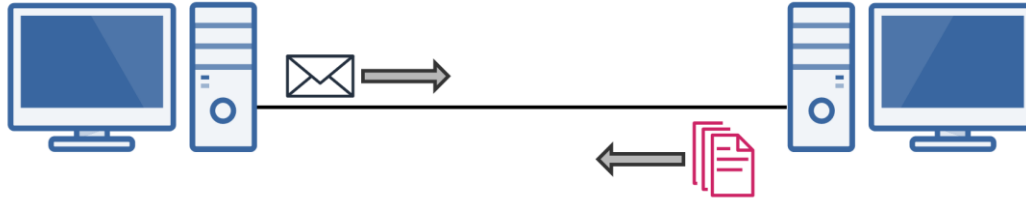


# *Introduction to Computer Networking Protocols*

# Computer Networking Protocols



- Computers communicate with each other with network protocols.
- Protocols are rules governing how machines exchange data and enable effective communication.
- **Some Everyday Examples**
  - When you call somebody, you pick up the phone, ensure there is a dial tone, and if there is, you dial the number.
  - When you drive your car, you obey the rules of the road.

## *Protocols Continued*

- **Physical Protocols:** describe the medium (wiring), the connections (RJ-45 port), and the signal (voltage level on a wire).
- **Logical Protocols:** software controlling how and when data is sent and received to computers, supporting physical protocols.
- Computer networks depend on many different types of protocols in order to work properly.
- Example Common TCP/IP Suite of Protocols:
  - **Web Communication:** HTTP
  - **E-mail:** POP3, SMTP, IMAP
  - **File Transfers:** FTP

# *Introduction to the OSI Model*

# The OSI Model

## What is it?

The *Open Systems Interconnection (OSI) Reference Model*

- A **conceptual** framework showing us how data moves throughout a network.
- Developed by the International Organization for Standardization (ISO) in 1977.

## It's Purpose

- Gives us a guide to understanding how networks operate.

It's only a **reference model**, so don't get wrapped up in the details.

- Wasn't implemented in the **real world**, TCP/IP is.

# *The OSI Model Stack*

The OSI Model breaks down the complex task of computer-to-computer network communications into seven layers.

