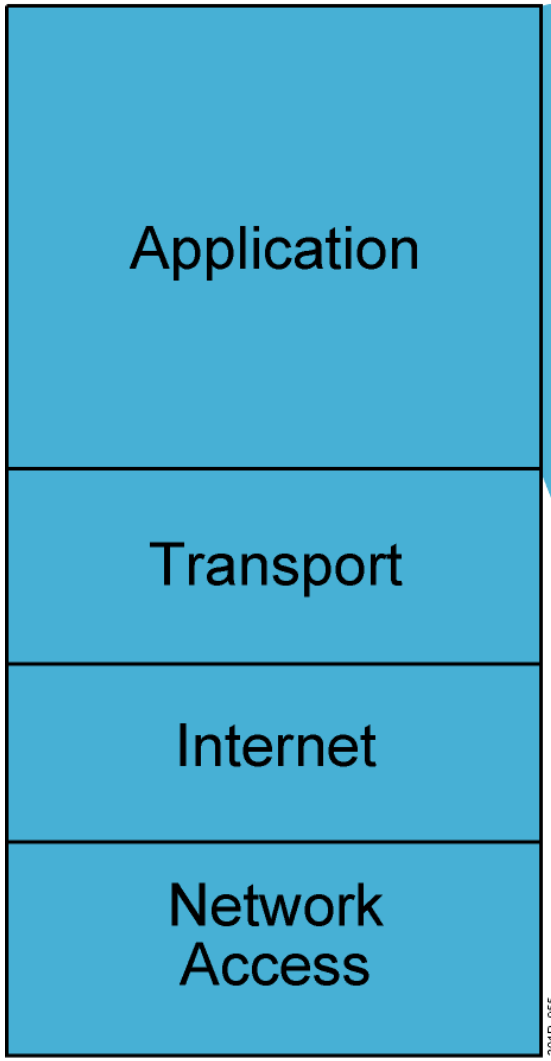
DoD Model (**D**epartment **o**f **D**efense)

- Developed by **ARPA** (**A**dvanced **R**esearch **P**rojects **A**gency)
- Defines four layers
- Uses different names for Layers 1 through 3
- Combines Layers 5 through 7 into single application layer

