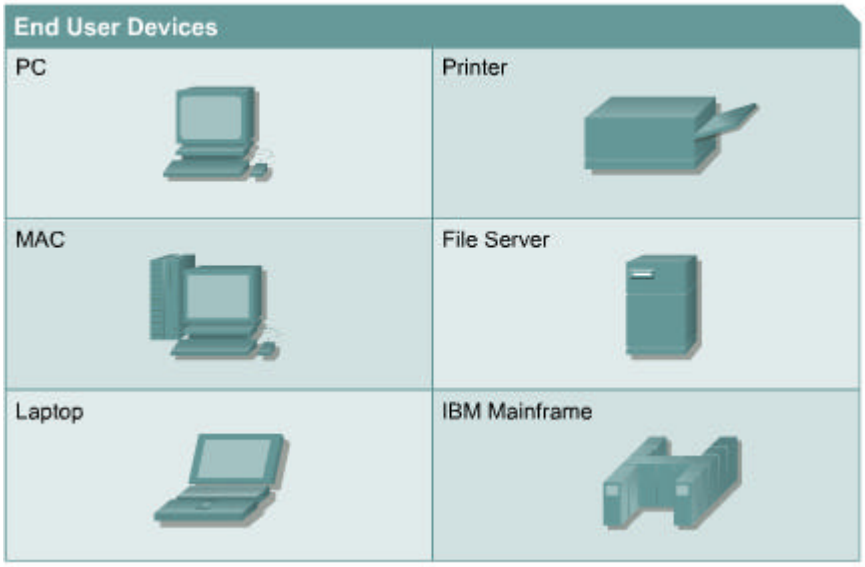
# Networking Fundamentals

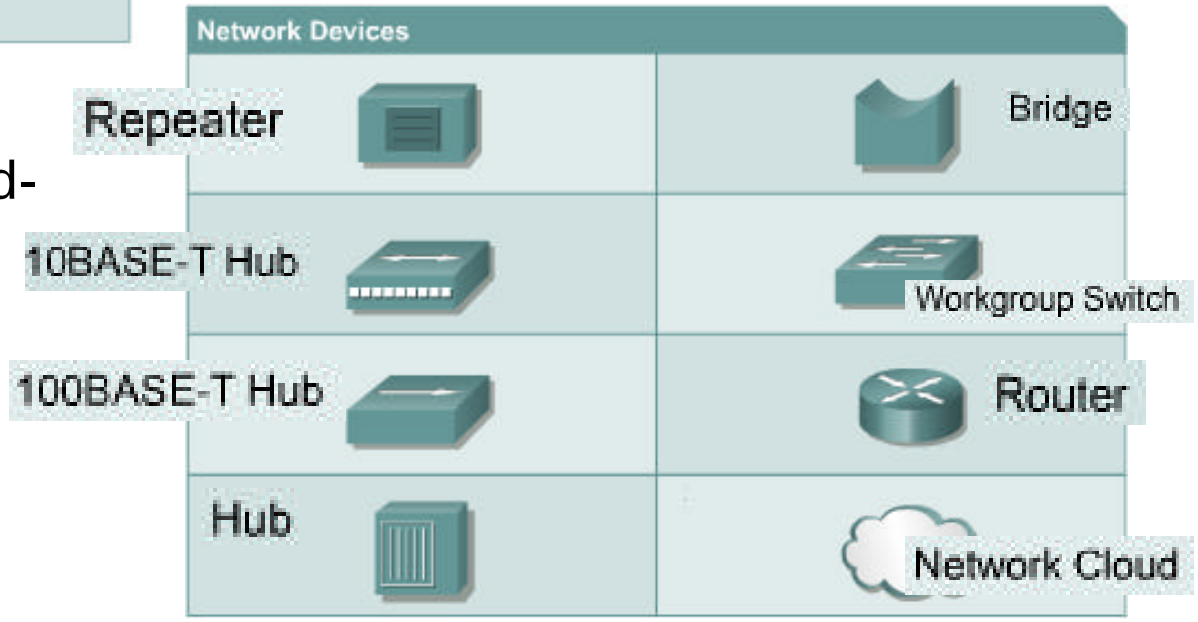
CCNA 1 v3 – Module 2

# Networking Terminology



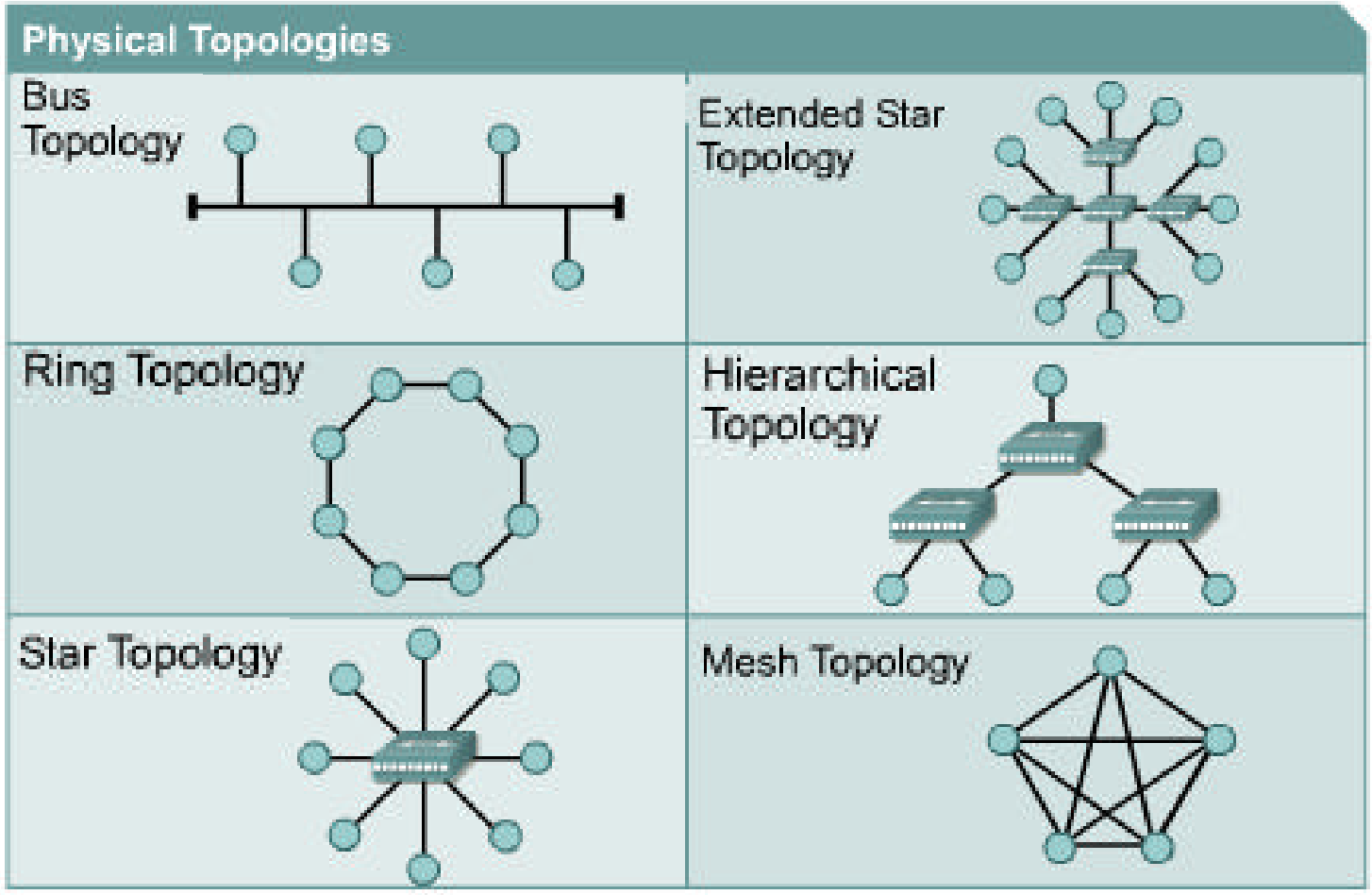

**End-user devices** provide users with a connection to the network.
Also referred to as **hosts.**
Allow users to share, create, and obtain information.

**Network devices** provide transport for data between end-user devices.
Provide cable connections, extensions, concentration.
Conversion of data formats, and management of data transfers