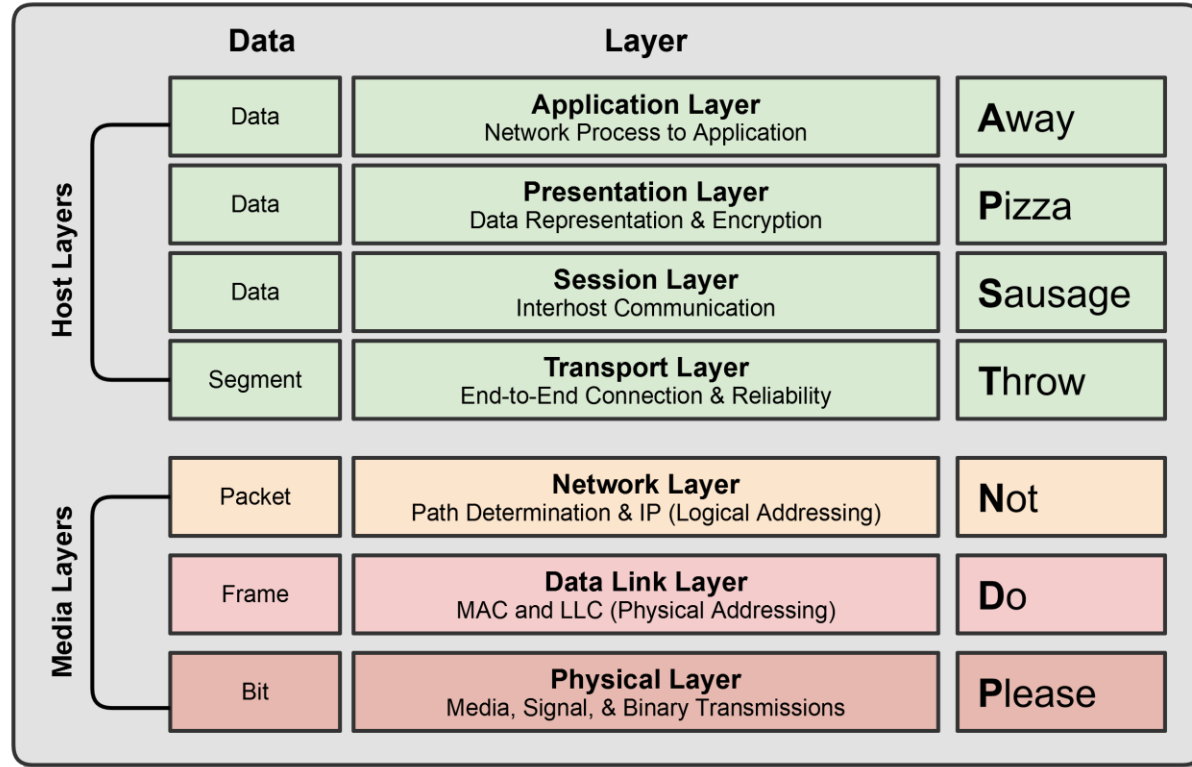
## **Upper Layers (Host Layers)**

- Handled by the host computer and performs application-specific functions, such as data formatting, encryption, and connection management.

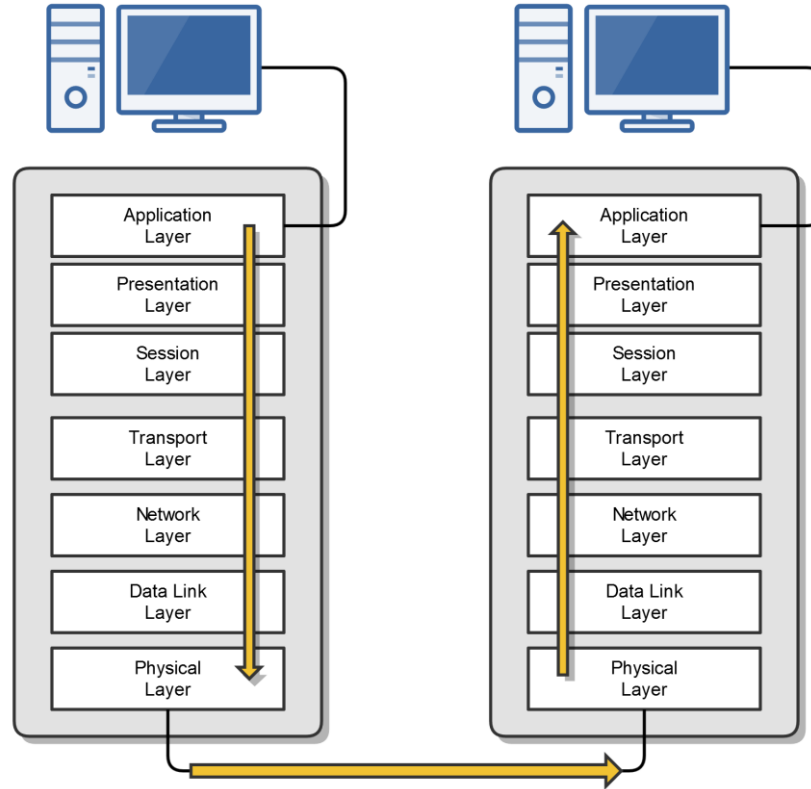
## **Lower Layers (Media Layers)**

- Provide network-specific functions, such as routing, addressing, and flow control.