Applications

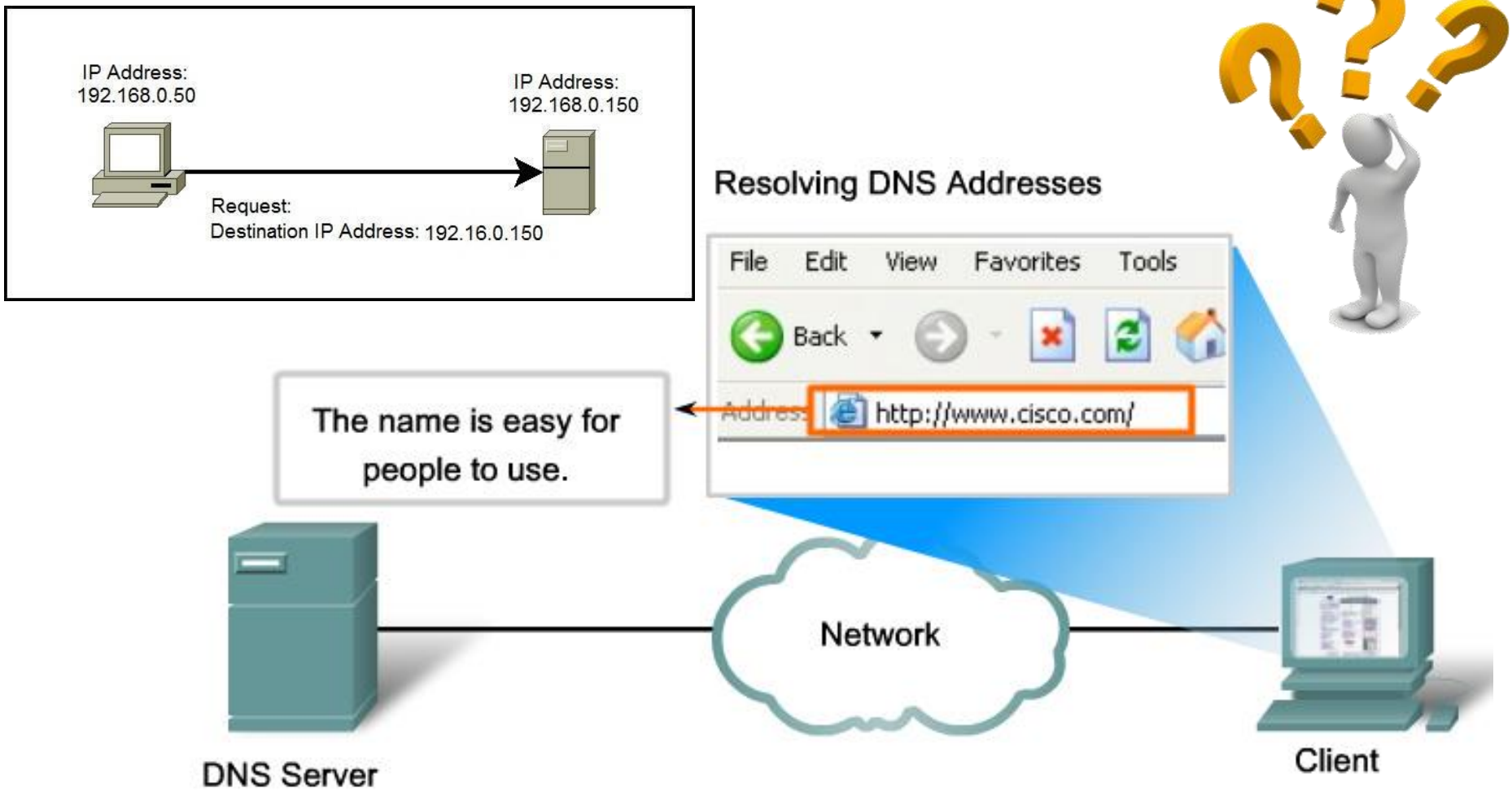


TCP/IP Application Layer Overview

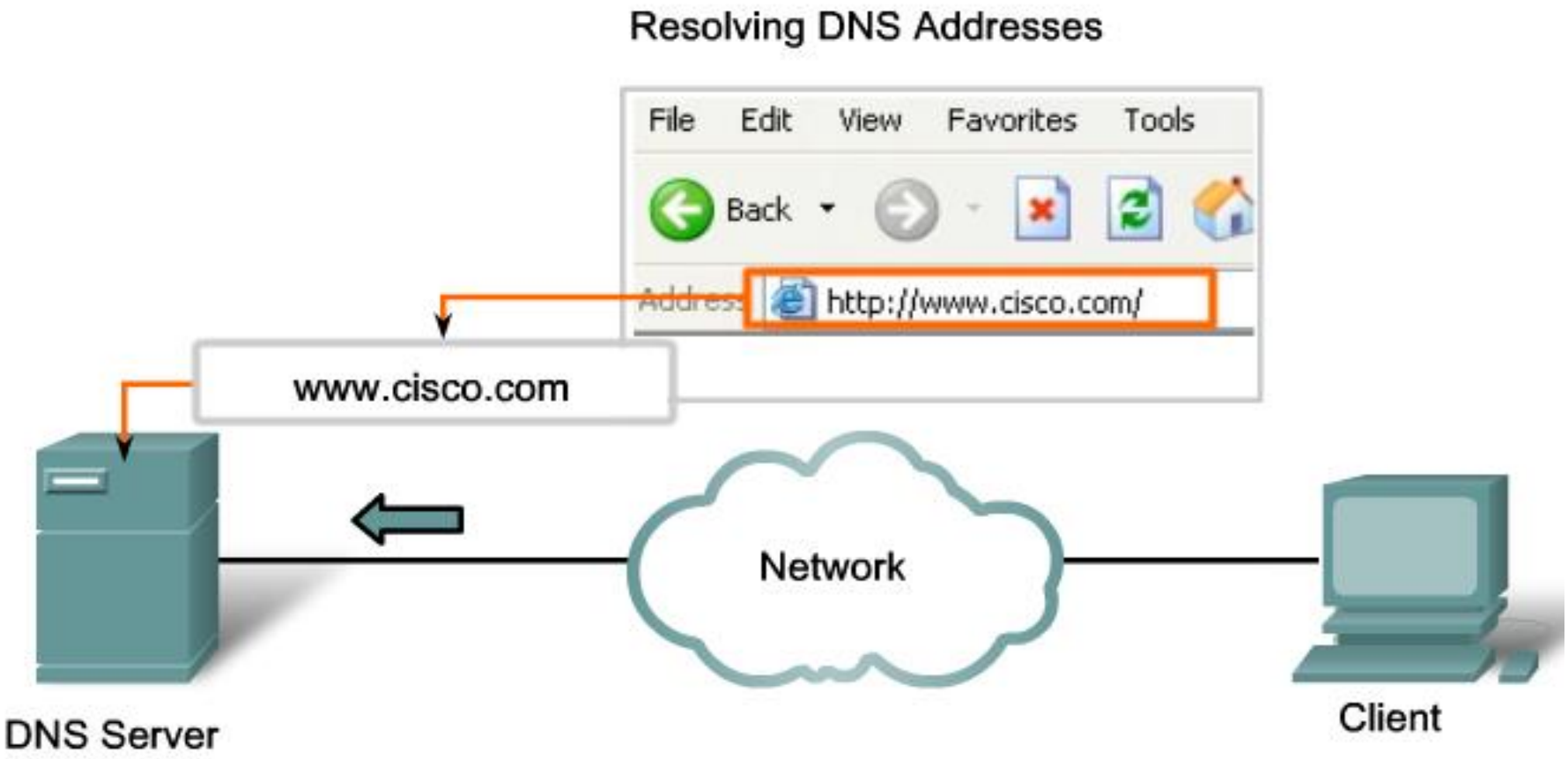


- **File transfer**
  - FTP (File Transfer Protocol)
  - TFTP (Trivial File Transfer Protocol)
  - Network File System (NFS)
- **E-mail**
  - Simple Mail Transfer Protocol (SMTP)
- **Remote login**
  - Telnet
  - rlogin
- **Network management**
  - Simple Network Management Protocol (SNMP)
- **Name management**
  - Domain Name System (DNS)

