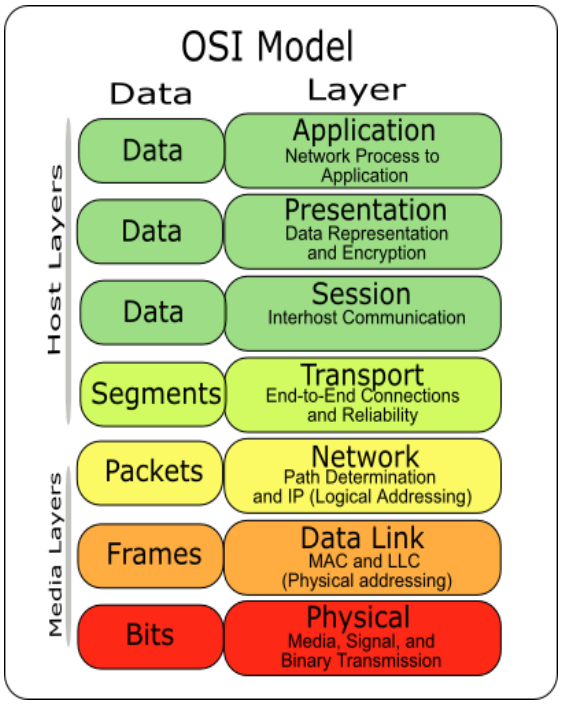
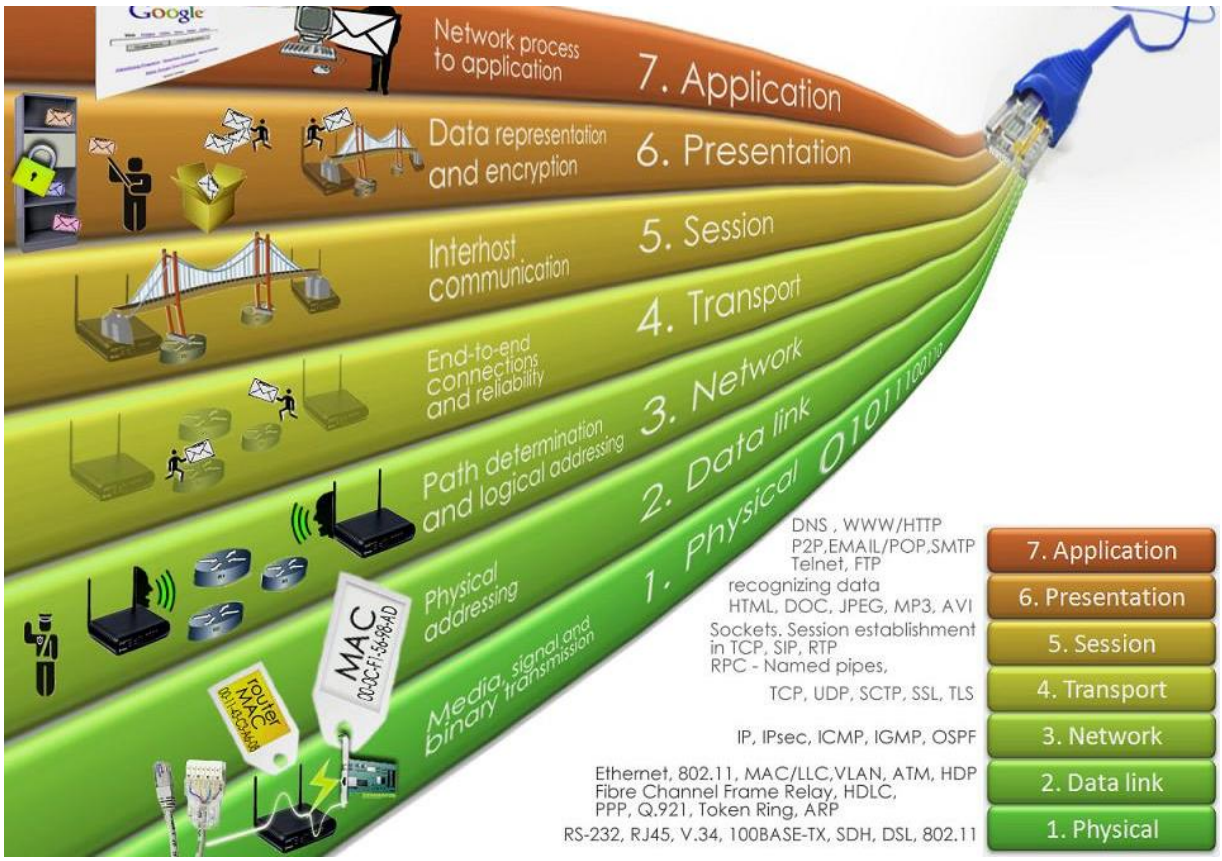
OSI Model





