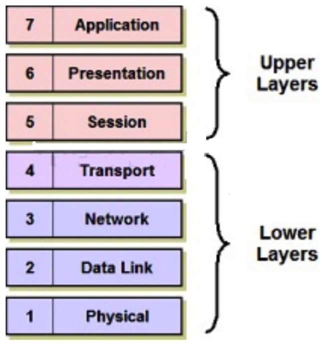
Chapitre 2

OSI Model (1 course)

At the end of the 1970s, we saw the development of several independent network solutions (IBM's SNA, DEG's DECNET, Bull's DSA, etc.) and we needed an international standard for inter-communication.

The ISO (International Standard Organization) supported the establishment of the OSI (Open system interconnections : standard of interconnection of the open systems), this standard is presented in the form of seven layers :



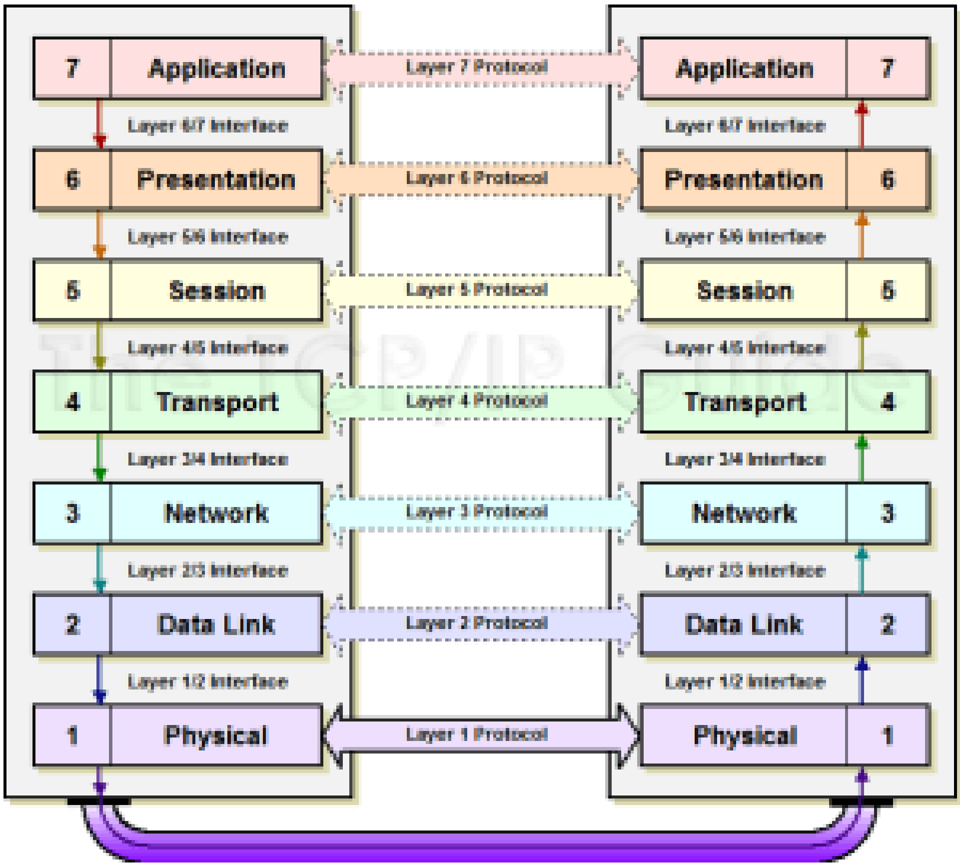
1. **Physical layer :** Studies the signals carrying information (modulation, power, range) as well as the transmission media (cables, optical fibers,...).
2. **Data link layer :** Responsible for establishing, maintaining and releasing connections between network elements. It is also responsible for detecting and correcting errors.
3. **Network layer :** Responsible for addressing machines, and routing data in the network.
4. **Transport Layer :** Ensures transparent transfer of data between users, making it invisible to them how communications resources are implemented.

5. **Session layer :** Provides optimization and fixes for some non-network issues such as resuming a long file transfer after a disk access error.
6. **Presentation layer :** Ensures functions such as data compression, data representation (Example : most significant on the left or on the right).
7. **Application layer :** Provides software with the same principles and standards for network access (Virtual file concept).

2.1 Layered communication

We call **protocol**, a dialogue known by both parties, between two layers of the same level. A layer of level (n) will only be able to communicate with another layer of the same level as it.

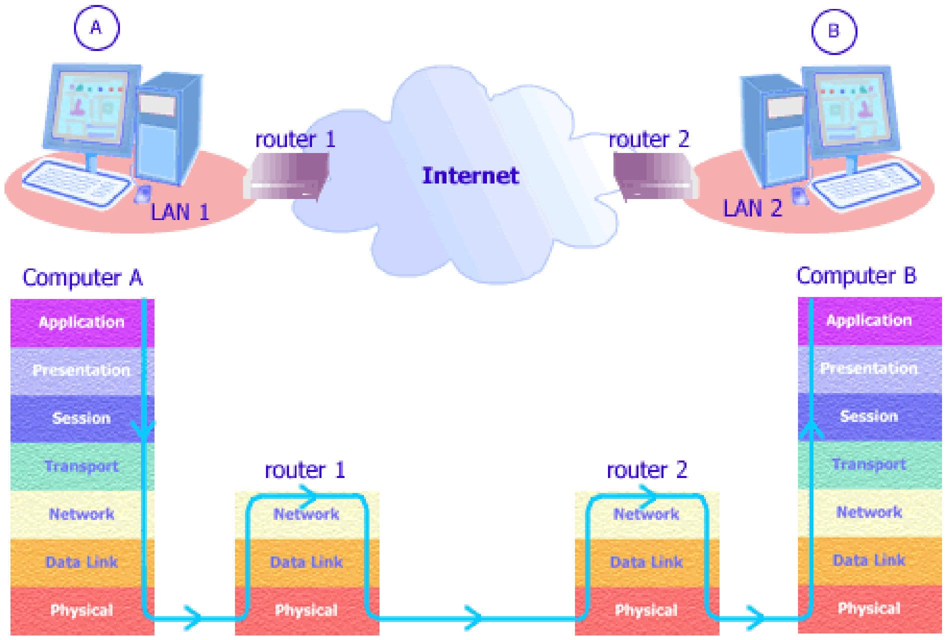
We call **service** the set of functions that a layer absolutely must perform, providing the interface to transmit data from layer (n) to layer (n+1).



To carry out a communication through one or several intermediate systems (relays) it is necessary :

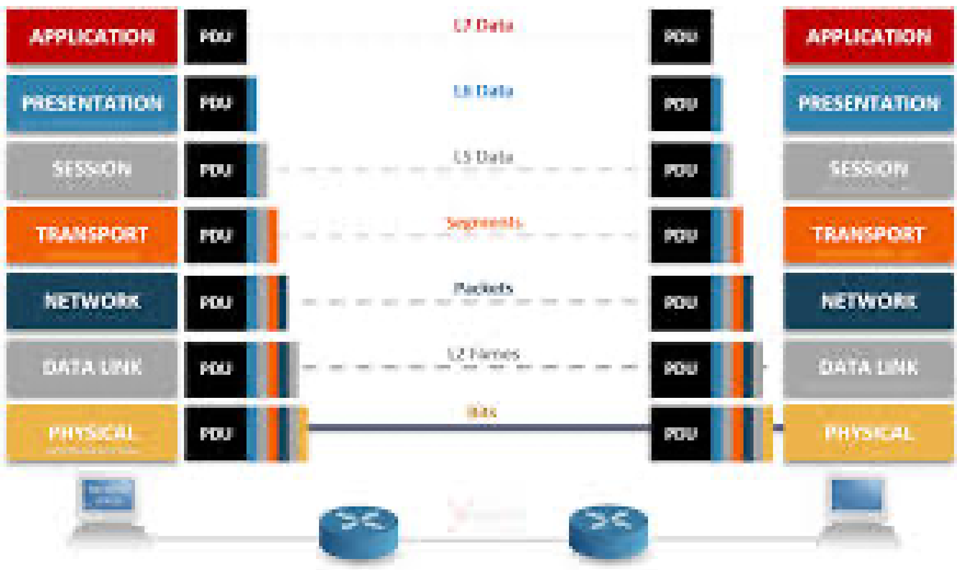
1. connect the systems by a physical link (PHYSICAL layer) ;

2. check that a link can be correctly established on this link (LINK layer) ;
3. ensure that through the relay (network) the data is correctly routed and delivered to the correct recipient (NETWORK layer) ;
4. check, before delivering the data to the application, that the transport has been carried out correctly from end to end (TRANSPORT layer) ;
5. organize the dialogue between all the applications, by managing exchange sessions (SESSION layer) ;
6. translate the data into an application presentation syntax so that it is understandable by both application entities (PRESENTATION layer) ;
7. provide the user application with all the necessary mechanisms to hide transmission constraints from it (APPLICATION layer).



2.2 Encapsulation

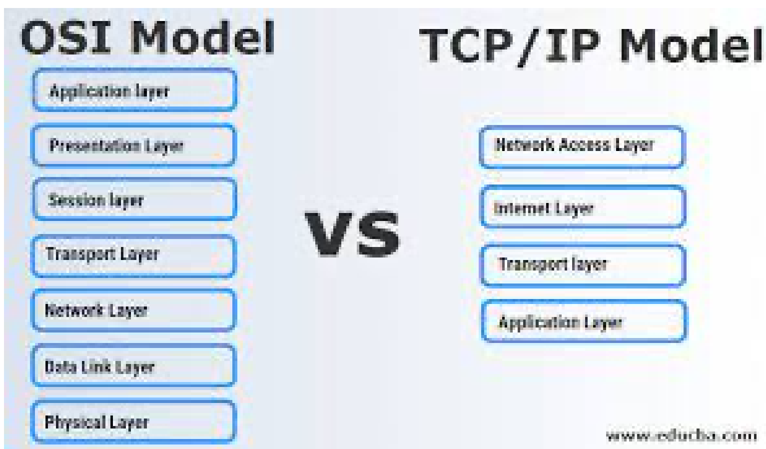
When an application sends data through the OSI model, the data traverses from top to bottom each layer until it ends up at the physical medium where it is then emitted as a string of bits. Each layer adds information called "Header" to the data received from the upper layer before transferring it to the lower layer. This header allows this layer to perform its role. On reception, each layer removes the header, added by the layer at the same level, from the data before transmitting it to the upper layer.



2.3 TCP/IP Model

The Transmission Control Protocol / Internet Protocol (TCP/IP) series originated from the Defense Advanced Research Project Agency (DARPA) project of the US Defense Advanced Research Project Agency in the late 1960s. evolved in the 70s to pass in 1980 to the use in the research teams and the universities of the USA. The number of networks using TCP/IP grew rapidly to form a large community called the Internet. Today, the Internet Activities Board (IAB) is responsible for the development and ratification of TCP/IP protocols.

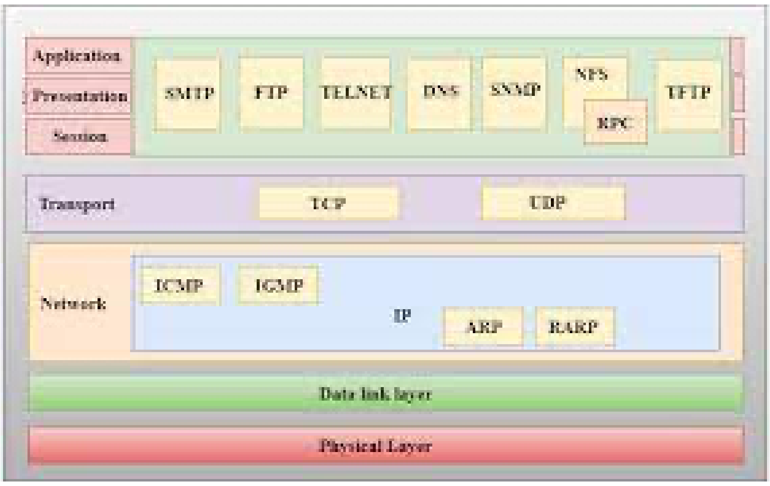
The TCP/IP architecture is similar to the OSI layered model, but has only 4 layers in most cases.



– Application layer : FTP, TELNET, HTTP, SMTP.

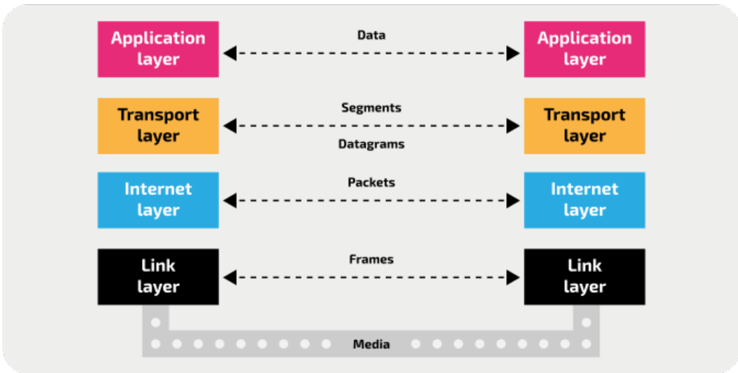
– Transport Layer : TCP (reliable), UDP (unreliable)

– Internet layer : IP, ICMP
– Internet network layer : Interface with the network used : ARP.

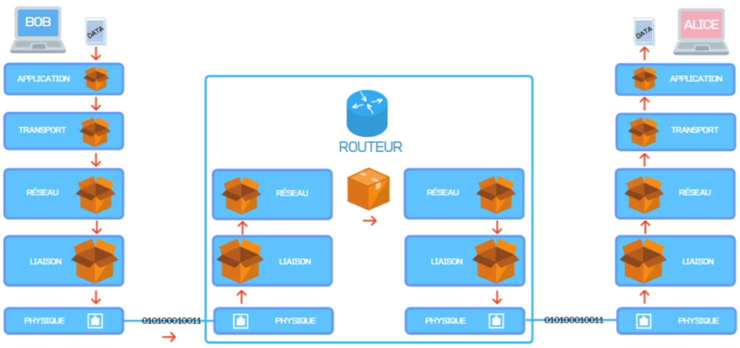


– **The link layer** is the interface with the network and consists of an operating system driver and a computer interface card with the network (network card, modem, ..).
– **The network layer** or IP layer (Internet Protocol) manages the circulation of packets through the network by ensuring their routing. It also includes the ICMP (Internet Control Message Protocol) and IGMP (Internet Group Management Protocol) protocols.
– **The transport layer** first ensures end-to-end communication by disregarding the intermediate machines between the sender and the recipient. It takes care of regulating the flow of data and ensures a reliable transport (data transmitted without error and received in the order of their emission) in the case of TCP (Transmission Control Protocol) or unreliable in the case of UDP (User Datagram Protocol). For UDP, it is not guaranteed that a packet (called datagram in this case) arrives at the right port, it is up to the application layer to make sure.
– **The application layer** is that of user programs such as telnet (connection to a remote computer), FTP (File Transfer Protocol), SMTP (Simple Mail Transfer Protocol), etc...

This architecture and these different protocols make it possible to operate a local network, for example on an Ethernet bus connecting a client computer A which queries an FTP server B :



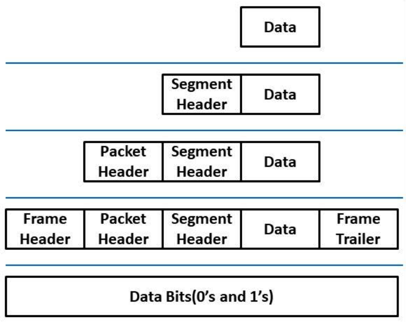
But, above all, this makes it possible to constitute an Internet, that is to say an interconnection of possibly heterogeneous networks :



Computers A and B are end systems and the router is an intermediate system. As can be seen, datagram delivery requires the use of two different frames, one from the Ethernet network between machine A and the router, the other from the Token-Ring network between the router and machine B. In contrast, the principle of layered structuring indicates that the packet received by the transport layer of machine B is identical to that transmitted by the transport layer of machine A.

When an application sends data using TCP/IP the data traverses from top to bottom each layer until arriving at the physical support where it is then emitted in the form of series of bits. Each layer adds information called "Header" to the data received from the upper layer before transferring it to the lower layer. This header allows this layer to perform its role.

On reception, each layer removes the header from the data before transmitting it to the upper layer



OSI Layers	TCP/IP Layers
Application, Presentation, Session	Application
Transport	Transport
Network	Internet
Data-Link	Data-Link
Physical	Physical