IP → Internet Protocol

OSI → Open System Interconnection

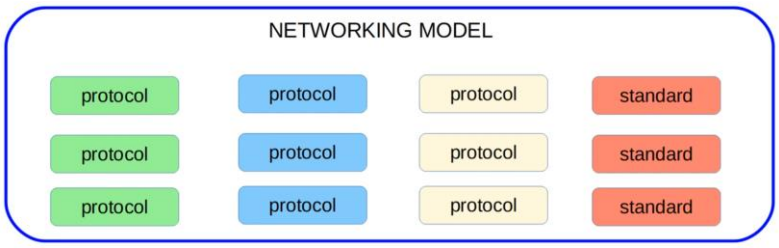
←----------→

Networking Models categorize and provide a structure for networking protocols and standards.

A Network Protocol:

Is a set of rules defining how network devices and software should work, including how they should work together.

**Protocols refer to -logical- rules about how devices should communicate, not physical standards




** The different colors represent different categories of protocols and standards

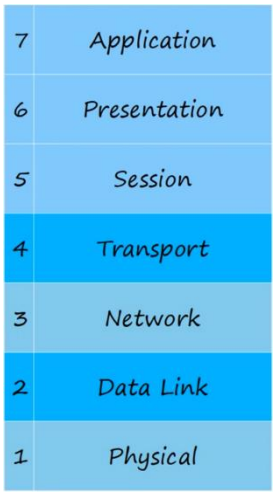
These protocols and standards could define something like the structure and usage of IP addresses or maybe physical details like electrical voltage used on copper cables when transmitting data.

The OSI model is one attempt at standardizing network communications

** Although it isn't actually in use today, It has had a big impact on how Network Engineers think about networking, and we still refer to it today.

OSI is a conceptual model that categorizes and standardizes the different functions in a network

Functions in the OSI Model are divided into '7 Layers' :




**Layer 7 (Application):**

** The Layer is closest to the end user

** The Application Layer interacts with software applications like web browsers, Brave, Chrome etc

** HTTP and HTTPs are Layer7 protocols

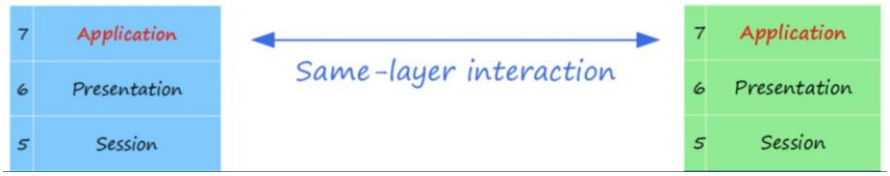
** Doesn't include the application itself, but rather the protocols that interact with the application like HTTPS.

** Functions of Layer 7 is:

1. Identifying communication partners
2. Synchronizing communication

** Both the Encapsulation and De-encapsulation processes are examples of 'Adjacent-Layer Interaction', interaction between the different layers of the OSI model.

** The communication between the Application layers of two different systems is called 'Same-Layer Interaction'




** This Same-Layer Interaction between application layers is: what allows the application layer to perform its functions of Identifying communication partners and Synchronizing communications etc.

### Layer 6 (Presentation):

** Data in the application is in the 'Application format', a format that application understands.

** It needs to be translated to a different format to be sent over the network.

** The **Presentation Layer**'s Job, is to translate between application and network formats.

It also translate between different application-layer formats, to ensure that the data is in a format the receiving host host can understand.

** For example, Encryption of data as it is sent, and Decryption of data as it is received

So that only the intended recipient can read it.

** To summarize, the Presentation Layer translates data to the appropriate format.

### Layer 5 (Session):

** The **Session Layer** controls dialogues (aka sessions) between communicating hosts

** It establishes, manages and terminates connections between the local application (for example, your web browser) and the remote application (for example, YouTube)

**** YouTube's servers are being used by countless people at every moment, and there has to be a way to manage all of these sessions, that is the purpose of the session layer of the OSI model

** Network Engineers don't really work these 3 layers (Application, Presentation and Session) of the OSI model

That is the Job of Application Developers

** Application Developers work with the top 3 layers of the OSI model to connect their applications over networks

** Data prepared at the top 3 layers is then sent over the bottom 4 Layers, which actually do the work of sending it over the network.

### Layer 4 (Transport):

After the top 3 layers hand data over to the bottom 4 layers, the next step before sending data is that Layer 4, the Transport Layer, adds a header in front of the data, like this:


** Layer 4 segments and reassembles data for communications between end hosts.

** To reword that, It breaks large pieces of data into smaller segments which can be easily sent over the network and are less likely to cause transmission problems if errors occur

** It provides host-to-host (a.k.a end-to-end) communication

** This also provides process-to-process communications for applications


** This unit of data + Layer 4 header is called a **Segment**.

** If the data being sent is large enough, it will automatically be segmented into smaller parts and a Layer 4 header will be added to each segment.