Teran Subasinghe

MBCS, Bsc.(Hons) in Computer Science - University of Greenwich, UK

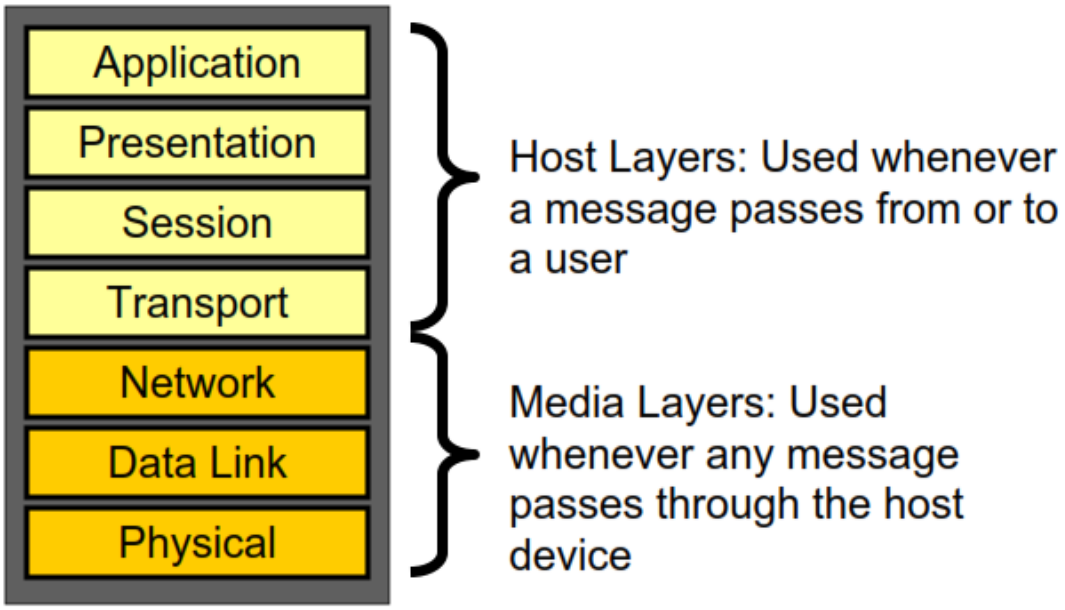
What is OSI Model?

- Open Systems Interconnection Reference Model
- Developed in 1984 by the International Standards Organization (ISO)
- It is a way of sub-dividing a communications system into smaller parts called layers.
- A layer is a collection of conceptually similar functions that provide services to the layer above it and receives services from the layer below it.
- Provides a set of design standards for equipment manufacturers so they can communicate with each other
- Basic guideline for protocol development

The following illustrate the seven layers of OSI Model:

Layers can be categorized as follows:

- Each layer provides a set of functions to the layer above and relies on function of the layer below.
- Each layer communicates with its peer layer on another node back and



