# The OSI (Open Systems Interconnection Model)

## All People Seem To Need Data Processing

### Application Layer
- The layer the end user sees
- Protocols used
  - HTTP
  - FTP
  - DNS
  - POP3
- Real World Application
  - The images and content on your browser

### Presentation Layer
- Converts the data into an understandable form
- It deals with character encoding, encryption, etc..
- Usually combined with layer 7 because the functionality is so closely associated with the usability of the application
- Real World Application
  - Application Encryption (SSL/TLS)

### Session Layer
- Communication management (used to start, stop, and restart communication between a device and another)
- Protocols used
  - Control protocols and tunneling protocols

### Transport Layer
- The post office layers
- Protocols used
  - TCP (Transmission Control Protocol)
  - UDP (User Datagram Protocol)
- It delivers data
- Real World Application
  - TCP segments
  - UDP datagram

### Network Layer
- It's called the routing layer because it's associated with IP addresses and the routers make forwarding decisions based on the IP addresses
- Fragments frames to traverse different networks
- Communication is done between different types of networks
- Real World Application
  - IP address
  - Router
  - Packet

### Data Link
- It's the foundation of communication
- Data Link Control (DLC) Protocols
  - Media Access Control (MAC) addresses
- It's called the switching layer because the switches make forwarding decisions based on the MAC addresses
- Real World Application
  - Frame
  - MAC address
  - Extended Unique Identifier (EUI-48/64)
  - Switch

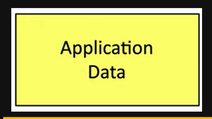
### Physical Layer
- The physicals of the network
  - Cables
  - Devices
  - Connectors
- It's about the signaling
- It's not about protocols
- Real World Application
  - Cables
  - Fiber
  - Signal

## Data Communication

- Data communication is based on PDU ( Protocol Data Unit) also know as Transmission units
- These PDUs have different groups of data at different OSI layers

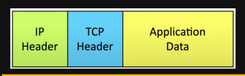
### At Different Layers

Layer 5,6,7

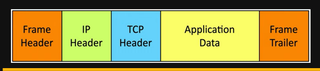


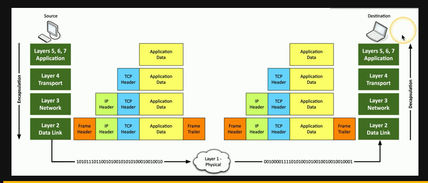

Layer 4

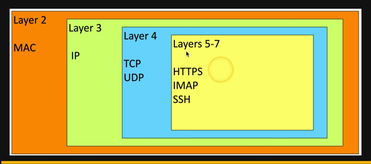

Layer 3




Layer 2




### There are also flags in the IP Header

In the layer 4 the header contains important information on how to process the data including a set of bits called TCP flags

- SYN - Synchronize Sequence Numbers
- PSH - Push the Data to the Application Without Buffering
- RST - Reset the Connection
- FIN - Last Packet From the Sender

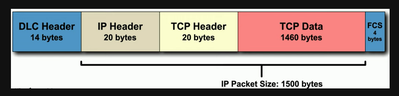
It deals with the fragmentation of the data determining the maximum the size of the data that can be sent

The disadvantages of fragmentation are

- Slows things down
- Requires overhead along the path

It's difficult to know the MTU (Maximum Transmission Unit) all the way through because there might be more than 1 hop with different MTUs that's why automated methods are often inaccurate especially if ICMP is filtered

### IP Fragmentation




The maximum size is 1500 bytes

Fragments are always in multiples of 8 because of the number of fragmentation offset bits in the IP header

### Troubleshooting MTU

MTU sizes are usually configured once (it's difficult to change the MTU once it's configured)

A significant concern for tunneled traffic ( the tunnel might be smaller than the ethernet segment)

There is a flag called don't fragment (DF) in the ip header, if this flag is set and the data sent is larger than the MTU then you will get an ICMP message that the data is too large to be sent through this network " Packets needs to be fragmented but DF is set."

Ping with don't fragment (DF) and force a maximum size of 1472 (1500 bytes - 8 bytes ICMP header - 20 bytes IP address)

- In windows: ping -f -l 1472 IP address
- Linux and macOS: ping -D -s 1472 IP address