Lecture 7

What we discussed in the last class

- **Request and Response**

Networking is complex :

The first thing to understand is that networking is a quite complex task

- Converting analog to digital (Many analog types exist, copper wire, fiber optic, etc)
- Routing the digital packet to the right computer
- Having multiple packets transmit at once
- Utilizing the complete bandwidth of the line
- Maintaining the connection quality
- Managing for lost packets
- Converting the IP to human readable domain system
- Encrypting the connection for security

And these are just what I can recall from the back of my head, not even the complete list of what is required.

But, good for us, over 50 years network programmers experts have created a layered approach to networking and all we need to care about is the final layer the **application layer.**

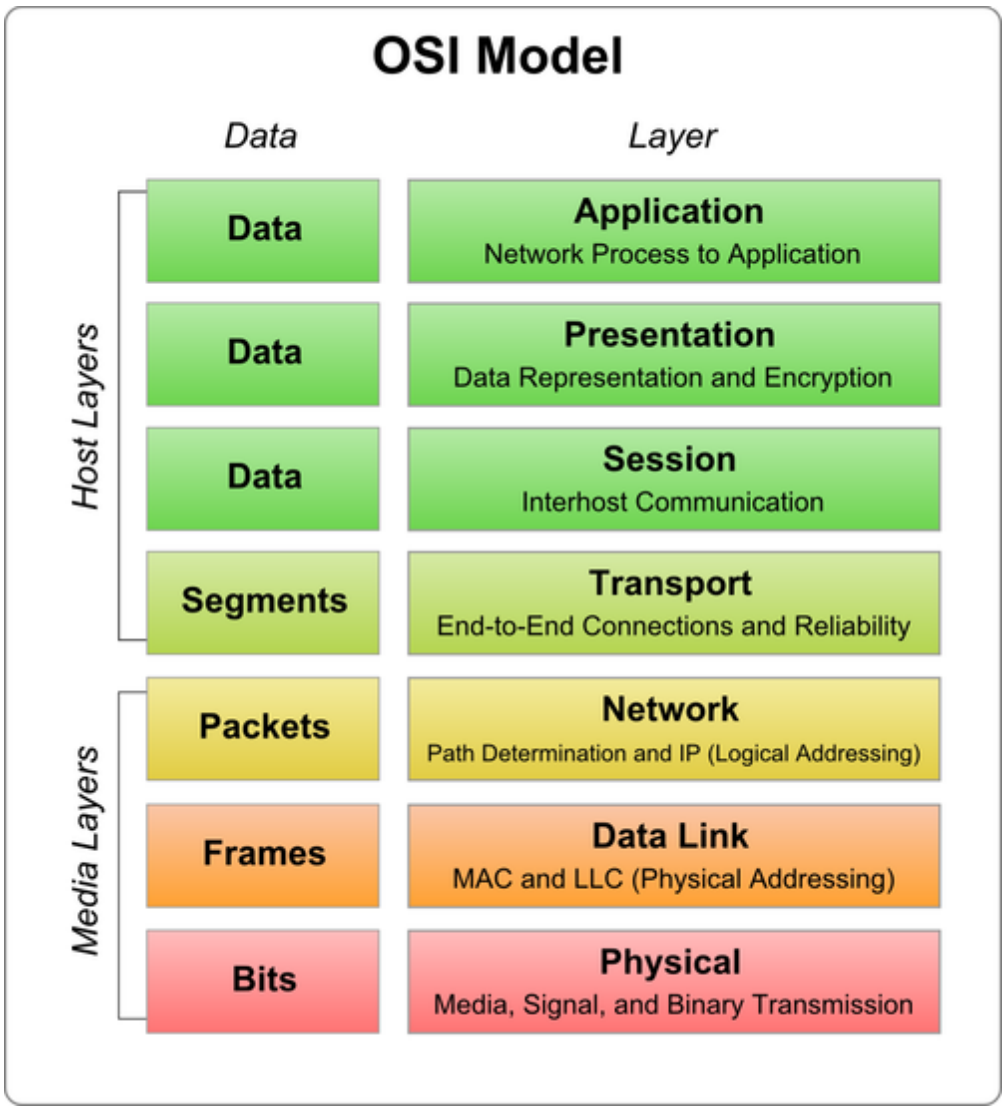
First some terminologies :

Protocol : For any kind of communication, there needs to certain rules in place. For e.g. In Humans two people communicating don't talk at the same time rather in turns, this is a rule for understanding communication.

Protocols are set of rules followed by computers to transmit data.