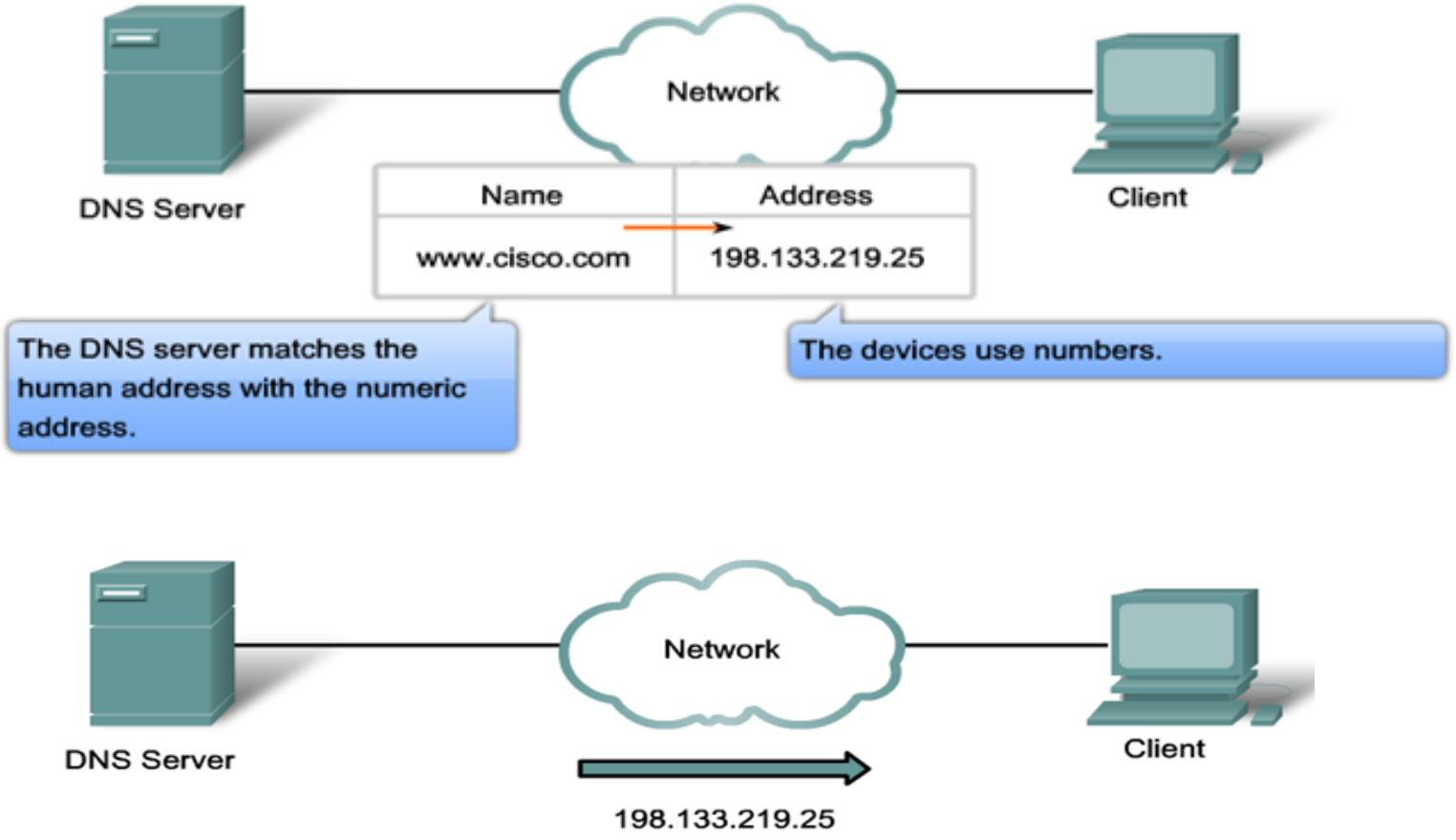
Domain Name Server - DNS



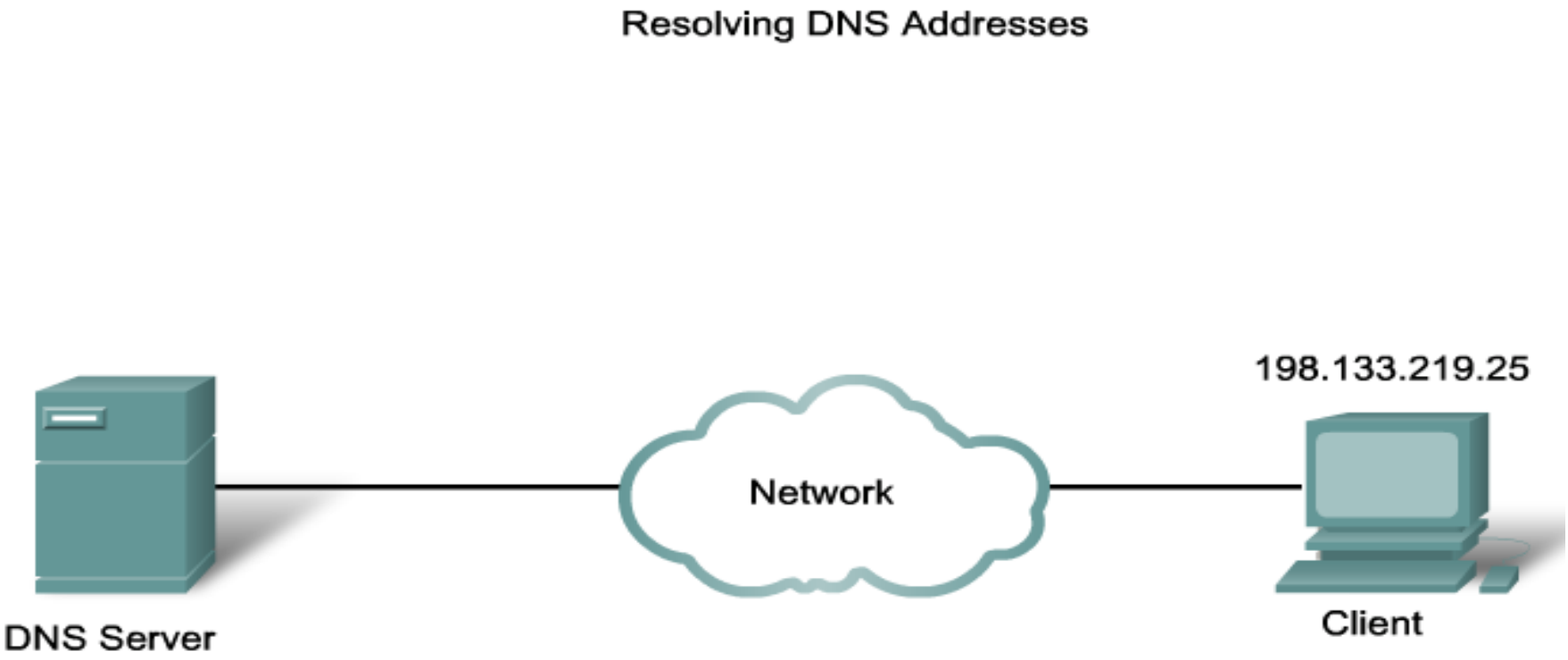
Domain Name Server - DNS



Domain Name Server - DNS

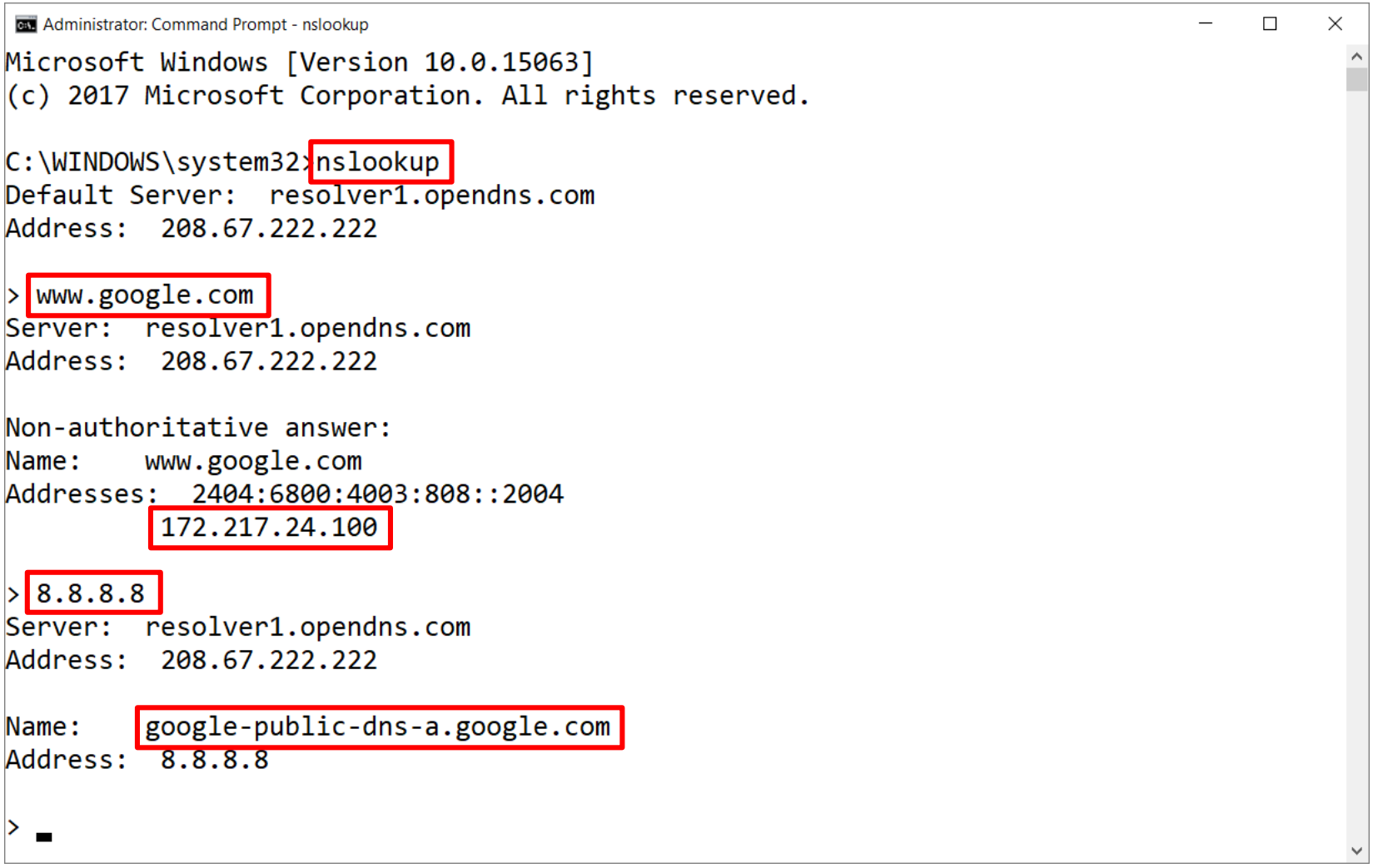


Domain Name Server - DNS

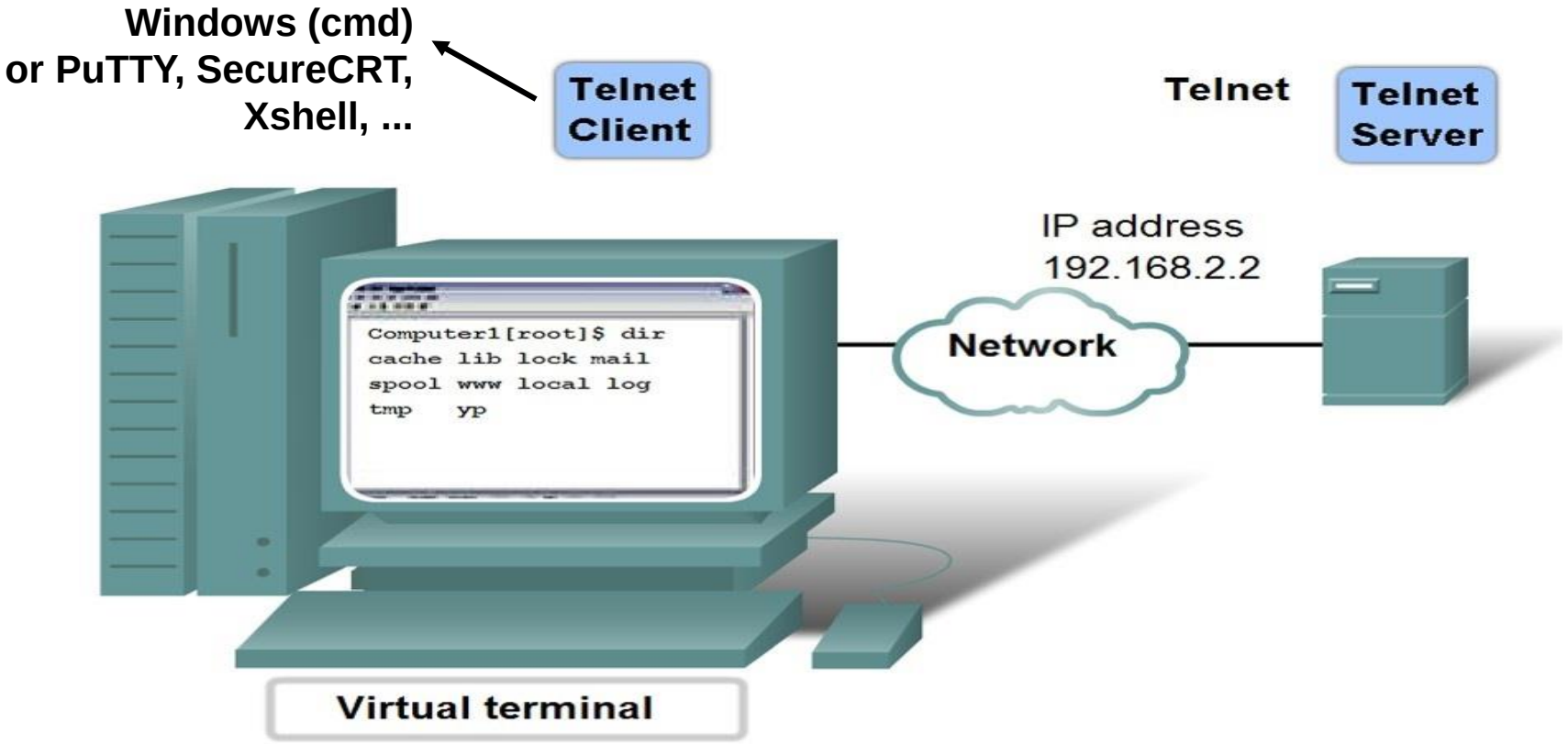


A human legible name is resolved to its numeric network device address by the DNS protocol.