# The OSI Model Visualized



# OSI Communication

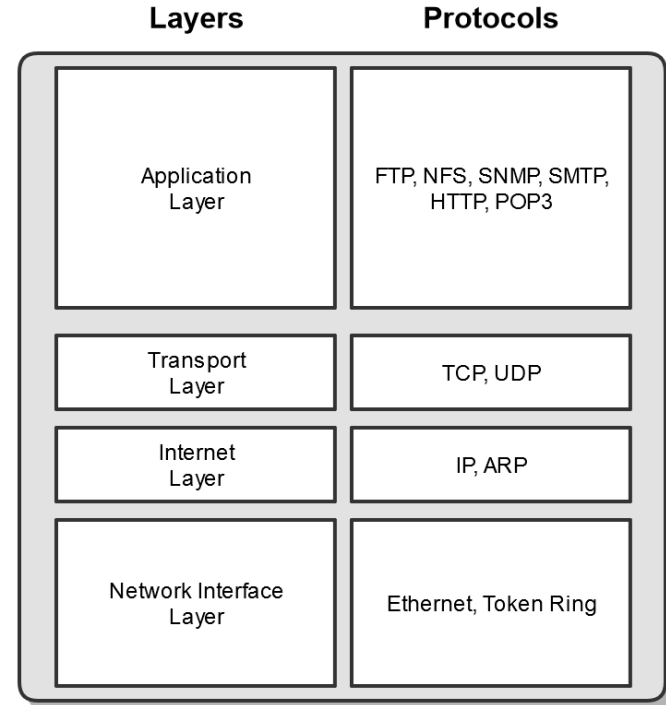




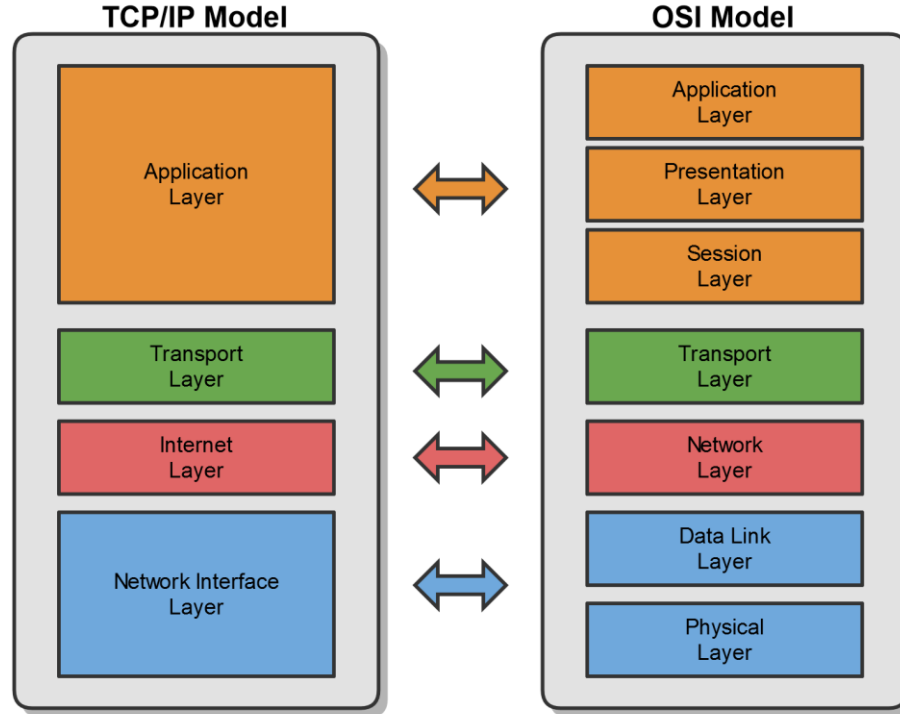
# *Introduction to the TCP/IP Model*

# The TCP/IP Model

- The TCP/IP suite is the most commonly used protocol suite in the networking world.
- It's essentially the protocol suite in which the Internet was built.
- It's the standard for computer networking.
- It is based on a 4-layer model that is similar to the OSI model.
- History of TCP/IP:
  - Developed by the United States Department of Defense (DoD) in the early 1970s.
  - In 1982, the DOD declared TCP/IP as the standard for all military computer networking.
  - In 1984, broad adoption of TCP/IP began (IBM, AT&T, etc.).