# Physical Topologies

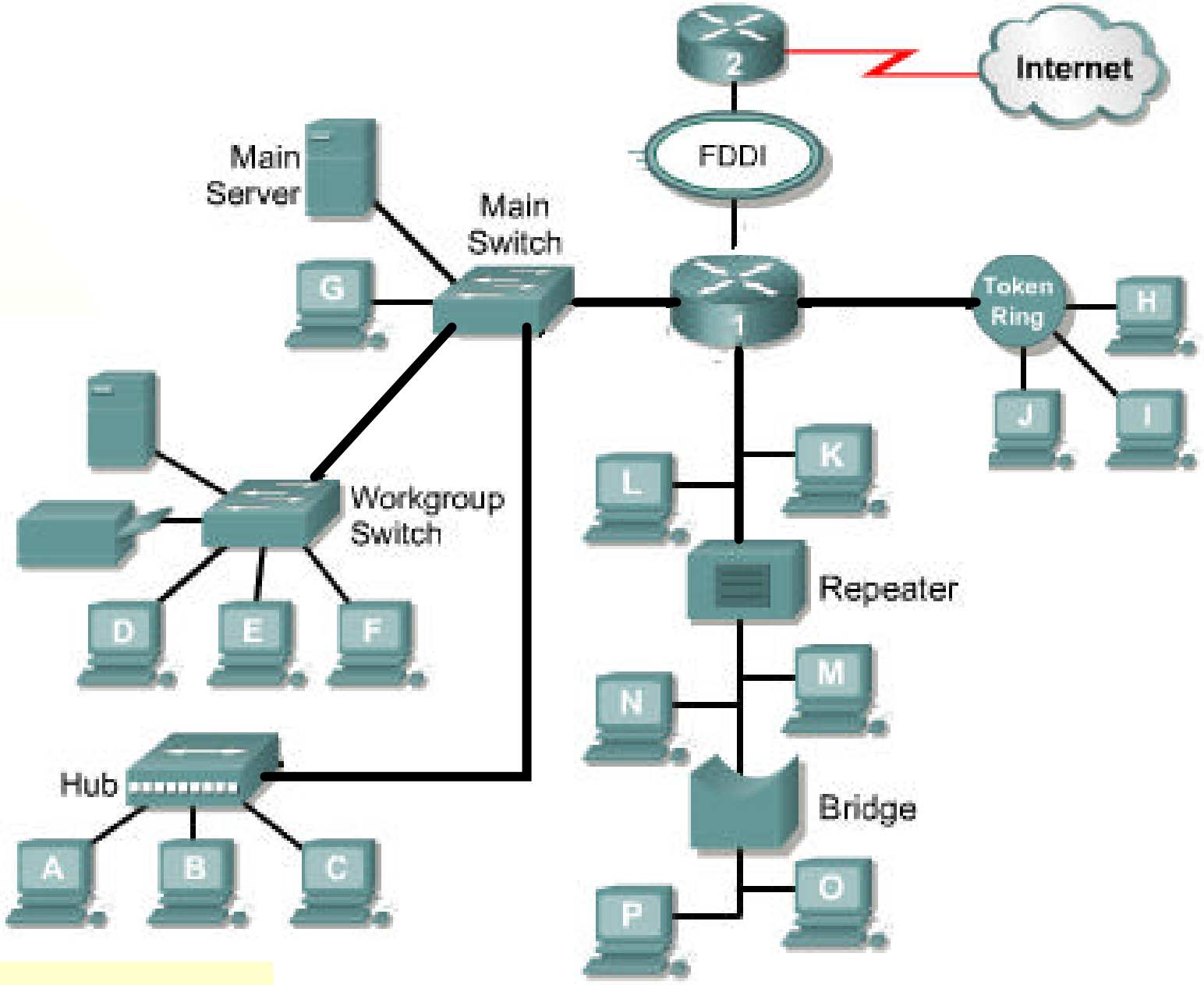
**Physical topology** is the actual layout of the wire or media



# Logical Topology

**Logical topology** defines how media is accessed by hosts

1. **Broadcast** means that each host sends its data to all other hosts on the network medium.
   Non-deterministic - there is no order that the stations must follow to use the network. First come, first served.
   Example: **Ethernet**
2. **Token Passing** controls network access by passing an electronic token sequentially to each host.
   When a host receives the token, that host can send data on the network.
   If the host has no data to send, it passes the token to the next host and the process repeats itself.
   Examples: **Token Ring, FDDI**


2
Internet
FDDI
Main
Server
Main
Switch
G
1
Token
Ring
H
J
I
K
L
Workgroup
Switch
Repeater
D
E
F
M
N
Hub
Bridge
A
B
C
O
P

**LAN**

- Operate within limited geographical area
- Allow multi-access to high bandwidth media
- Control network privately under **local** administration
- Provide full-time connectivity to local services
- Connect physically adjacent devices

**MAN**

- Spans a **metropolitan area** such as a city or suburban area
- Usually consists of  LANs in a common geographic area
- Example: a bank with multiple branches may utilize a MAN

**WAN**

- Operate over a large geographical area
- Allow access over serial interfaces operating at lower speeds
- Provide full-time and part-time connectivity
- Connect devices separated over **wide areas**

