Networking
Recap

OSI Model

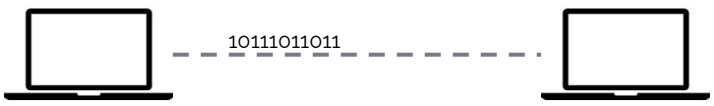
OSI Model

- Nodes must follow rules to communicate
    - Example: any language - English, Spanish, etc
- Rules for networking are divided into 7 layers (OSI Model)

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

Layer 1 - Physical - Transporting Bits

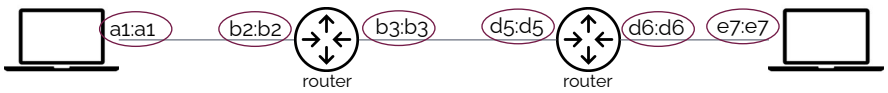
7	Application
6	Presentation
5	Session
4	Transport
3	Network
2	Data Link
1	Physical



- **Purpose: Transporting Bits**
    - Transmits bits (1's, 0's) between nodes
- **Technologies**
    - Cables, WiFi, Repeaters, Hubs

Layer 2 - Data Link - Hop to Hop

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



- **Purpose: Hop-to-Hop**
  - Addressing scheme: **MAC Address** (e.g. 74:56:D9:84:AB:6F)
  - Often traffic is sent over multiple "hops"
- **Technologies**
  - Network Interface Card (NIC)
  - Switch

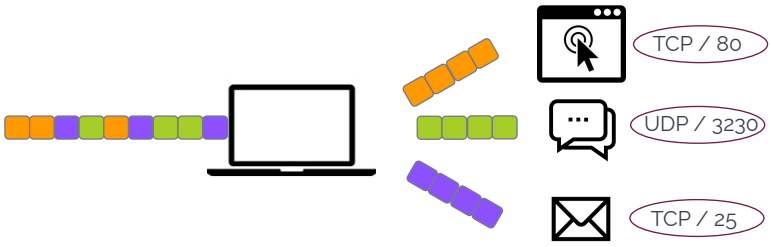
Layer 3 - Network - End-to-End

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

- **Purpose: End-to-End**
  - Addressing scheme: **IP Address**
    - 32-bits / 4 Octets each 0-255 (e.g. 192.168.1.20)
- **Technologies**
  - Routers, Hosts
  - Anything with an IP

Layer 4 - Transport - Service-to-Service

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



- **Purpose: Service-to-Service**
  - Deliver to the right service (aka software)
    - Distinguish data streams
  - Addressing scheme: **Port / Protocol**
  - Ports - 0 to 65535
  - Protocols - TCP, UDP

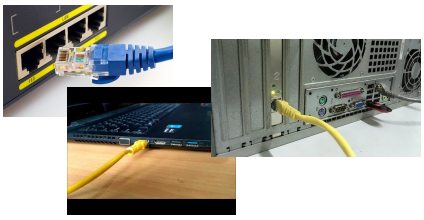
Encapsulation

7	Application	Data		
6	Presentation			
5	Session			
4	Transport	TCP	Data	Segment
3	Network	IP	TCP Data	Packet
2	Data Link	MAC	IP TCP Data	Frame
1	Physical	101110110111011101101110110111011101110111		Bits

Ethernet Protocol
(IEEE 802.3)

What Ethernet Defines

- **Physical Layer**
  - Cabling
  - Connectors
  - … and more …
- **Data Link Layer**
  - Device addressing (via MAC Addresses)
  - Media access control
  - Data frames
  - … and more …



CSMA/CD

- **C**arrier **S**ense **M**ultiple **A**ccess/**C**ollision **D**etection is the protocol that is used to transmit frames

- **Multiple** devices can **simultaneously access** the same media, only **one** can **transmit**
  - Protocol must **sense** existing transmissions
  - Protocol must **detect collisions** and retransmit

Network Devices

Common Network Devices

- **Repeater**
  - Strengthens signals
  - Physical Layer
- **Hub**
  - Small LANs
  - No routing: cross-connects all devices
  - Not secure
  - Physical Layer
- **Bridge**
  - Creates exactly 2 segments
  - Limits collisions between segments
  - Data Link Layer
- **Switch**
  - Connects devices on same network
  - Routes traffic based on MAC address
  - Data Link Layer
- **Router**
  - Connects multiple networks
  - Uses IP for routing
  - Network Layer
- **Firewall**
  - Prevents unauthorized access
  - Port / protocol / IP based
  - Transport and Network Layer
- **Intrusion Detection/Prevention (IDS/IPS)**
  - Monitor and/or stop malicious activity
  - Performs "deep packet inspection"
  - Typically part of "next generation firewall"
  - Transport, Network, Application Layer