# TCP/IP & OSI Models Side-by-Side



# *Introduction to the MAC Addresses*

# MAC Addresses

## Media Access Control (MAC)

- Physical address of the network adapter card
- **OSI Layer 2** (Data Link) Layer Address
- **TCP/IP Layer 1** (Network Interface) Layer Address



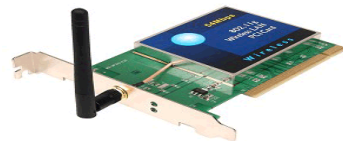
Six bytes (48 bits), Usually Represented Hexadecimal

- First three bytes (24 bits) are assigned by the IEEE to the manufacturer
  - **Organizationally Unique Identifier (OUI)** assigned by IEEE (ex: Dell or HP)
- **Last three bytes (24 bits) are usually assigned sequentially:**
  - Unique Numbers

**00:21:70:6f:06:f2**

**00-21-70-6F-06-F2**

**$2^{24} = \sim 16.7$  Million Unique Addresses**



# *Introduction to IP Addresses*

# IP Addresses

- An IP Address is a **logical** address used in order to **uniquely identify** a device on an IP network.
- It's a **Network Layer** address associated with routing.
  - **OSI Layer 3:** Network Layer
  - **TCP/IP Layer 2:** Internet Layer
- There are two versions:
  - **IP version 4 (IPv4)**
    - Example: 192.168.0.1
  - **IP version 6 (IPv6)**
    - Example: 2001:DB8:85A3:0:0:8A2E:370:7334
- We'll be discussing both versions in this course.

# *IP versus MAC Addresses*



# *Comparing IP and MAC Addresses*

## **IP Addresses**

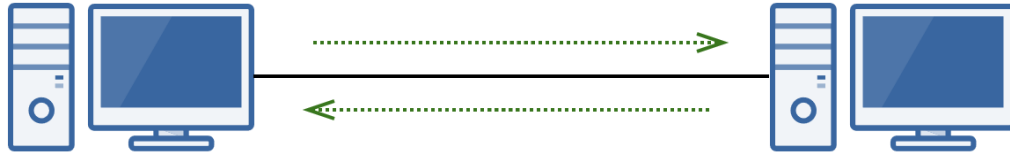
- Network (OSI Layer 3) Addresses
- Logical Addresses
- Assigned in Operating System
- Allows network-to-network communication via routers
- WAN communication

## **MAC Addresses**

- Data Link (OSI Layer 2) Addresses
- Physical Addresses
- Physically burned on NIC
- Allows internetwork communication via hubs, switches, and routers
- Local LAN communication

# *Duplex Communication*

# Half vs. Full Duplex Communication



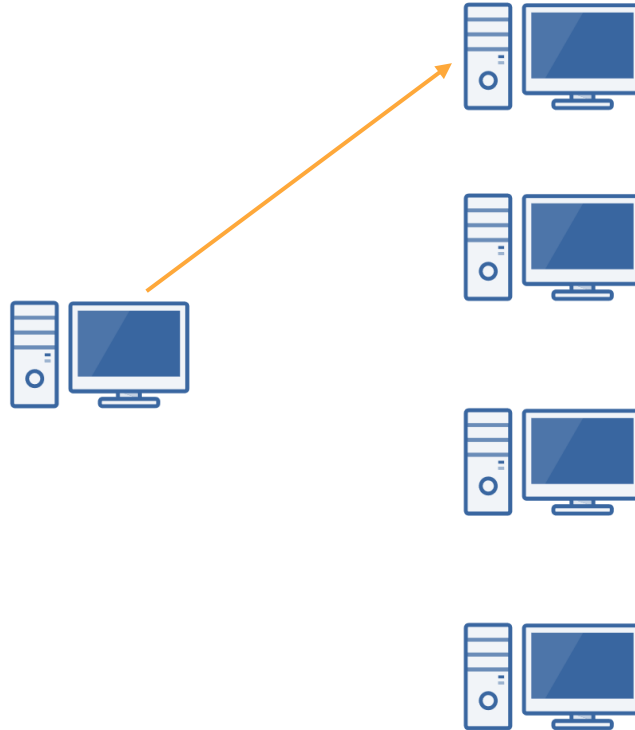
- Network communication will occur in either full or half duplex mode:
  - **Half Duplex:** Can send and receive data, but not at the same time.
  - **Full Duplex:** Can send and receive data simultaneously.