Domain Name Server - DNS

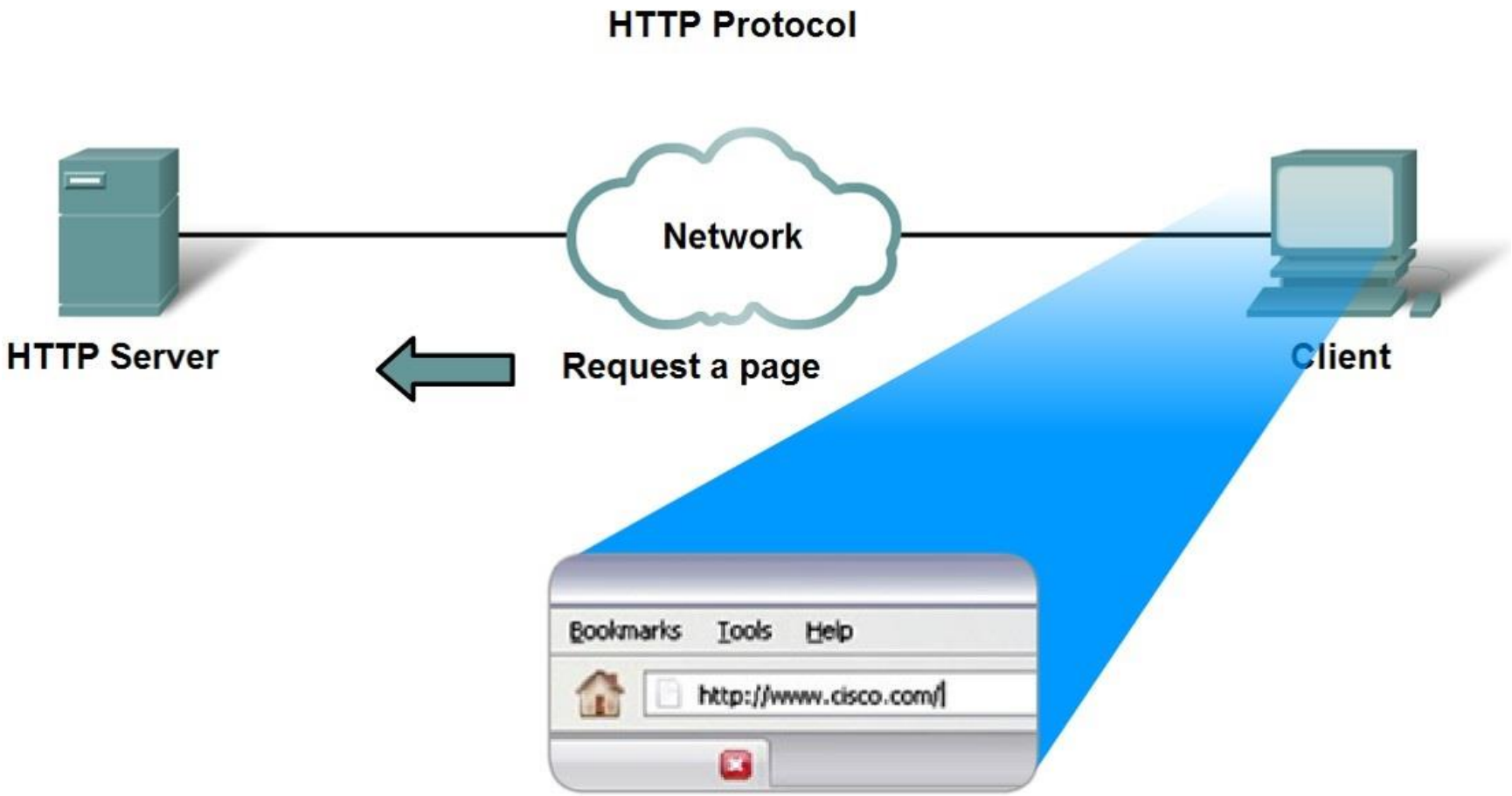


Telecommunication Network - Telnet

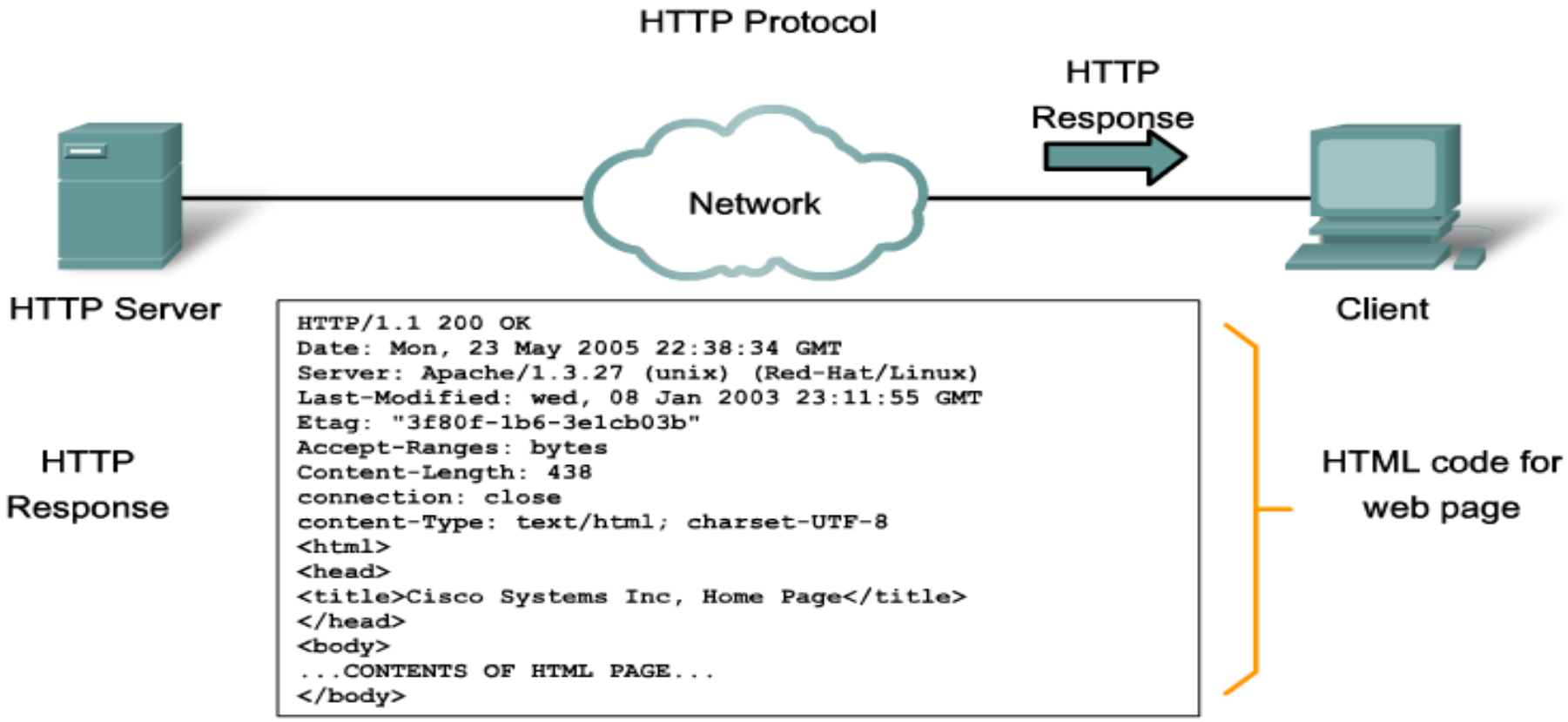


Telnet provides a way to use a computer, connected via the network, to access a network device as if the keyboard and monitor were directly connected to the device.

