The OSI Model and You

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The Open System Interconnection (OSI) model describes the way in which information travels across a network, such as how a user's request for a web page, is communicated from the user's browser program over the network to the web server and how that page is sent back. Using a model like this allows programmers to standardize their software design and break the program into modular pieces which can be independently developed and revised.

The Protocol Stack

The collection of communication layers is commonly referred to as the 'protocol stack', visualized as a stack of seven interconnecting sections. Each layer accomplishes its own task and then hands the information on to the next layer, using a variety of protocols (communication standards) to interface with the user, for operating system functions, information conversion and the delivery of this information to the destination device.

Communication Between Layers

The various layers pass network requests to each other using a particular protocol. Typically these protocols add control, encapsulation, conversion functions and/or routing information to the front or back of the original message. This allows seemingly transparent delivery of the message to the destination.

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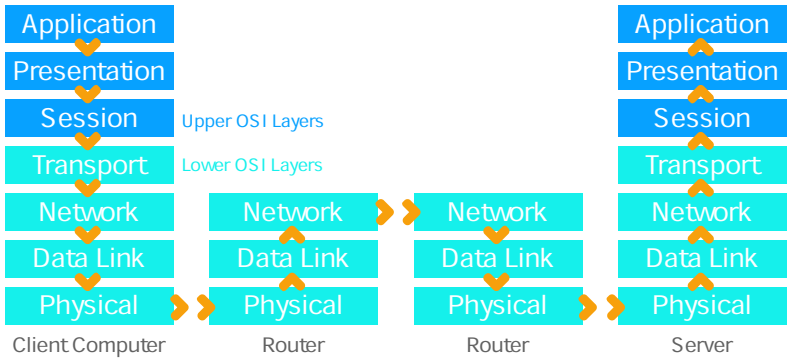

The Open Systems Interconnection model visualized

Separation Between Layers

The OSI model is separated into two distinct levels. The upper 'application' level includes the application, presentation and session layers while the lower 'dataflow' levels include the transport, network, data link and physical layers.

Layer 7: Application

The top layer of the OSI model is the Application Layer. Applications (another term for interactive computer program) allow the end-user to browse the web, email friends or colleagues, and initiate various network related tasks and operations. One of the best known protocols used in the application layer is the Hyper Text Transfer Protocol (HTTP), the standard used to send Web requests and pages between browsers and servers.

Layer 6: Presentation

This layer defines data formats, such as text and images, translating data between the computer and the network formats. This includes character set conversion (between languages), data compression and encryption. Common examples of this format are HTML and JPEG.

Layer 5: Session

The Session Layer manages communications between computer systems. It establishes the connection ID numbers, the coordination of acknowledgement numbering and retransmission procedures, the release of a connection when finished, and re-establishing a session between computers should it fail. The Session layer would either resume the interrupted dialog, or initiates a new session to the destination device. A common Session protocol is RCP.

Layer 4: Transport

This layer provides reliable end-to-end communications by providing service addressing, flow control, multiple connections, datagram segmentation, and raw data error checking. The Transport layer breaks data into segments so it can be sent over the network and reassembles the segments at the other

end, and ensures that the data is received at the appropriate device. An example Transport protocol is Transport Control Protocol (TCP), used on the Internet.

Layer 3: Network
The Network layer has many functions. One of the most important of these functions includes the assignment of logical IP addressing (the names of the network computers) to network devices. Other functions include providing for network routing, flow control of the connections, and sequencing of the constructed packets. A common Network Protocol is Internet Protocol (IP) used on the Internet.

Layer 2: Data Link
The Data Link layer provides the physical addressing –known as MAC addresses– to the device on the network and manages flow control. The Data Link layer organizes data bits into a rudimentary structure known as a frame. The frame contains information about the physical source and destination address and fields that are responsible for synchronization, flow control, and error checking. An example protocol is PPP, used by home computer modems to call their ISPs.

Layer 1: Physical
The foundation of communications between any computer systems, the Physical layer, defines the physical path through which the information flows. It includes the transmission media (the wires) and the actual data signals (the current).

The physical layer has multiple specifications that work together. A common example of the Physical layer is the Ethernet cables we use to connect computers to the network at the office. The cables themselves are a standard called "Category 5". "RJ45" is the standard for the size and shape of the jack at the end of the cable, and the Ethernet standard defines what the pins on the plug are used for.

A Simplified Walk Through
Let's say that you, the end-user are using your PC to do some online banking with your bank's web site over a secure (https) connection.

When the user clicks on a link, the web page request enters the OSI stack at the Application layer, using the browser as an entrance point. The requested data is passed to the Presentation layer, where the data packet is encrypted and formatted. The Session layer will establish and maintain the HTTP session. Data continues on to the Transport layer, where the end-to-end communication between user and destination device is established. The data passes down to the Network layer where logical source and destination addressing is attached and encapsulated within the data packet. The data passes to the Data Link layer, where logical (IP) addressing is converted into physical source and destination addresses (MAC), and information is added for flow control. Finally, the data reaches the Physical layer where a transportation medium such as Ethernet cabling is utilized.

The data packet travels over the Internet and arrives at the Bank's web server. It then travels in reverse order up the OSI stack (Physical layer first) to be processed by the web server's Application layer. The process is then reversed and data is sent back down the OSI stack on the bank's server towards the end user's machine. Once the data is received, it travels up the OSI stack on the end user's machine until it reaches the browser (Application layer where the initial communication began) with a response, completing the process.

Behind each click of your mouse there is a vast and complex system of packets, protocols and processes that comes to life. It works even if you don't understand it, but you no longer have that problem.

for more information

Internetworking basics
http://www.ieng.com/cpress/cc/td/cpress/fund/ith/ith01gb.htm

ISO's OSI reference model
http://www.cstp.umkc.edu/personal/kkev/osi/osi.html

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