# *Network Transmission Types*

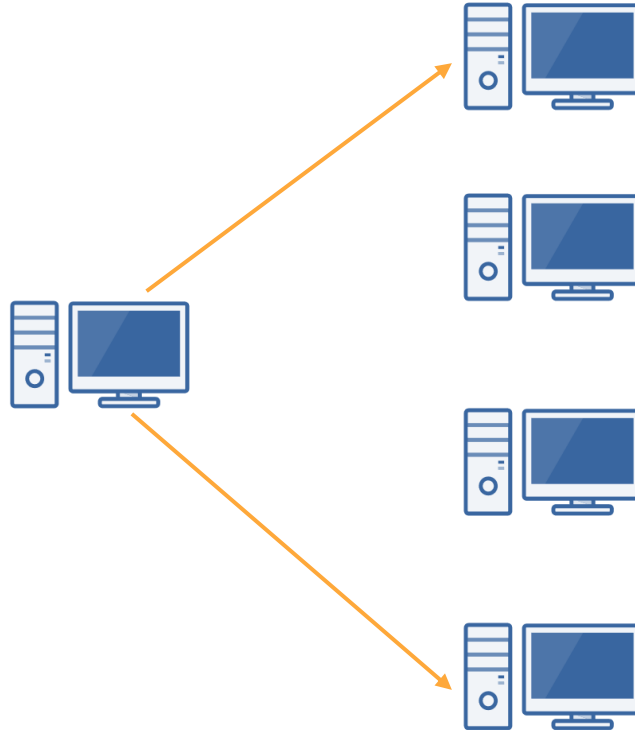
# *Network Transmission Types*

- Unicast
- Multicast
- Broadcast

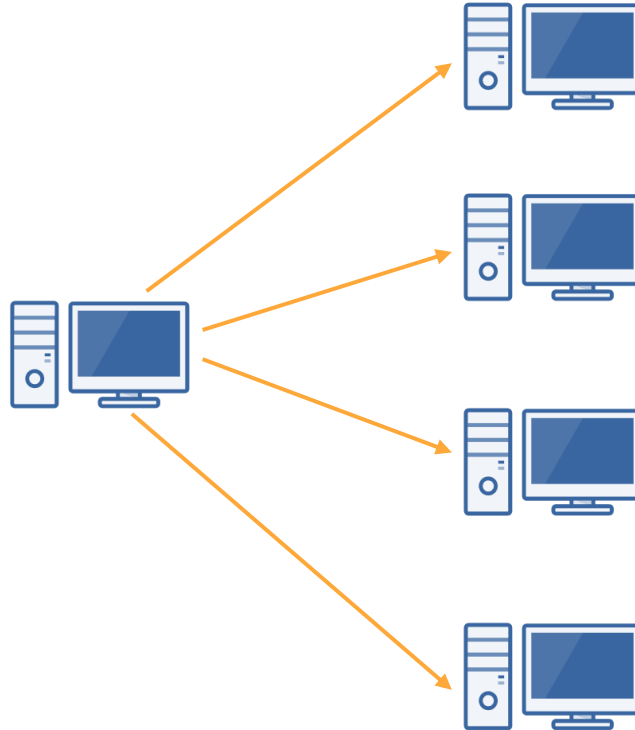
# Unicast (One-to-One)



# Multicast (One-to-Many)



# Broadcast (One-to-All)





# *Introduction to Ethernet*

# *Introduction to Ethernet*

- The most popular networking technology in the world!
- Refers to a family of standards that define the **physical** and **logical** aspects of the world's most popular type of LAN.
- The standard communications protocol for building a local area network (LAN).
- **Physical**
  - Cabling, Connectors, Equipment, etc.
- **Logical**
  - Network Access Method, i.e., Carrier Sense Multiple Access (CSMA)