**SAN**

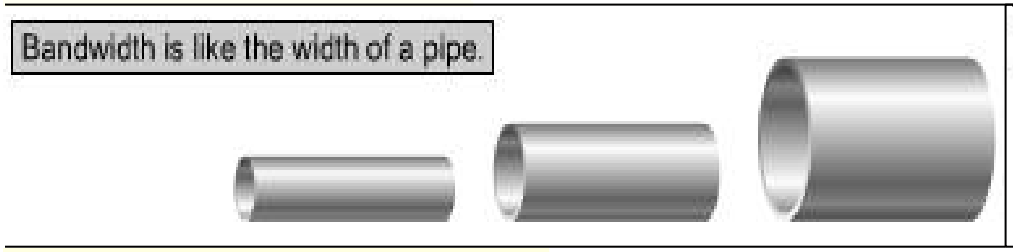
- High-performance network to move data to/from **storage** areas
- Separate, dedicated network avoids traffic conflict

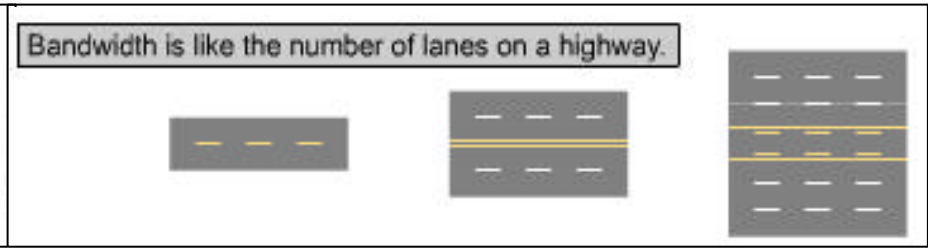
**VPN**

- **Private network** constructed within public network such as Internet
- Access VPNs, Intranet VPNs, Extranet VPNs

# Bandwidth

- Bandwidth is limited by physics and technology
- Bandwidth is not free
- Bandwidth requirements are growing at a rapid rate
- Bandwidth is critical to network performance




| Unit of Bandwidth | Abbreviation | Equivalence |
|---|---|---|
| Bits per second | bps | 1 bps = fundamental unit of bandwidth |
| Kilobits per second | kbps | 1 kbps = ~1,000 bps = $10^3$ bps |
| Megabits per second | Mbps | 1 Mbps = ~1,000,000 bps = $10^6$ bps |
| Gigabits per second | Gbps | 1 Gbps = ~1,000,000,000 bps = $10^9$ bps |
| Terabits per second | Tbps | 1 Tbps = ~1,000,000,000,000 bps = $10^{12}$ bps |

# Throughput

Throughput refers to **actual measured bandwidth**, at a specific time of day, using specific Internet routes, and while a specific set of data is transmitted on the network.
Often far less than the maximum possible digital bandwidth.

Factors that determine throughput:

- Internetworking devices
- Type of data being transferred
- Network topology
- Number of users on the network
- User computer
- Server computer
- Power conditions