Hyper Text Transfer Protocol - HTTP

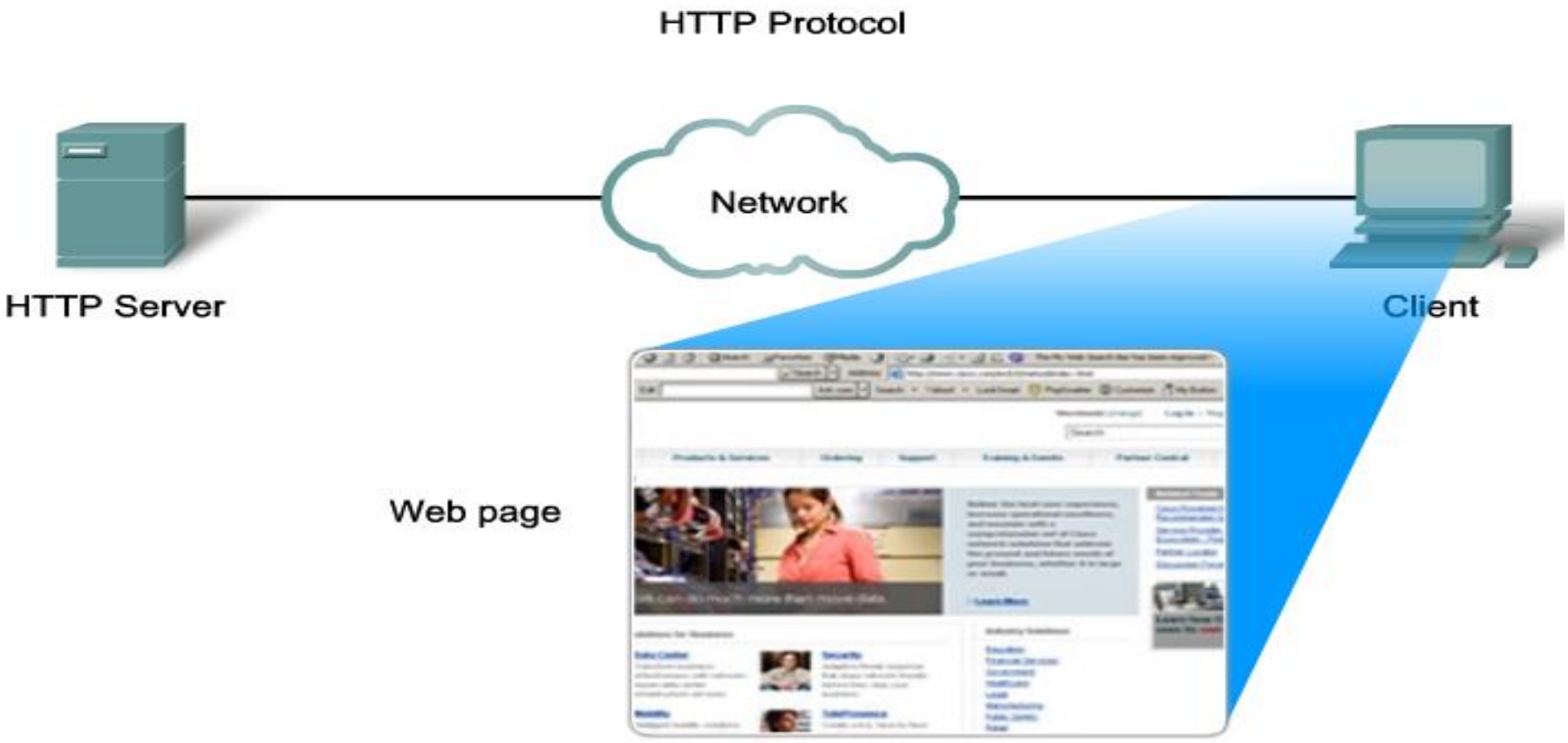


HyperText Transfere Protocol - HTTP



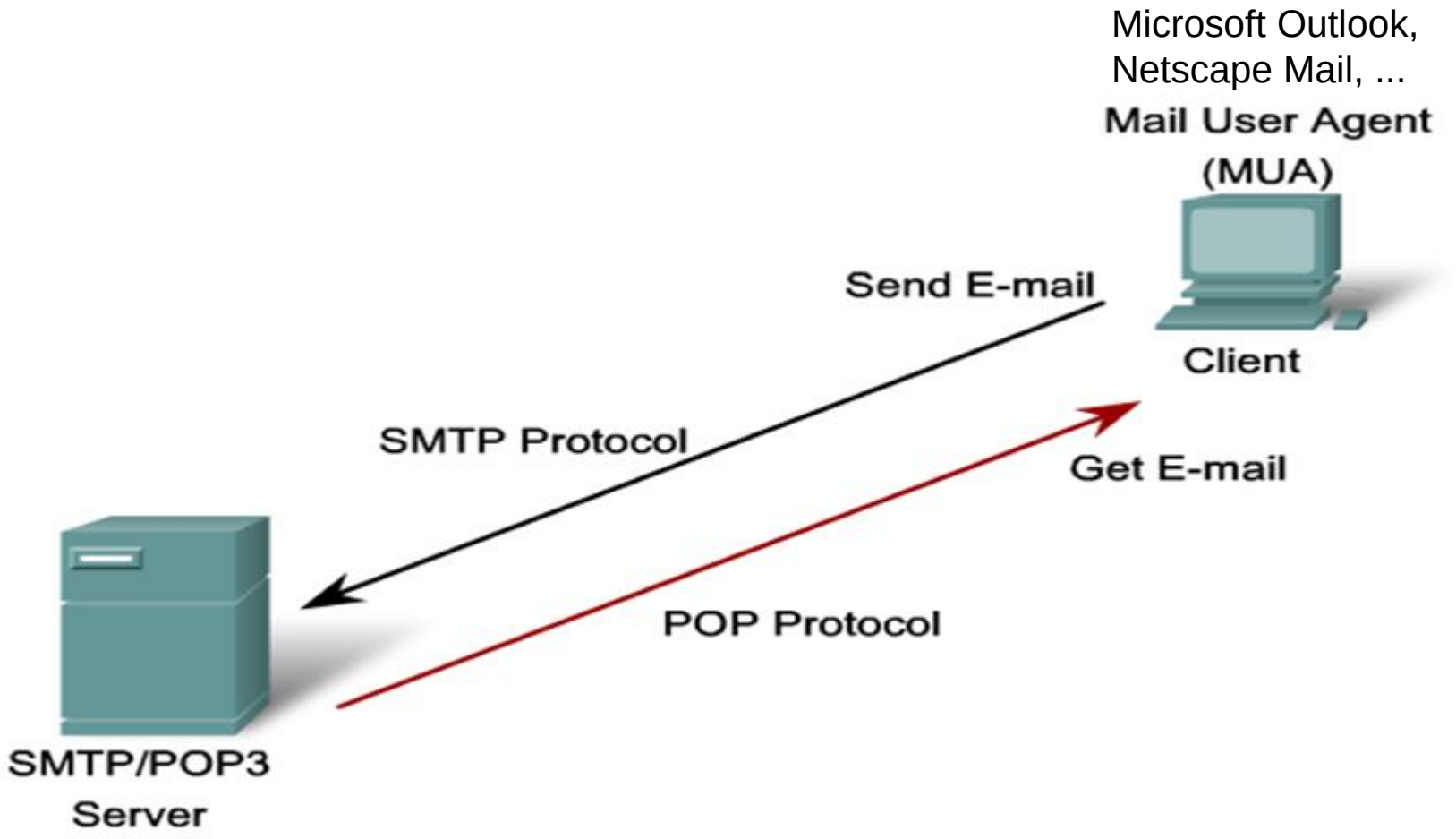
In response to the request, the HTTP server returns code for a web page.

HyperText Transfere Protocol - HTTP



The browser interprets the HTML code and displays a web page.