Tasks of each layer

1: Physical Layer

- Conveys the bit stream through the network at the electrical and mechanical level
- Defines physical means of moving data over network devices
- Interfaces between network medium and devices
- Defines optical, electric and mechanical characteristics: voltage levels, timing of voltage changes, physical data rates, transmission distances and physical connections

2: Data Link Layer

- Takes a string of bits and delivers it across a link
- Conveys the bit stream through the network at the electrical and mechanical level (i.e., Layer 1)
- Turns packets into raw bits and bits into packets
- Framing & Error Detection – Break the bit stream up into frames – Compute an error-detection code – Transmit each frame separately

3: Network Layer

- Translates logical network address and names to their physical address (e.g., Device name to MAC address)
- Responsible for – Addressing – Determining routes for sending – Managing network problems such as packet switching, data congestion and routing
- Breaks the data into smaller unit and assembles data
- Shields higher layers from details of how the data gets to its destination

4: Transport Layer

- Divides streams of data into chucks or packets
- Reassembles the message from packets
- Provide error-checking to guarantee error- free data delivery, with no losses or duplications
- Provides acknowledgment of successful transmissions
- Requests retransmission if some packets don't arrive error-free
- Provides flow control and error-handling

5: Session Layer

- Establishes, maintains and ends sessions across the network
- Responsible for name recognition (identification) so only the designated parties can participate in the session
- Provides synchronization services by planning check points in the data stream
- If session fails, only data after the most recent checkpoint need be transmitted
- Manages who can transmit data at a certain time and for how long

