OSI and TCP/IP Data Models

Reference Models
TCP/IP

An architectural model is a common frame of reference for explaining Internet communications and developing communication protocols. It separates the functions of protocols into manageable layers. Each layer performs a specific function in the process of communicating over a network.

The TCP/IP model was created by researchers in the U.S. Department of Defense (DoD). The TCP/IP suite of protocols is the dominant standard for transporting data across networks and the Internet. It consists of layers that perform functions necessary to prepare data for transmission over a network. The chart shows the four layers of the TCP/IP model.

A message begins at the top application layer and moves down the TCP/IP layers to the bottom network access layer. Header information is added to the message as it moves down through each layer and is then transmitted. After reaching the destination, the message travels back up through each layer. The header information that was added to the message is stripped away as the message moves up through the layers toward its destination.

Application Layer Protocols

Application layer protocols provide network services to user applications, such as web browsers and email programs. Common protocols that operate at the application layer include HTTP, Telnet, FTP, SMTP, DNS, and HTML.

Transport Layer Protocols

Transport layer protocols provide end-to-end management of the data. One of the functions of these protocols is to divide the data into manageable segments for easier transport across the network. Common protocols that operate at the transport layer include TCP and UDP.

Internet Layer Protocols

Internet layer protocols provide connectivity between hosts in the network. Common protocols that operate at the Internet layer include IP and ICMP.

Network Access Layer Protocols

Network access layer protocols describe the standards that hosts use to access the physical media. The IEEE 802.3 Ethernet standards and technologies, such as CSMA/CD and 10BASE-T, are defined in this layer.

TCP/IP Layer

TCP/IP Layer	Description
Application	Where high-level protocols such as SMTP and FTP operate
Transport	Specifies which application requested or is receiving data through specific ports
Internet	Where IP addressing and routing take place
Network Access	Where MAC addressing and physical components of the network exist

OSI

In the early 1980s, the International Standards Organization (ISO) developed the Open Systems Interconnect (OSI) reference model to standardize the way devices communicate on a network. This model was a major step toward ensuring interoperability between network devices.

The OSI model divides network communications into seven distinct layers. Although other models exist, most network vendors today build their products using this framework.

A system that implements protocol behavior consisting of a series of these layers is known as a protocol stack. Protocol stacks can be implemented either in hardware or software, or a combination of both. Typically, only the lower layers are implemented in hardware, and the higher layers are implemented in software. Each layer is responsible for part of the processing to prepare data for transmission on the network. The chart shows what each layer of the OSI model does.

In the OSI model, when data is transferred, it is said to virtually travel down the OSI model layers of the sending computer and up the OSI model layers of the receiving computer.

When a user sends data, such as an email, the encapsulation process starts at the application layer. The application layer provides network access to applications. Information flows through the top three layers and is considered to be data when it gets down to the transport layer.

At the transport layer, the data is broken down into more manageable segments, called protocol data units (PDUs), for orderly transport across the network. A PDU describes data as it moves from one layer of the OSI model to another. The transport layer PDU also contains information used for reliable data transport, such as port numbers, sequence numbers, and acknowledgement numbers.

At the network layer, each segment from the transport layer becomes a packet. The packet contains logical addressing and other Layer 3 control information.

At the data link layer, each packet from the network layer becomes a frame. The frame contains physical address and error correction information.

OSI Model

OSI Model	Layer	Description
Application	7	Responsible for network services to applications
Presentation	6	Transforms data formats to provide a standard interface for the application layer
Session	5	Establishes, manages, and terminates the connections between the local and remote application
Transport	4	Provides reliable transport and flow control across a network
Network	3	Responsible for logical addressing and the domain of routing
Data Link	2	Provides physical addressing and media access procedures
Physical	1	Defines all the electrical and physical specifications for devices

At the physical layer, the frame becomes bits. These bits are transmitted one at a time across the network medium.

At the receiving computer, the de-encapsulation process reverses the

process of encapsulation. The bits arrive at the physical layer of the OSI model of the receiving computer. The process of traveling up the OSI model of the receiving computer brings the data to the application layer, where an email program displays the email.

NOTE: Mnemonics can help you remember the seven layers of the OSI. Some examples include “All People Seem To Need Data Processing” and “Please Do Not Throw Sausage Pizza Away”.

Comparing the OSI and TCP/IP Models

The OSI model and the TCP/IP model are both reference models used to describe the data communication process. The TCP/IP model is used specifically for the TCP/IP suite of protocols, and the OSI model is used for the development of standard communication for equipment and applications from different vendors.

The TCP/IP model performs the same process as the OSI model, but uses four layers instead of seven. The chart shows how the layers of the two models compare.