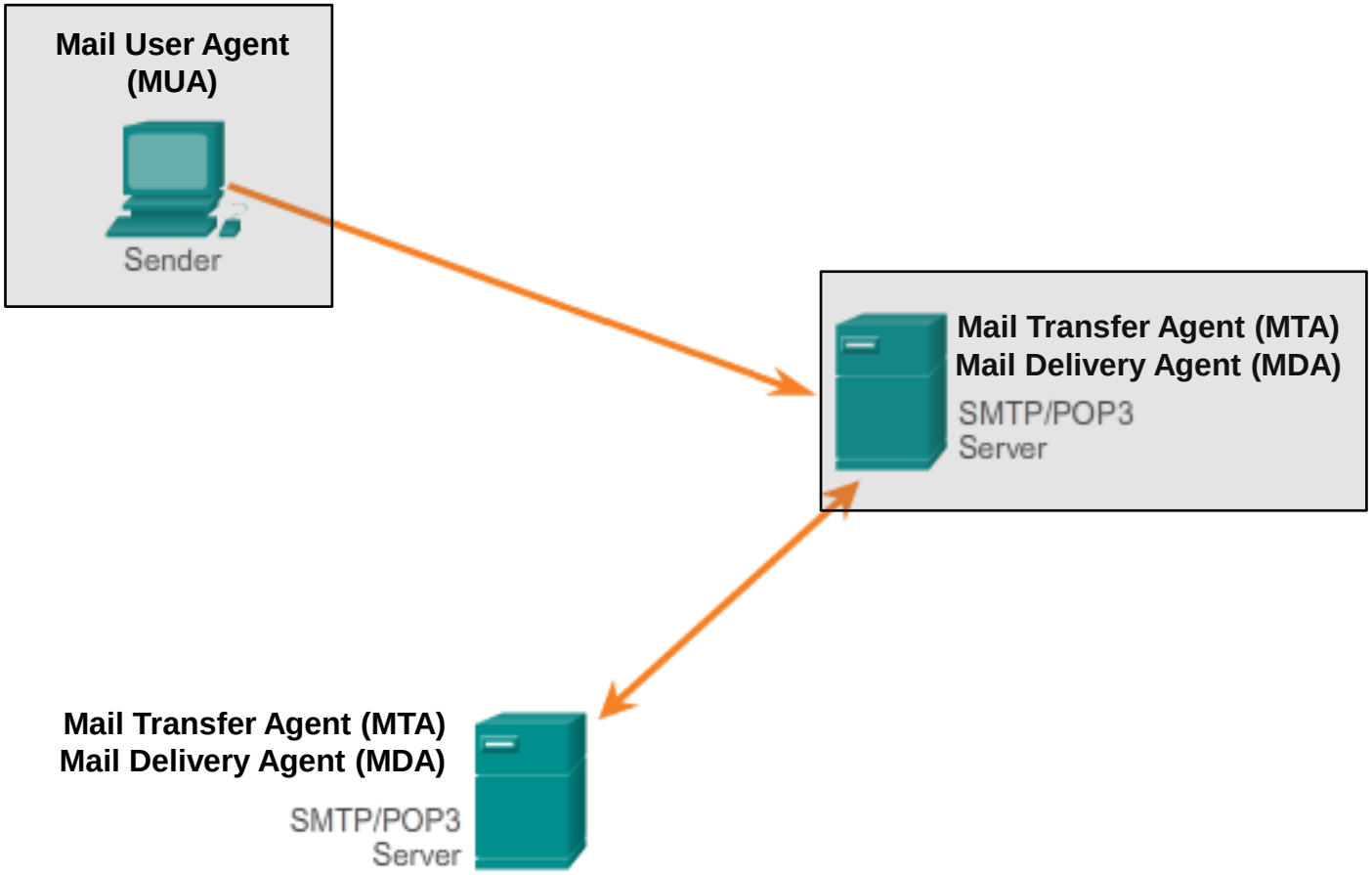
Post Office Protocol POP / Simple Mail Transfer Protocol - SMTP



MTA (**M**ail **T**ransfer **A**gent): send & receive emails
MDA (**M**ail **D**elivery **A**gent): filter & transfer emails to client

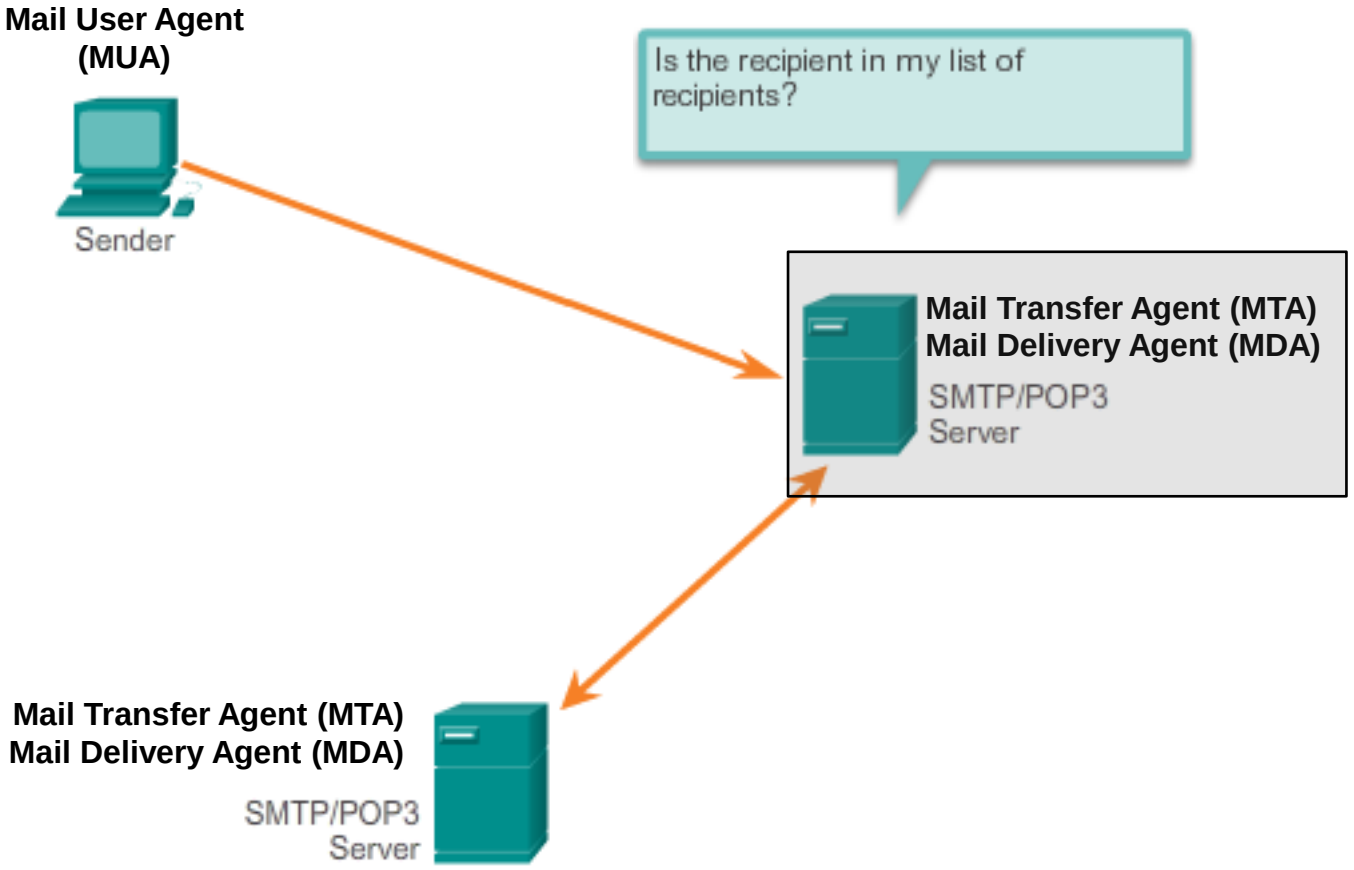
SMTP Example: MUA to MTA

The MUA sends an email to recipient@domain.com to its SMTP server.