### Layer 3 (Network):

** Another header will be added to the segment after it reaches Layer 3, This header includes information like the source and the destination of IP address to the segment.


** Provides Connectivity between end hosts on different networks (i.e. outside of the LAN).

** It provides logical addressing, in the form of IP addresses

** Provide Path selection between source and destination.

** There are many possible paths which data can take to reach its destination, especially over a huge network like Internet

** Provides the means of selecting the best path.


** Routers operate at Layer 3.

** Routers are used when end hosts need to reach a destination outside of their LAN.

** Routers are Layer 3 Devices.

** This combination of (Data, Layer 4 header, Layer 3 header) is called a **Packet**.

### Layer 2 (Data Link):


*packet*

** The packet is further encapsulated at Layer 2.

** Now this time there are Layer 2 header added and a Layer 2 trailer.


** Layer 2 Provides node-to-node connectivity and data transfer

(for example, direct connections between PC and Switch, Switch and Router, Router and Router).

** Because Layer 2 is adjacent to Layer 1, the Physical Layer, It also defines how data is formatted for transmission over a physical medium, like (copper UTP cables).

** Detects and (possibly) corrects Physical Layer errors.

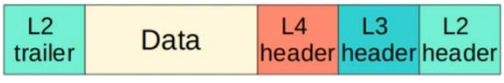
** Like Layer3, Layer 2 also uses an addressing system, however it is separate from Layer 3 addressing.

** Switches operate at Layer 2.

** Switches look at the destination Layer 2 address to determine where to send the data.

** The combination of (Data, L4 header, L3 header, L2 header and L2 trailer) is called a **Frame** .

*frame*




** Now the data is not further encapsulated at **Layer 1**. This frame is then sent over the connection, whether it's electrical signals over a wire, or wireless signals in the case of Wi-fi, to the neighboring system.

**Layer 1 (Physical):**

** Defines physical characteristics of the medium used to transfer data between devices.

For example, Voltage Levels, Maximum Transmission Distances, Physical Connectors, Cable Specifications etc.

**Digital bits are converted into electrical (for wired connections) or radio (for wireless connections) signals.

** All of the information in Day 2's video (like cables, pin layout etc.) is related to the Physical Layer.

** Once the frame reaches the neighboring system (the remote device), the reverse process of Encapsulation,

De-encapsulation takes place.

** The Data Link Layer translates the raw physical data into a complete frame once again.

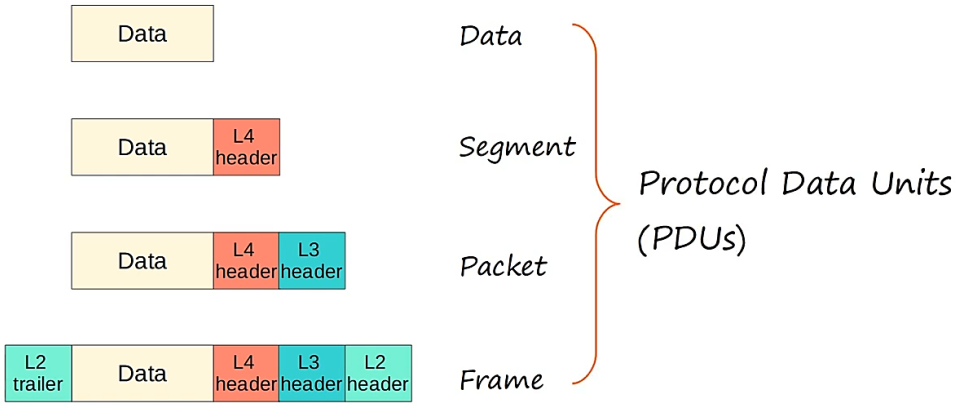
** Then the Layer 2 header and trailer are removed, leaving the Layer 3 Packet.

** The Layer 3 Packet is removed, leaving the Layer 4 segment.

** Finally, The Layer 4 header is removed, and we are left with the original data prepared by the Upper Layers of the original device. (That's the process of De-encapsulation).

** ** There is one new term that is used to refer to all of these.

**Protocol Data Units** (PDUs).




** For example, Segment is the term for Layer 4 PDU, Packet is the term for Layer 3 PDU etc.

** At Layer 1, The Physical Layer, the name for the **PDU** is **bit**, referring to the bits being transferred on the wire.

** Here are some Acronyms to help you remember the OSI model stack: