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The OSI model

Introduction

Network equipment manufacturers have proposed and developed network architectures specific to their devices. For instance, IBM has developed SNA, DEC has developed DNA... These architectures have all the same defect: as they are manufacturer-specific systems, it is difficult to interconnect them, unless manufacturers agree on a common architecture. Consequently, in order to avoid the development of hundreds of solution for the interconnection of these heterogeneous architectures, the **ISO** (International Standards Organisation), body that depends on the UNO and composed of 140 national normalisation bodies, has developed a reference model called the **OSI model** (Open Systems Interconnection model). This model describes the fundamental concepts and the approach used to normalize the interconnection of **open systems** (a network is made up of open systems when modifying, adding or removing one of these systems does not modify the global working of the network).

When designing this model, taking the heterogeneity of the equipment into account was a fundamental issue. Indeed, this model was designed to allow the interconnection of heterogeneous systems for historical and economic reasons. Besides, it should not support a particular provider. Lastly, it should make it possible to adapt to the evolution of data to process without calling into question the investments. Thus, all this led the adoption of common communication and co-operation rules between the equipment, i.e. this model should logically carry out to an international standardization of protocols.

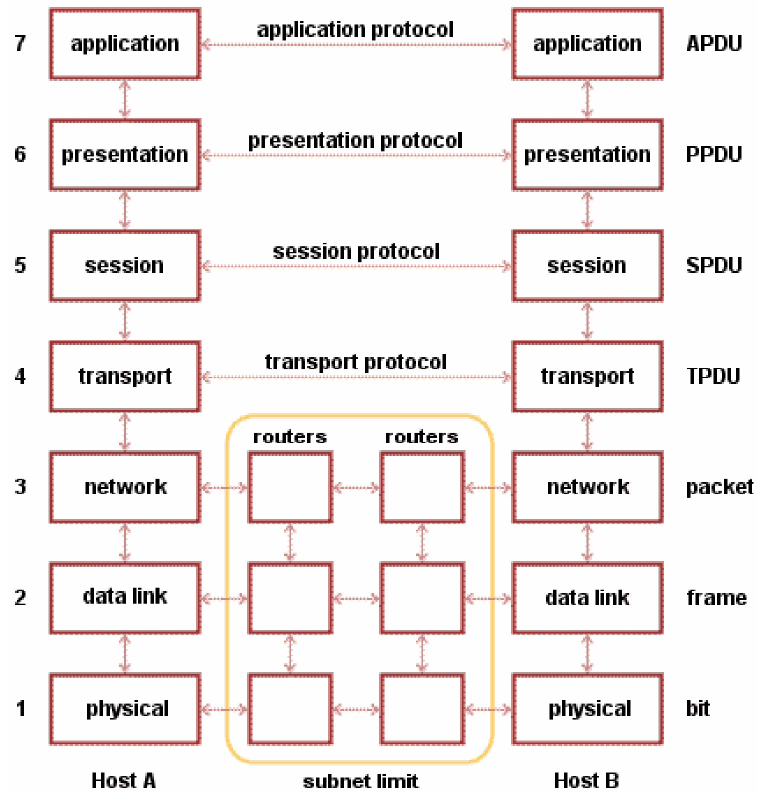
The OSI model is not a real network architecture, because it does not really specify the services and protocols each layer should use. It rather describes what the layers must do. Nevertheless, the ISO has developed its own standards for each layer, and this independently of the OSI model, i.e. as does any manufacturer.

The first works related to the OSI model date from 1977. They were based on the experience gained in the area of wide area networks and local private networks; the OSI model was indeed supposed to be valid for any type of network. In 1978, the ISO proposed this model as the standard ISO IS7498. In 1984, 12 European manufacturers, joined in 1985 by the main American manufacturers, adopted this standard.

