0.1 Open Systems Interconnection model [1]

The Open Systems Iterconnection (OSI) model is a conceptual model created to characterise and standarise the communications between systems without regard to their internal structure and technology. This model is a product of the Open Systems Interconnection project at the International Organization for Standardization (ISO), maintained by the identification ISO/IEC 7498-1.

The OSI models divides the communication into layers. There are seven layers in the original model, being layer 1 the lowest layer and layer 7 the highest layer. Each layer serves the layer above it, and it is served by the layer below it.

Layer	**Name**
7	Application
6	Presentation
5	Session
4	Transport
3	Network
2	Data link
1	Physical

Although the OSI in not a protocol itself, the ISO has protocols for every layer of the OSI model, called the OSI protocols. However, although the OSI model is widely used for teaching and documentation, the OSI protocols are not very popular, and only the X.400, X.500, and IS-IS protocols are used nowadays. Instead, the TCP/IP protocols are used.

0.1.1 Layers

Layer 1: Physical Layer

The Physical layer defines the electrical and mechanical characteristics of the physical medium. The physical medium can be a copper wire, a fiber optical cable or a radio frequency. It provides:

- Data codification: it modifies the simple model of digital signal (0 and 1) to accomodate better the characteristics of the physical medium. It also establishes how is a 1 represented, how does the recieving station know when a bit starts, how the recieving station delimits a frame.
- Connection to the physical environment, accommodating various possibilities in the medium. For example, how many pins does the connector have, and how it is used each one.
- Transmission technique: establish whether the bits will be coded as digital or analogic.
- Transmission in the pshysical medium: transmits digitals bits through electrical or optical signals adequated for the pshysical medium and establishes the relation of volts/dB to represent a specific signal state.

Layer 2: Data Link Layer

The Data link layer provides data transfer between two directly connected nodes, detecting and correcting errors that may occur in the physical layer. According to IEEE 802, this layer is divided into two sublayers:

- Media Access Control (MAC) layer. Controls how devices in a network gain access to the physical medium and how obtain permission to transmit in it. It provides:
  - Establishment and conclusion of links.
  - Flow control: indicates the transmitting node to "back off" when there is no frame buffer avaiable.
  - Medium access management: decides if the node can use the physical medium
- Logical Link Control (LLC) layer. Identifyes Network layer protocols and encapsulates them, and controls error cheking and frame sinchronisation.It provides:
  - Frame sequencing: transmit and recieve frames sequentially.
  - Frame confirmation: provides/waits for frame confirmation. Detects errors and recovers from them when they happen in the physical layer through retransmitting non-confirmed frames.
  - Frame delimitation: creates and recognises the frame limits.

Layer 3: Network Layer

The Network layer provide the means for transferring data sequences from one node to another node connected to the same network. It translates the logical network adress into pshysical machine adress. It provides:

- Routing: selecting the best path between two nodes in a network, often using intermediate nodes (called routers)
- Network flow control: routers may indicate a transmitting node to reduce its transmission when the router's buffer becomes full.
- Package fragmentation: If the message to be transmitted is too large to be transmitted in the Data link layer, the network may split it into several packages in one node, send them independently an reassemble them in another node.
- Logical-pshysical adress allocation: Translates the logical adress (or names) of the network nodes into physical adress.

Layer 4: Transport Layer

The Transport layer provides means for transferring dara sequences from a source to a destinetion via oneor more networks. It provides:

- Mesage segmentation: It takes a message from the Session layer and divides it into smaller units if if is too big and transmit them to the Network layer. Each fragment has a header to allow the recieving Transport layer know whan a message starts and ends, and in which order reassemble the message.
- Message confirmation: reliable message delivery with confirmations.

- Message flow control: indicates the transmitting station to "back off" when there is no message buffer avaiable.
- Session multiplexing: multiplexes various message sequences,or sessions, ina logical link, and traces which message belongs to which session

OSI defines five classes of connection-mode transport protocols which range from class 0 (also known as TP0) to class 4 (TP4), in increasing number of features. TP0 is dessigned for very reliable networks, so it has less features. On the contrary, TP4 is designed for less reliable networks. The following talbe showns the features of each class:

Feature name	**TP0**	**TP1**	**TP2**	**TP3**	**TP4**
Connection-oriented network	Yes	Yes	Yes	Yes	Yes
Connectionless network	No	No	No	No	Yes
Concatenation and separation	No	Yes	Yes	Yes	Yes
Segmentation and reassembly	Yes	Yes	Yes	Yes	Yes
Error recovery	No	Yes	Yes	Yes	Yes
Reinitiate connection	No	Yes	No	Yes	No
Multiplexing/demultiplexing over single virtual circuit	No	No	Yes	Yes	Yes
Explicit flow control	No	No	Yes	Yes	Yes
Retransmission on timeout	No	No	No	No	Yes
Reliable transport service	No	Yes	No	Yes	Yes

Layer 5: Session Layer

The sessionlayer controls the communications between computers, establishing, managing and terminating the connections between the local and remote applications. It provides:

- Establishment, management and termination of sessions: allow two application processes in different systems to establish, use and terminate a connection, also called session
- Full-duplex, half-duplex, or simplex operation, and establishes checkpointing, adjournment, termination, and restart procedures.

Layer 6: Presentation Layer

The Presentation layer gives format to data that is presented in the Application layer. It can translate data from a format used in the Application data to a common format used in the transmitting station, and then translate that common format to a format known by the Application layer of the recieving station.It provides:

- Conversion of character code: for example, from ASCII to EBCDIC
- Data conversion: bit order, CR-CR/LF, floating point between integers, etc.
- Dara compression: reduce the number of bits needed to be transmitted
- Data encoding: encode the dara for seafty reasons

Layer 7: Application Layer

The Application layer is the layer closest to the user. It acts as a window for users and application processes to have access to network processes. This layer contains many features frequently used, such as:

- Shared use of resources and device redirection
- Remote access to files
- Remote access to printer
- Communication between processes
- Network management
- Dirtctory services
- electronic messaging
- Virtual network terminal

Bibliography

[1] International Telecommunication Union. X.200: Data Networks and open system communications. 4:59, 1994.