IP : Internet Protocol
TCP : Transmission Control Protocol
UDP : User Datagram Protocol
HTTP : Hypertext transmission protocol
HTTPS : Hypertext transmission protocol secure

A very basic understanding of how the internet works : This is presented using the OSI Model.



Read the below carefully, I will also discuss in the next class beginning.

First the ethernet wire you plug in is essentially **copper wire**, carrying electrical signals. These signals are converted into digital signal or bits at the Physical Layer.

Next these digital bits received at the physical layer are converted into frames.

Frames *are the streams of bits received from the network layer into manageable data units. This division of stream of bits is done by Data Link Layer.*

The Data link layer has four jobs to carry out: [Taken from

http://www.studytonight.com/computer-networks/osi-model-datalink-layer]

1. **Physical Addressing:** The Data Link layer adds a header to the frame in order to define physical address of the sender or receiver of the frame, if the frames are to be distributed to different systems on the network.

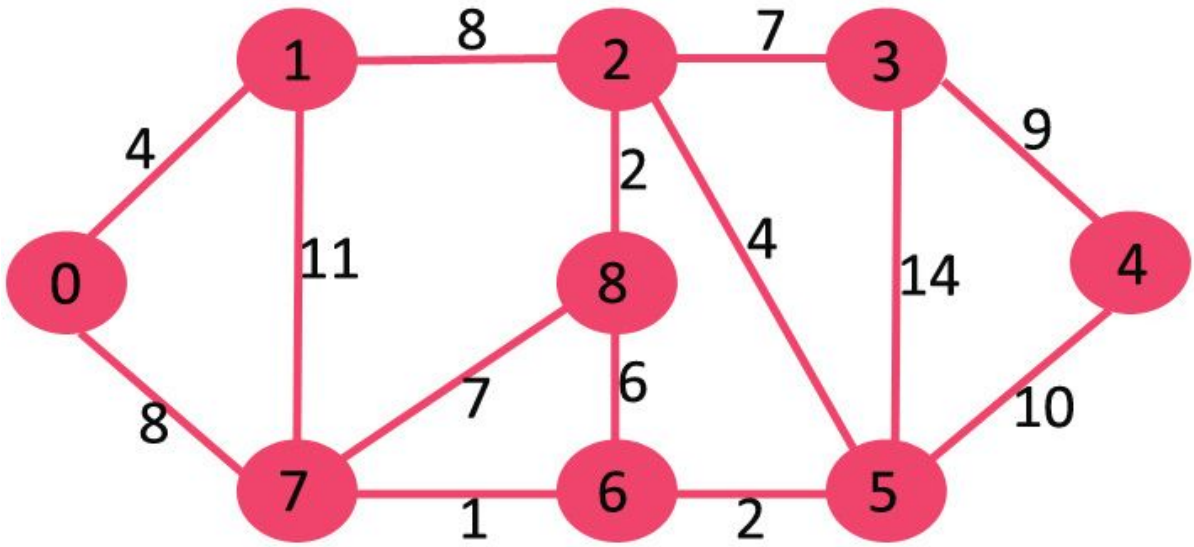
*This is the **MAC address**. For example a person in Ashok is trying to download files on DC from Meera Bhawan, then the connection needs to pass through various interconnecting routers but if the person is downloading files from someone in Ashok Bhawan only then there is no need to jump through various interconnecting routers of the campus. This identification whether to jump through network hoops or not is decided by the MAC address at the rudimentary level.*

2. **Flow Control:** A flow control mechanism to avoid a fast transmitter from running a slow receiver by buffering the extra bit is provided by flow control. This prevents traffic jam at the receiver side.
3. **Error Control:** Error control is achieved by adding a trailer at the end of the frame. Duplication of frames are also prevented by using this mechanism. Data Link Layers adds mechanism to prevent duplication of frames.
4. **Access Control:** Protocols of this layer determine which of the devices has control over the link at any given time, when two or more devices are connected to the same link.

Note : Each layer attaches a header to the received payload. So when frames are created a header is attached with it which contains information like MAC, etc.

Network Layer:
Network layer is the layer where what we call packets are created. This is the layer where the internet protocol works. Every device is assigned an **IP address** at this layer. An additional header is attached which contains IP related information.

It is at the network layer where path optimisation algorithms also work. I guess you would have heard about the **Dijkstra's algorithm** which finds the shortest path, algorithms like this optimise the routes that the packets take.