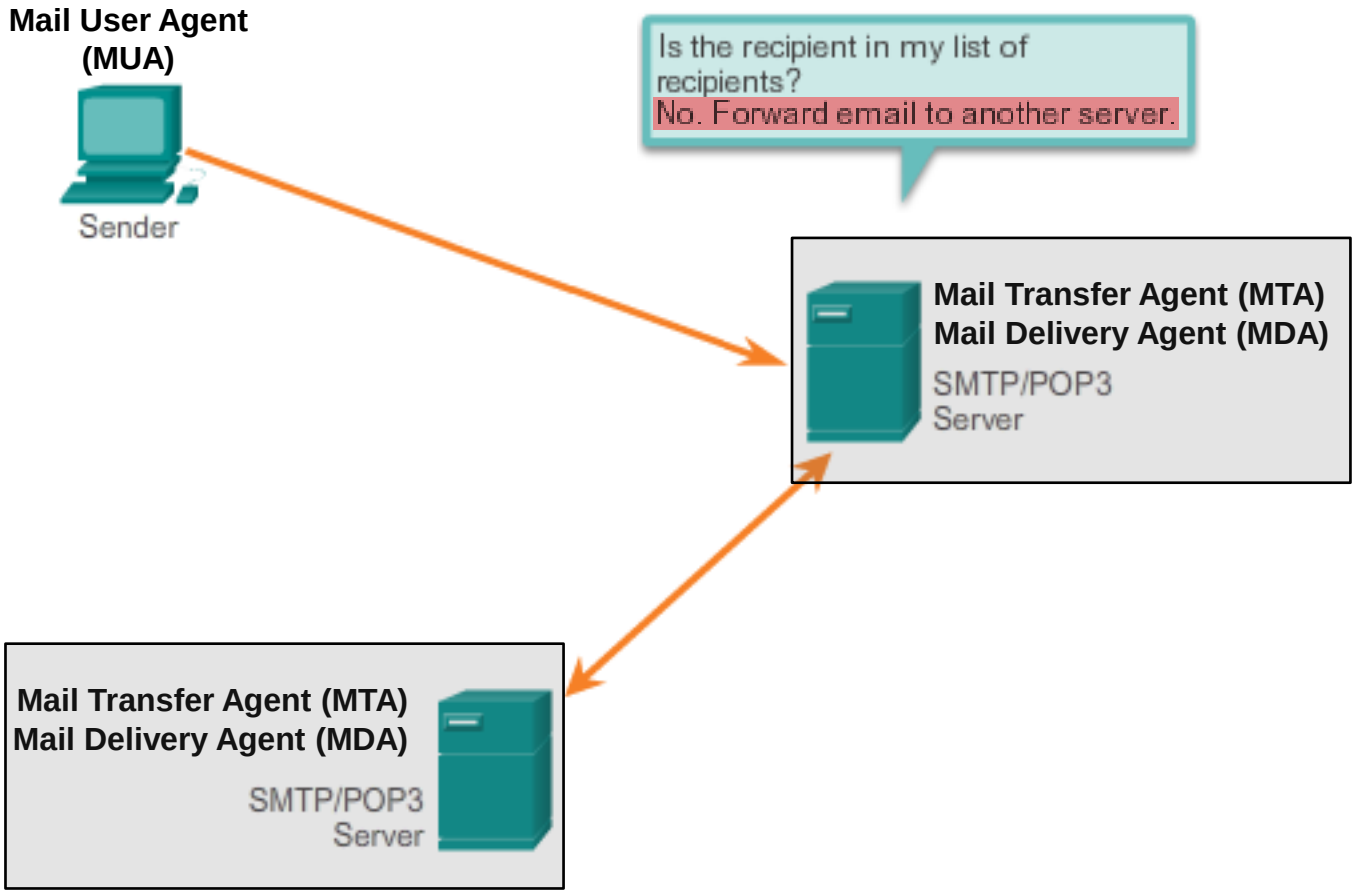
SMTP Example: MTA to Local MDA

If the-mail recipient is local, then the email server becomes an MDA and forwards the email to the recipient.



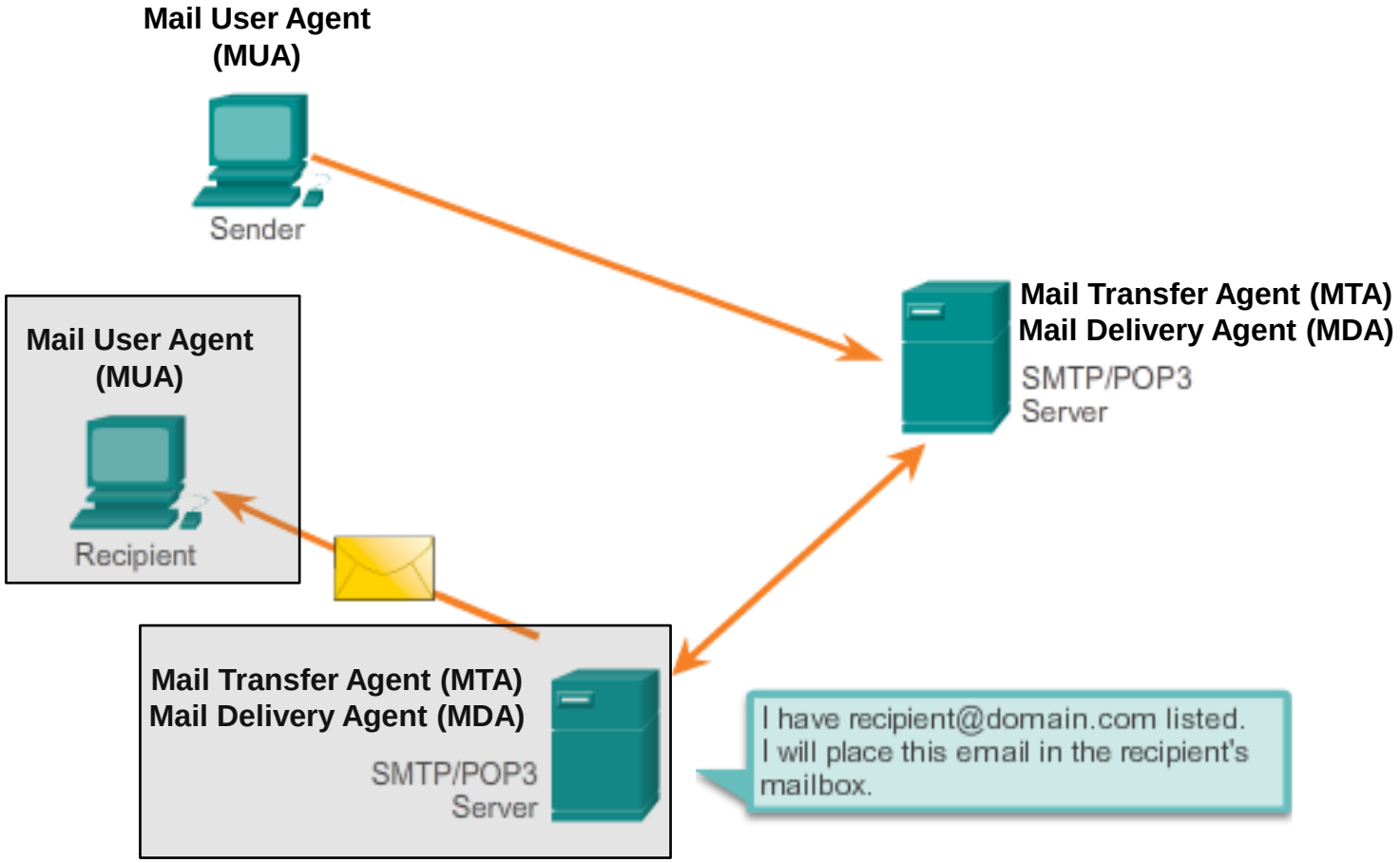
SMTP Example: MTA to MTA

If the-mail recipient is not on the local server, then the email server becomes an MTA and routes the e-mail to the appropriate email server.

