Seneca

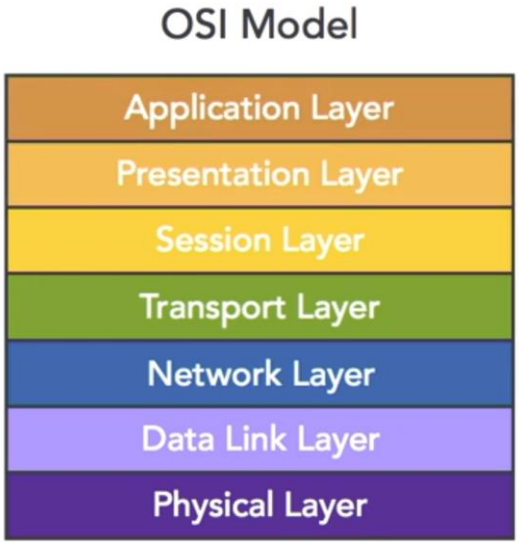
# Introduction to IP Addressing

# Agenda

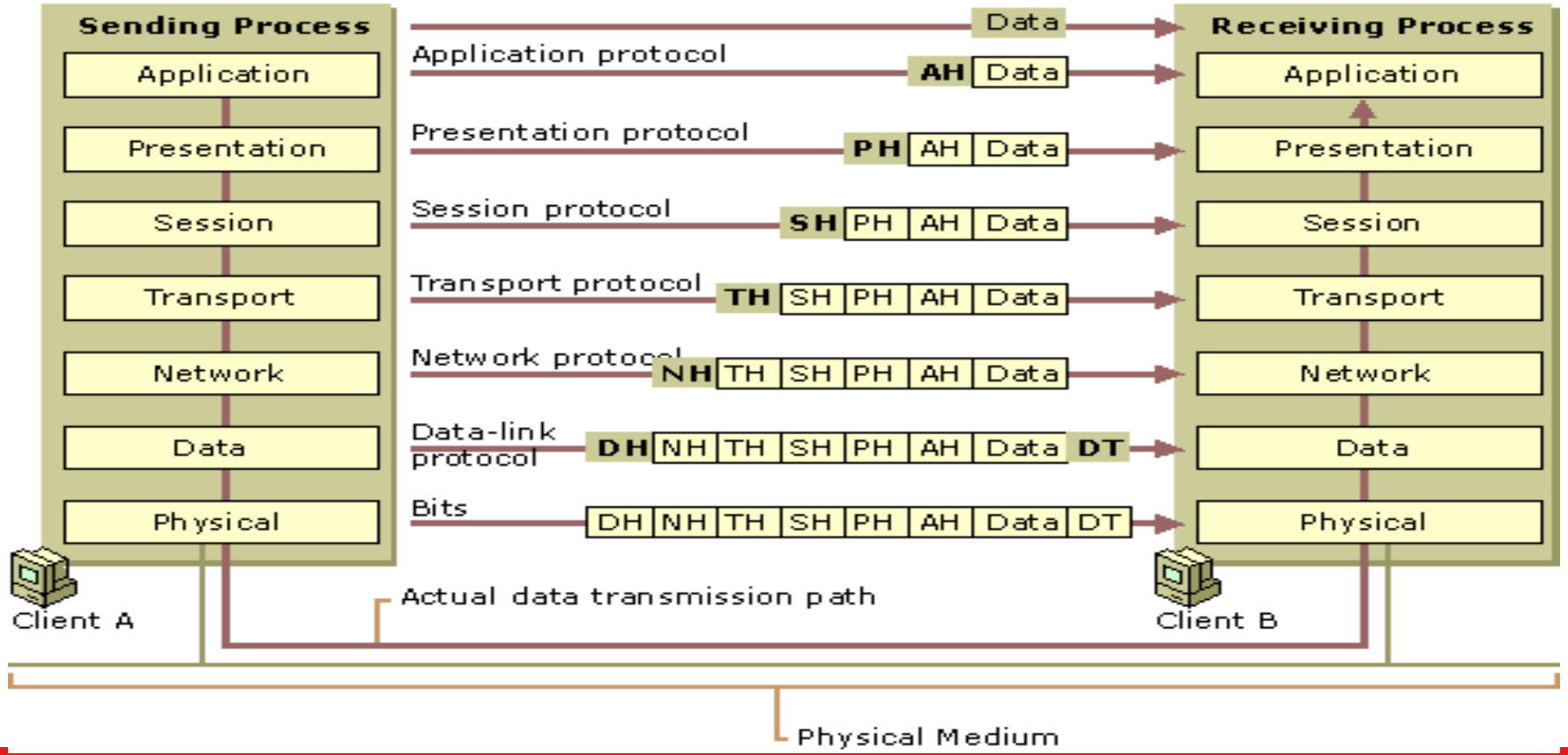
- Internet Protocol Suite (TCP/IP Model)
  - Link Layer
  - Internet Layer
- IPv4 Addresses
  - Versions
  - Subnet Mask
  - Classes
  - Reserved
  - Private
  - Network
  - Broadcast