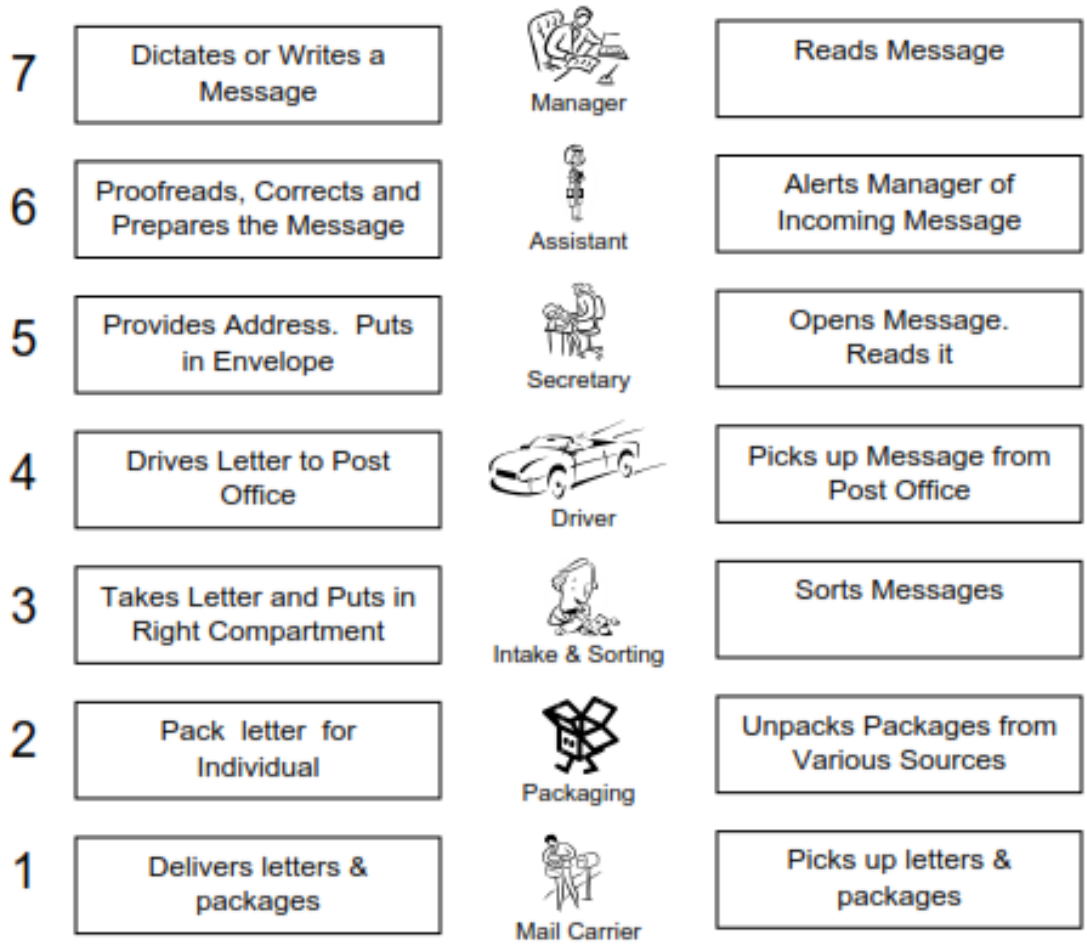
6: Presentation

- Translates from application to network format and vice-versa
- All different formats from all sources are made into a common uniform format that the rest of the OSI can understand
- Responsible for protocol conversion, character conversions, data encryption / decryption, expanding graphics commands and data compression
- Sets standards for different systems to provide seamless communication from multiple protocol stacks

7: Application Layer

- Used for applications specially written to run over the network
- Allows access to network services that support applications
- Directly represents the services that directly support user applications (e.g., file transfer and email)
- What the user sees or does

The following illustrates the above-mentioned topics:



Network Components

Network Layer – Routers, Layer 3 Switches

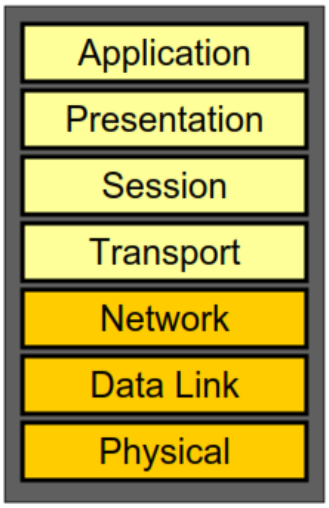
Data Link Layer – Switches, Bridges

Physical Layer – NICs, Cables, Hubs, Repeaters

Ethernet Standards

Standard	Description
802.3	Ethernet CSMA /CD (10 Mbps)
802.3u	Fast Ethernet (100 Mbps)
802.3z	Gigabit Ethernet over fiber-optic cabling or coaxial cabling
802.3ab	Gigabit Ethernet over twisted-pair cabling
802.3ae	10-Gigabit Ethernet

Protocols



NNTP, SIP, SSI, DNS, FTP, Gopher, HTTP, NFS, NTP, SMPP, SMTP, DHCP, SNMP, Telnet, Netconf

MIME, XDR, TLS, SSL

Named Pipes, NetBIOS, SAP, SIP, L2TP, PPTP

TCP, UDP, SCTP, DCCP

IP (IPv4, IPv6), ICMP, IPsec, IGMP, IPX, AppleTalk

ATM, SDLC, HDLC, ARP, CSLIP, SLIP, PLIP, IEEE 802.3, Frame Relay, ITU-T G.hn DLL, PPP, X.25

EIA/TIA-232, EIA/TIA-449, ITU-T V-Series, I.430, I.431, POTS, PDH, SONET/SDH, PON, OTN, DSL, IEEE 802.3, IEEE 802.11, IEEE 802.15, IEEE 802.16, IEEE 1394, ITU-T G.hn PHY, USB, Bluetooth

Basic Protocols

Ethernet-IEEE 802.3(CSMA/CD) - Ethernet protocols refer to the family of local-area network (LAN) technology covered by the IEEE 802.3. It is working example of the more general carrier sense multiple access with collision detect (CSMA/CD).

Token ring – IEEE 802.5 - Token ring local area network (LAN) technology is a communications protocol for local area networks. It uses a special three-byte frame called a "token" that travels around a logical "ring" of workstations or servers.

IP - Internet Protocol (IP). Except for ARP and RARP all protocols' data packets will be packaged into an IP data packet. Provides the mechanism to use software to address and manage data packets being sent to computers.

TCP - A reliable connection oriented protocol used to control the management of application level services between computers.

UDP - An unreliable connection less protocol used to control the management of application level services between computers.

ICMP - Internet control message protocol (ICMP) provides management and error reporting to help manage the process of sending data between computers.

FTP - File Transfer Protocol (FTP). Allows file transfer between two computers with login required.

SMTP - Simple Mail Transfer Protocol (SMTP) is an Internet standard for electronic mail (email) transmission (Both Sending and Receiving).

POP - POP is short for Post Office Protocol, a protocol used to retrieve e-mail from a mail server. Most e-mail applications (sometimes called an e-mail client) use the POP protocol, although some can use the newer IMAP (Internet Message Access Protocol).

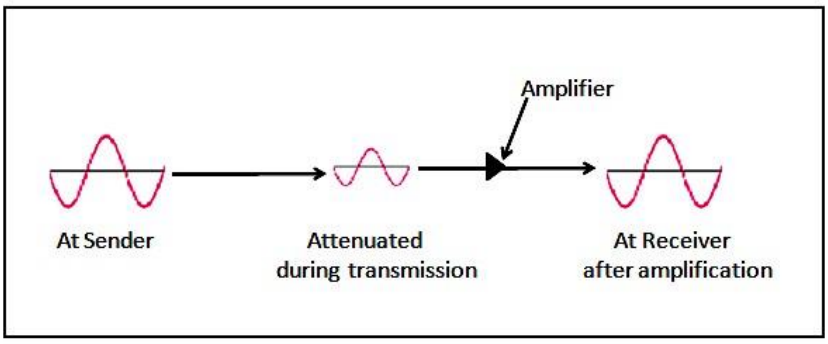
Telnet - A method of opening a user session on a remote host. Telnet is a terminal emulation program for TCP/IP networks such as the Internet. The Telnet program runs on your computer and connects your PC to a server on the network.

Transmission Impairments and Types

Data is transmitted through transmission medium which are not perfect. The imperfection causes signal impairment. Due to the imperfection error is introduced in the transmitted data i.e. the original signal at the beginning of the transmission is not the same as the signal at the Receiver. There are three causes of impairment: attenuation, distortion, and noise as shown below

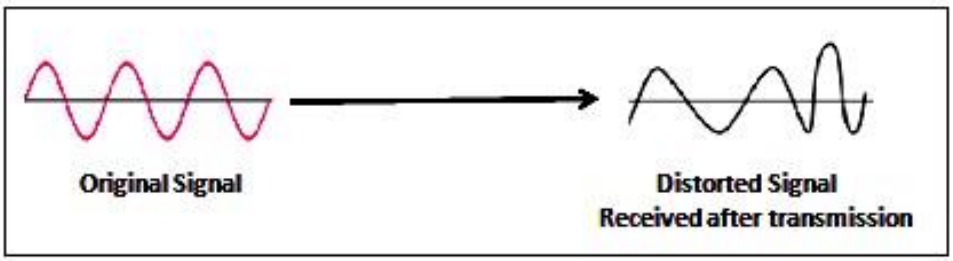
Attenuation

Attenuation results in loss of energy. When a signal travels through a medium, it loses some of its energy in overcoming the resistance of the medium. The electrical energy in the signal may converted to heat. To compensate for this loss, amplifiers are used to amplify the signal. Figure below shows the effect of attenuation and amplification.



Distortion

Distortion changes the shape of the signal as shown below



Noise

Noise is any unwanted signal that is mixed or combined with the original signal during transmission. Due to noise the original signal is altered and signal received is not same as the one sent.