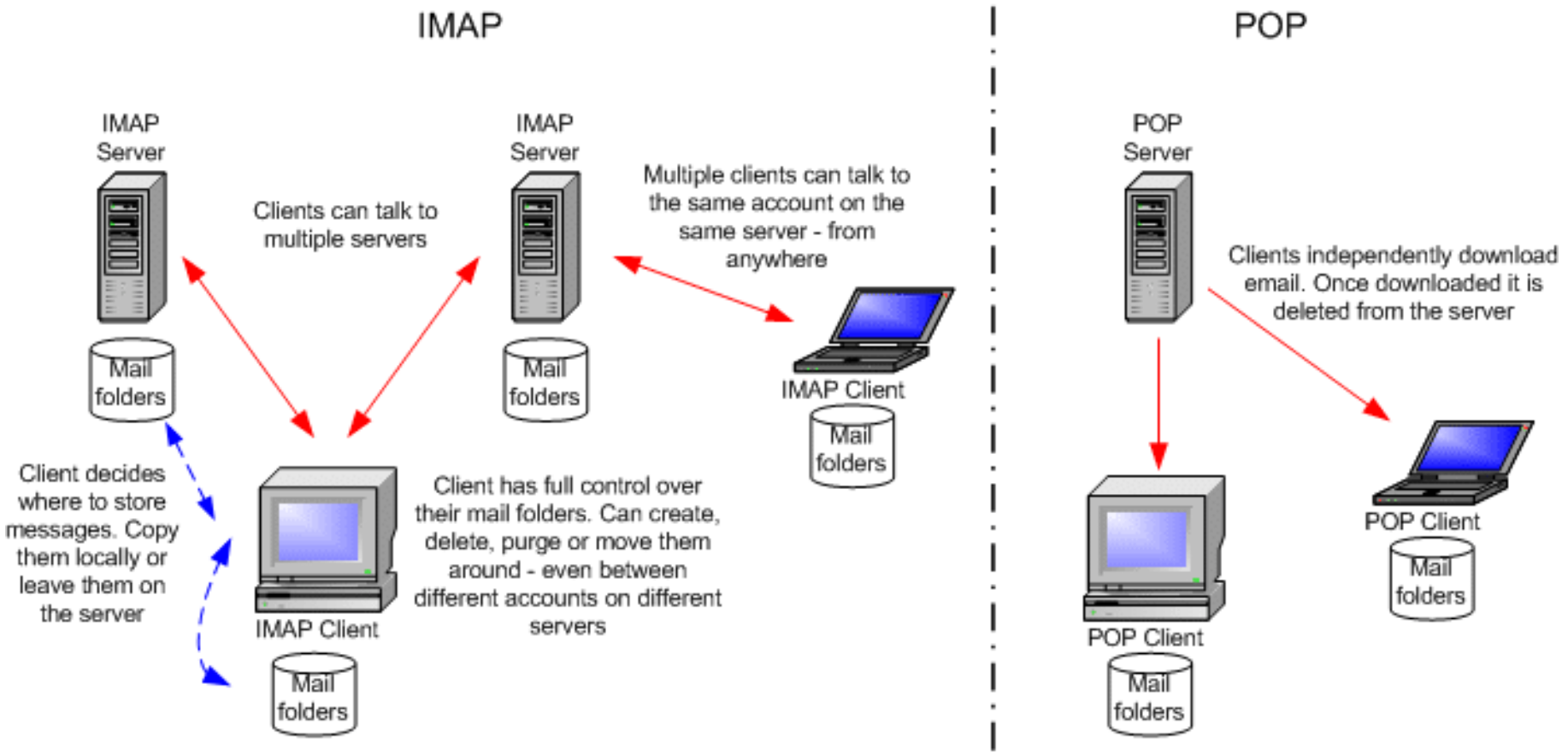


SMTP Example: MDA to MUA

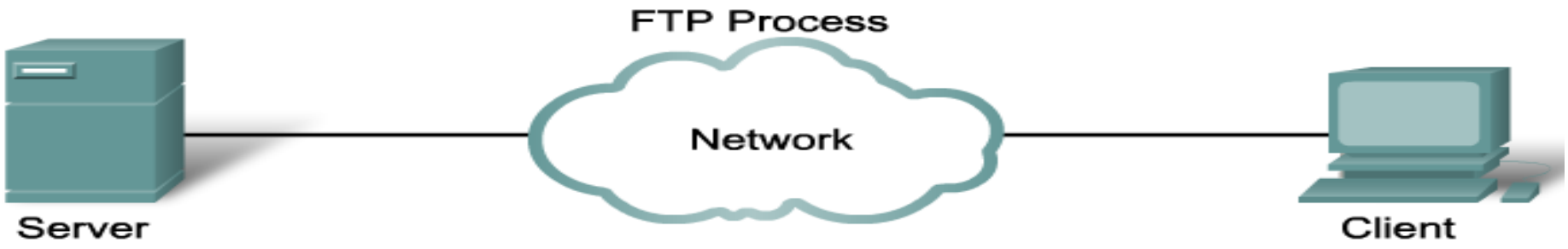
- **Since the-mail recipient is local, the email server becomes an MDA and forwards the email to the recipient.**



POP vs IMAP


IMAP
IMAP Server
IMAP Server
Clients can talk to multiple servers
Multiple clients can talk to the same account on the same server - from anywhere
Mail folders
Mail folders
IMAP Client
Mail folders
Client decides where to store messages. Copy them locally or leave them on the server
IMAP Client
Client has full control over their mail folders. Can create, delete, purge or move them around - even between different accounts on different servers
Mail folders
POP
POP Server
Clients independently download email. Once downloaded it is deleted from the server
POP Client
Mail folders
POP Client
Mail folders

File Transfer Protocol - FTP



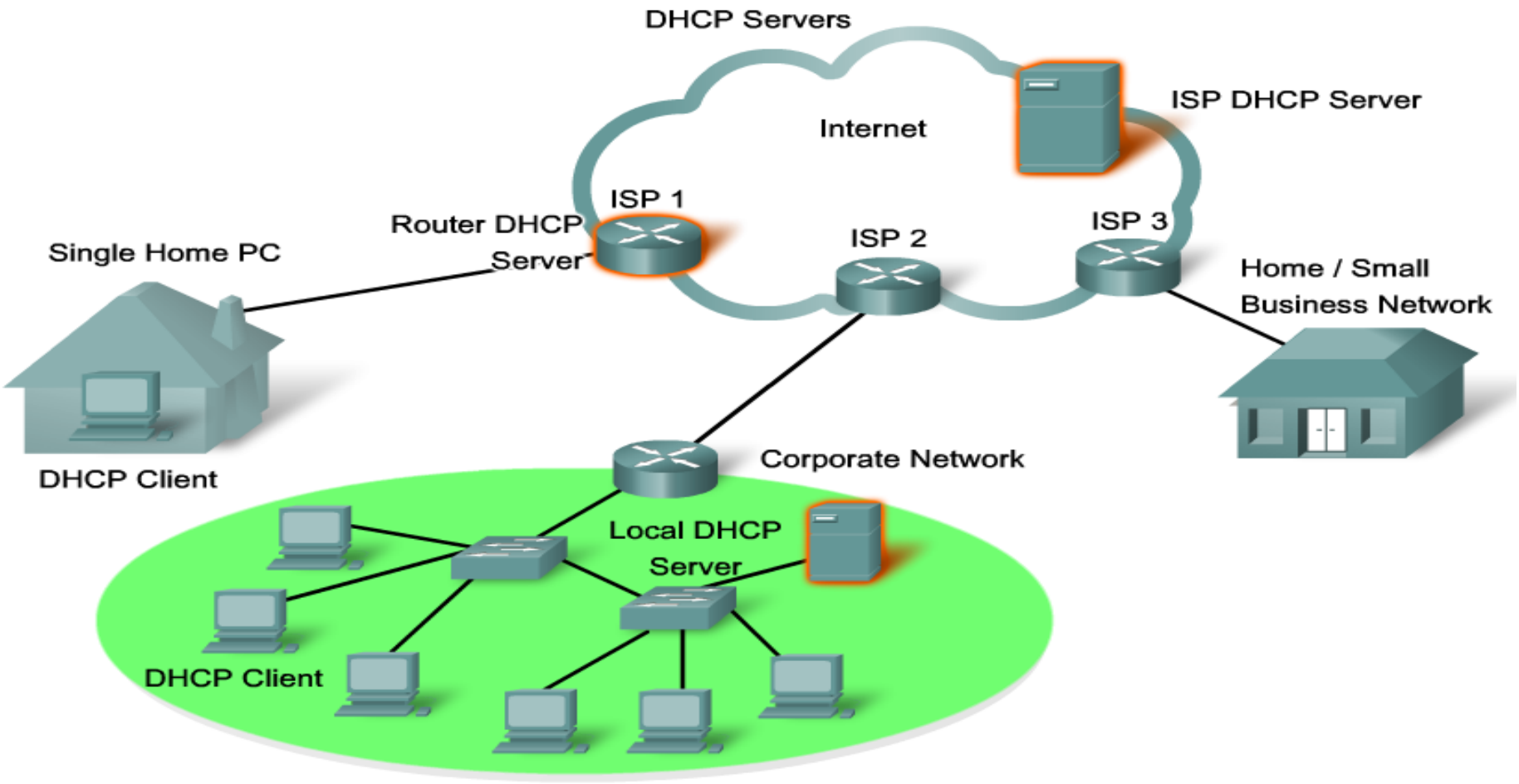
Control Connection:
Client opens first connection to the server for control traffic.

Data Connection:
Client opens second connection for data traffic.

Get Data

Based on command sent across control connection, data can be downloaded from server or uploaded from client.

Dynamic Host Configuration Protocol - DHCP




CISCO