# Recall: OSI Model

- OSI is an acronym for “Open System Interconnect”.
- Introduced in 1984 by the ISO and ITU-T.
- The OSI model is a reference model for how applications communicate over a network.
- The model contains 7 levels:
  7. Application
  6. Presentation
  5. Session
  4. Transport
  3. Network
  2. Data Link
  1. Physical



# Encapsulation



# OSI Layers Examples

| Layer | Layer Name | Example |
|---|---|---|
| 7 | Application | HTTP, FTP, SMTP |
| 6 | Presentation | JPEG, GIF, MPEG |
| 5 | Session | AppleTalk, Winsock |
| 4 | Transport | TCP, UDP, SPX |
| 3 | Network | Router – IP, ICMP |
| 2 | Data Link | Switch/Bridge – Ethernet, ATM |
| 1 | Physical | Hub, NIC – Ethernet, Token Ring |

# Protocol Data Units - PDU

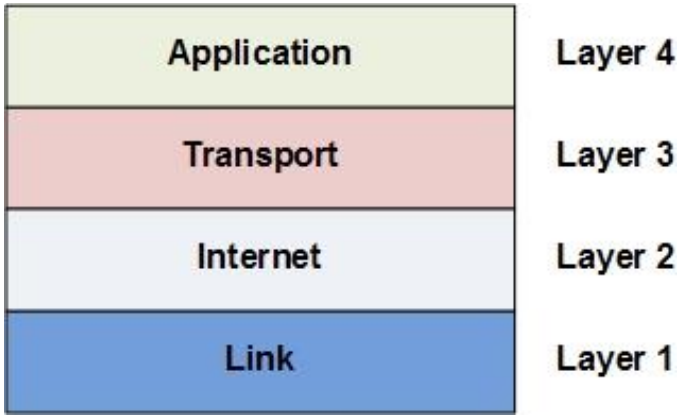
- In the OSI model, a **protocol data unit** (PDU) is a single **unit** of data which is specified in a protocol of a given layer and which consists of protocol-control information and user data of that layer

| Layer | Layer Name | PDU |
|---|---|---|
| 7 | Application | Data |
| 6 | Presentation | Data |
| 5 | Session | Data |
| 4 | Transport | Segments |
| 3 | Network | Packets (or Datagrams) |
| 2 | Data Link | Frames |
| 1 | Physical | Bits |

# Internet Protocol Suite

- Also known as the “TCP/IP Model”
- TCP/IP is an acronym for “Transport Control Protocol/Internet Protocol”.
- Introduced in 1970s by 2 DARPA scientists: Vint Cerf and Bob Kahn.
  - “Fathers of the Internet”
- The model contains 4 levels:

4. Application
3. Transport
2. Internet
1. Link



# TCP/IP Model

| OSI | TCP/IP |
| --- | --- |
| Application | Application |
| Presentation | |
| Session | |
| Transport | Transport |
| Network | Internet |
| Data Link | Link |
| Physical | |

# TCP/IP Model: Video

- Walking through OSI and TCP/IP

# MAC Address

- MAC address
  - Physical address
  - Unique identifier assigned to network card
  - 48 bit address
  - Example: **90-E6-BA**-85-3A-DB

# MAC Address Activity

- What is the MAC address of the NIC in your computer system?
- Who is the manufacturer of the NIC?

# IP Address: Versions

- IP Addressing
  - Logical address applied to a network card
  - Identifier for each device on a computer network
  - Assigned statically or dynamically (DHCP)
  - Uses Internet Protocol for communication

- There are 2 versions available: IPv4 and IPv6
  - IPv4 (we will be focus on this version in this class)
    - 32 bits represented in 4 octets
    - Example: 172.20.10.8
  - IPv6
    - 128 bits represented in 16 octets
    - Example: 2001:0db8:85a3:0000:0000:8a2e:0370:7334

# IP Address: Subnet Mask

- Distinguishes between the “network” and “host” portion of an IP address
- Represented with left most bits set to “1”
  - Example: 255.255.255.0
- The subnet mask can be expressed as a prefix
  - Example: 255.255.255.0 can be represented as “/24”
- An IP address along with this prefix is also called a Classless Interdomain Routing (CIDR) notation
  - Example: 192.168.0.1/24
- A device on the network must include an IP Address and a Subnet Mask

# IP Address: Subnet Mask Activity

- In groups, determine the subnet mask of the following prefixes:
  a) /8
  b) /12
  c) /13
  d) /16
  e) /20
  f) /28
  g) /30

# IP Address: Classes

- There are 5 classes of IPv4 Addresses

| Class | Address Range | Supports |
|---|---|---|
| Class A | 1.0.0.1 to 126.255.255.254 / 8 | Supports 16 million hosts on each of 127 networks |
| Class B | 128.1.0.1 to 191.255.255.254 / 16 | Supports 65,000 hosts on each of 16,000 networks |
| Class C | 192.0.1.1 to 223.255.254.254 / 24 | Supports 254 hosts on each of 2 million networks |
| Class D | 224.0.0.0 to 239.255.255.255 | Reserved for multicast groups |
| Class E | 240.0.0.0 to 254.255.255.254 | Reserved for future use, or research and development purposes |

# IP Address: Reserved

- These are reserved IPv4 IP Addresses

| Address Block | Address Range | Scope / Description |
|---|---|---|
| 0.0.0.0 / 8 | 0.0.0.0 to 0.255.255.255 | Software – reserved for self-identification |
| 127.0.0.0 / 8 | 127.0.0.0 to 127.255.255.255 | Used for loopback addresses to the local host |
| 169.254.0.0 / 16 | 169.254.0.0 to 169.254.255.255 | Microsoft APIPA - Used for link-local addresses |

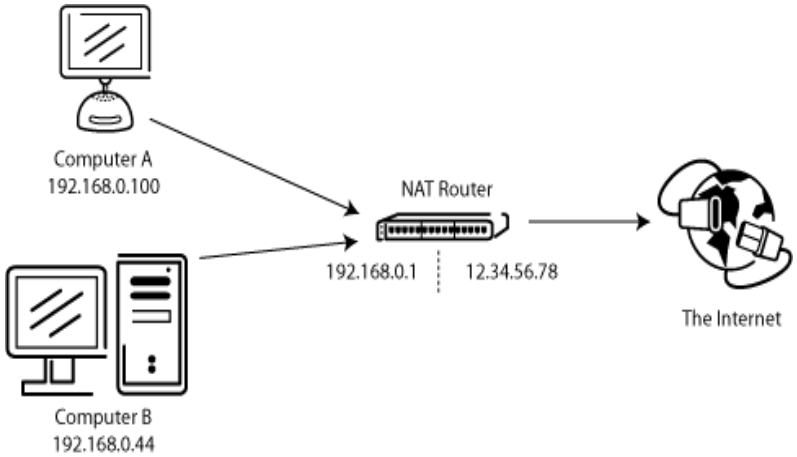
# IP Address: Reserved Activity

- In groups, perform the following:
  1. Remove the cable from a computer
  2. Open a command prompt
  3. Execute the command “ipconfig /release”
  4. Execute the command “ipconfig /renew”
  5. Record the IP address and share with the class

# IP Address: Network Address Translation

- There are 4,294,967,296 (4 billion) IP Addresses and 7 billion people
- There are not enough IP Addresses for all devices
- The solution is to use “Network Address Translation” (NAT)

**Network address translation** (**NAT**) is a method of remapping one IP address space into another by modifying network address information in the IP header of packets while they are in transit across a traffic routing device.



# IP Address: Private Address Ranges

- Address ranges to be used by private networks

| Class | Address Range |
|---|---|
| Class A | 10.0.0.0 to 10.255.255.255 / 8 |
| Class B | 172.16.0.0 to 172.31.255.255/ 16 |
| Class C | 192.168.0.0 to 192.168.255.255 / 24 |

# IP Address: Network Address

- An identifier to indicate the Network ID
- This is represented where all host bits are “0”
- The Network Address is not assigned to any devices
- Example: 10.1.1.0/24

# IP Address: Broadcast Address

- An identifier to indicate the Broadcast Address
- This is represented where all host bits are “1”
- The Broadcast Address is not assigned to any devices
- Example: 10.1.1.255/24

# IP Address: Activity

- Which of the following are Network Addresses and explain why.
  - 10.170.0.0 /16
  - 192.168.10.0 /16
  - 201.255.255.255 /8
  - 55.0.0.2 /24

# Additional Resources

- Walking through OSI and TCP/IP
- Video on IP Addresses
- Wiki on IP Addresses