For Example : Imagine all these numbered circles were bhavans. Let 0 be Budh Bhavan and 3 be Ram Bhavan. Assume the number on the line to represent the time taken to transfer a movie. Which path would be best suited for the movie transfer to take place?

This is what network layer tries to compute, the best possible path based on multiple factors like packet traffic, router load, line distance, etc.

I would not be going into greater detail of the transport layer, session layer and the presentation layer as it is not required at present.

Transport Layer :

The main aim of transport layer is to be delivered the entire message from source to destination. Transport layer ensures whole message arrives intact and in order. TCP and UDP protocols work at this layer.

Session Layer :

Its main aim is to establish, maintain and synchronize the interaction between networking devices.

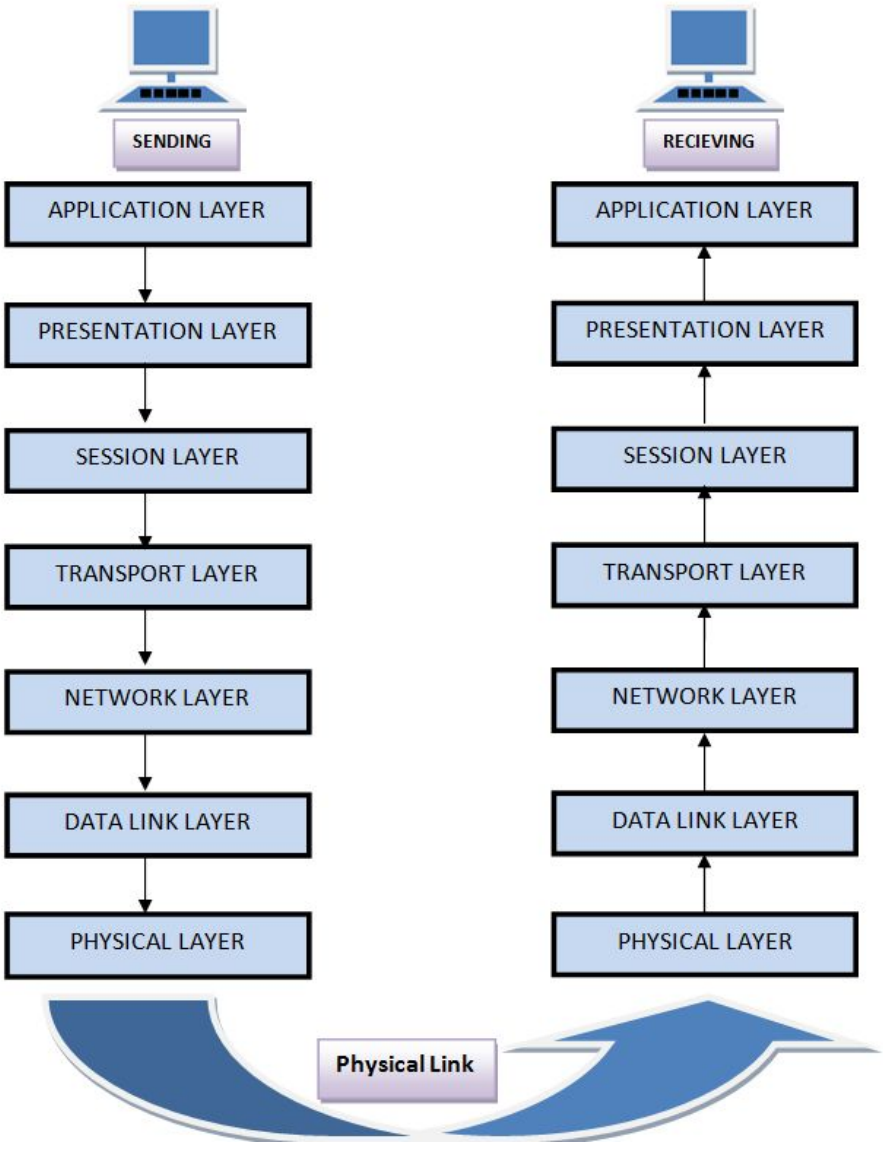
Presentation Layer :

Presentation layer ensures the syntax / semantics of the data being transferred between the networking devices is correct.

Finally we come down to the **Application Layer**.

Application Layer :
This is the layer where all our modern applications that we are familiar with exist. The web browser works at the application layer, the protocol that it follows at application layer is HTTP and the Payload is HTML.

Node works at the application layer. The requests and response that we see in node are working at the application layer and all the other networking details are handled below the application layer.



Picture taken from [http://www.studytonight.com/computer-networks/complete-osi-model]