The different layers of the OSI model

The 7 layers

The OSI model is composed of **7 layers**:



The principles that led to these 7 layers were the following:

- A layer must be created every time a new level of abstraction is necessary,
- every layer has well defined functions,
- the functions of each layer must be chosen in the objective of the international standardization of protocols,
- boundaries between layers must be chosen so as to minimize the flows of data through interfaces,
- the number of layers must be such as there is no cohabitation of completely different functions within the same layer and such as it is not too difficult to control the architecture.

The low layers (1, 2, 3 and 4) are necessary to the routing of information between the two concerned ends and depend on the physical medium. The higher layers (5, 6 and 7) are responsible for the data processing relative to the management of exchanges between information processing systems. In addition, layers 1 to 3 intervene between close machines, but not between ending machines that can be separated by several routers. On the contrary, layers 4 to 7 intervene only between distant hosts.

The physical layer

This layer is in charge of the raw transmission of bits over a communication channel. This layer must guarantee the perfect transmission of the data (a bit set to 1 must be received as a bit set to 1). Concretely, this layer must standardize the electrical characteristics (for instance, a bit set to 1 is represented by a voltage of 5V), the mechanical characteristics (the shape of the connectors, topology...), the functional characteristics of the circuits of data and the procedures of establishment, maintenance and release of the circuit of data.

The typical information unit for this layer is the **bit**, represented by a given voltage.

The data link layer

Its has a role of "binder": it will transform the physical layer into a connection a priori freefrom transmission errors for the network layer. It splits the input data of the sender into **frames**, sends these frames in sequence and manages the acknowledgement frames sent back by the receiver. To remind, for the physical layer, the data do not have any particular meaning. The data link layer must therefore be able to recognize the limits of frames. This can actually pose problems, since the sequences of bits used to identify boundaries may also appear in the data.

The data link layer must be able to signal a transmission problem by sending an appropriate frame. In a general way, an important role of this layer consists in detecting and correcting errors that occured on the physical layer. This layer integrates also a flow control function to avoid the blocking of the receiver.

The information unit for this layer is the **frame** made up of a few hundreds to a few thousands of bytes maximum.

The network layer

This layer is in charge of the sub-network, i.e. the routing packets over the sub-networks and the interconnection of the various sub-networks. When designing it, it is very important to determine the routing mechanism and calculation of the routing tables (static or dynamic tables...).

The network layer also controls sub-network congestions. It is also possible to complete it with accounting functions for invoicing on volume, but this may be delicate.

The information unit for this layer is the **packet**.

The transport layer

This layer is responsible for the good delivery of messages to the recipient. Its main role is to take the messages of the session layer, split them into smaller units and give them to the network layer, while checking pieces arrive correctly. Therefore, this layer also re-assembles the initial message when it receives the pieces.

This layer is also responsible for the optimization of the network resources: normally, the transport layer should create a network connection for every transport connection required by the session layer, but it is able to create several network connections by session layer's process, for example to improve the bit rate. Conversely, this layer can use one network connection to transport several messages at the same time, using multiplexing. In any case, all this must transparent for the session layer.

This layer is also responsible for the type of service to provide to the session layer, any finaly to the users of the network: connection-oriented or connectionless service, with or without guarantee of the delivery order, broadcast... Thus, this layer is also responsible for opening and closing network connections.

One of its latest role is flow control.

It is one of the most important layers, because it provides the basic service to the user and controls the whole connection process, with all the related constraints.

The information unit for this layer is the **message**.

The session layer

This layer sets up and synchronizes the exchanges between distant processes. It binds logical addresses to physical addresses for distributed tasks. It also binds two application programs that must cooperate control their dialogue (which one should speak, which is currently speaking...). In this latter case, the service of set up is called the **token management**. The session layer also makes it possible to insert recovery points in the data flow in order to resume dialogue after a failure.

The presentation layer

This layer deals with the syntax and semantics of the transmitted data: it processes the data so as to make it compatible between communicating tasks. It will ensure the independance between the user and the data transport.

Typically, this layer can convert, format, crypt and compress the data.

The application layer

This layer is the point of contact between the user and the network. Therefore, it brings the basic network services to the user, such as file transfer, electronic mail...

printable format

network software **the OSI model, continuation**