**Best Download**

$$T = \frac{S}{BW}$$

T = Time S = Size
BW = Bandwidth
P = Throughput

**Typical Download**

$$T = \frac{S}{P}$$

# Networking Models

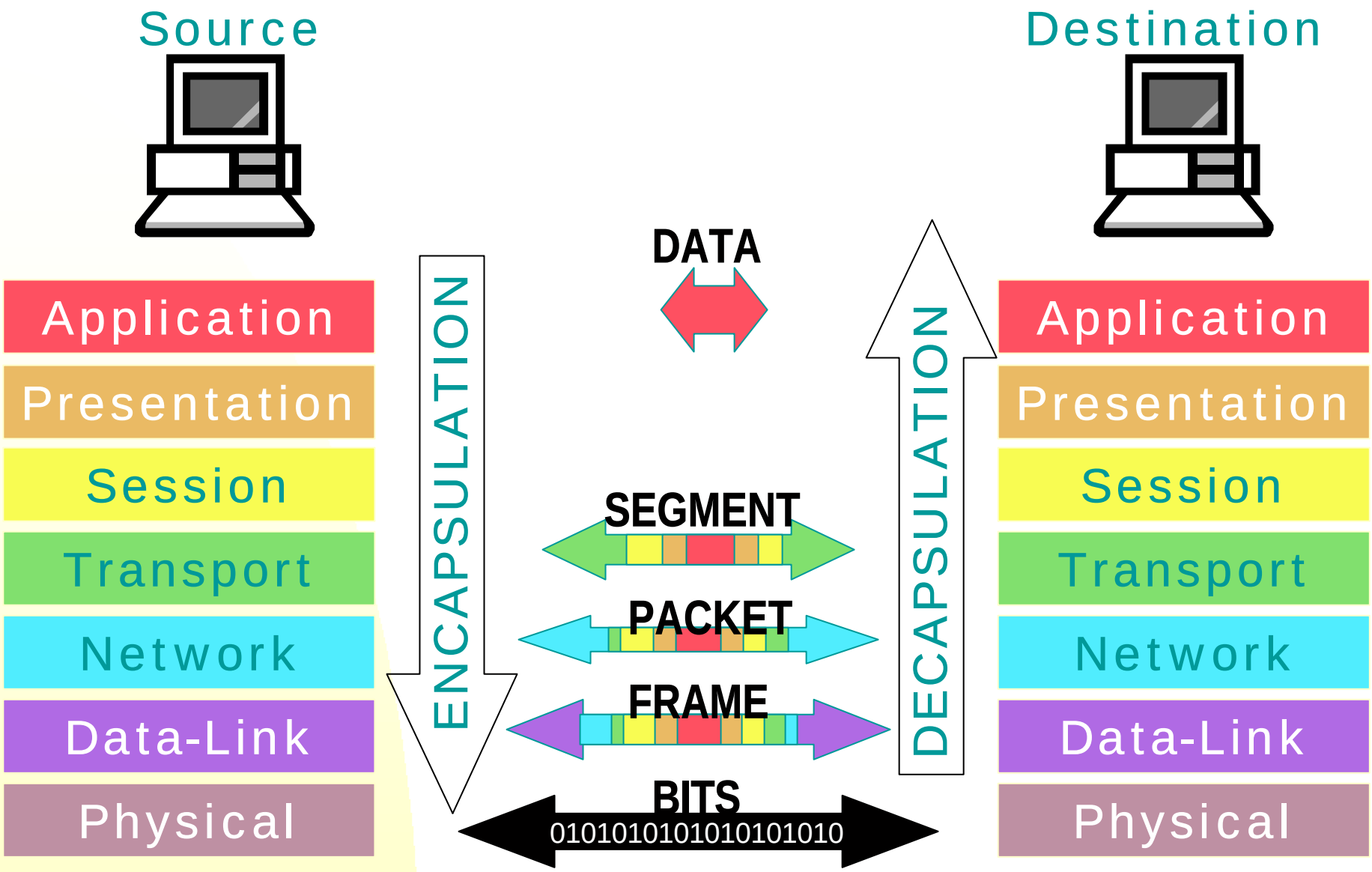
- The historical and technical standard of the Internet is the **TCP/IP model**
- The U.S. Department of Defence created the TCP/IP reference model, to design a network that could survive any conditions, including a nuclear war


- **Application** layer handles issues of representation, encoding, and dialog control.
- **Transport** layer deals with the quality of service issues of reliability, flow control, and error correction
- **Internet** layer is to divide TCP segments into packets and send them from any network. Best path determination and packet switching occur at this layer
- **Network Access** layer (aka host-to-network layer) concerned with all components, both physical and logical, that are required to make a physical link


# OSI Model

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

- The **OSI reference model** was released in 1984 to help network builders implement networks that could communicate (interoperability)
- The OSI reference model is the primary model for network communications
- The process of moving information between computers is divided into seven smaller and more manageable steps


Source
Destination
Application
Presentation
Session
Transport
Network
Data-Link
Physical
ENCAPSULATION
DECAPSULATION
DATA
SEGMENT
PACKET
FRAME
BITS
0101010101010101010

# OSI Top 3 Layers – Application issues

- **Application**
  - provides network services to the user's applications
  - file, print, message, database and application services
  - HTTP, SMTP, FTP
- **Presentation**
  - responsible for manipulating data's appearance as needed by the Application layer
  - Data encryption, compression and translation services
  - JPEG, MIDI, QuickTime, EBCDIC to ASCII
- **Session**
  - establish and maintain communication between two hosts
  - Dialogue control
  - NFS, SQL, RPC, X Window

# OSI Lower 4 Layers – Data Transport issues

- **Transport**
  - **PDU – Segment**
  - the transport layer establishes, maintains, and tears down virtual circuits
  - Windowing
  - TCP and UDP
- **Network**
  - **PDU - Packet**
  - Routing
  - Data packets and route update packets
  - connectivity and path selection between two hosts
- **Data-Link**
  - **PDU - Frame**
  - physical addressing, network topology, network access, error notification, ordered delivery of frames, and flow control
  - Ethernet LCC and MAC layers
- **Physical**
  - **PDU – bits**
  - Cabling, standards