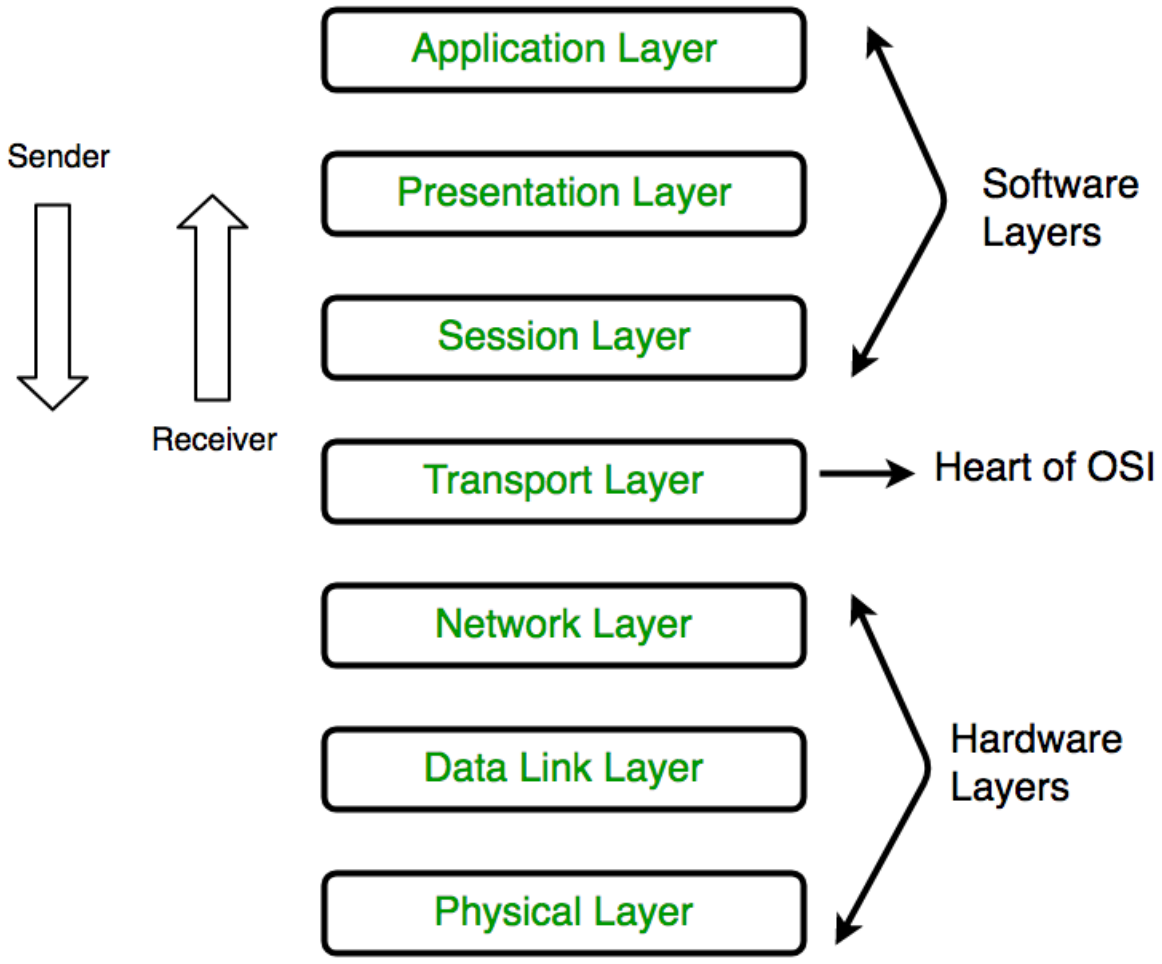
6.10 Investigates the role of reference models to describe the network architecture

OSI (Open Systems Interconnection) Model

OSI stands for Open Systems Interconnection. It has been developed by ISO – 'International Organization of Standardization', in the year 1974. It is a 7 layer architecture with each layer having specific functionality to perform. All these 7 layers work collaboratively to transmit the data from one person to another across the globe.



Layer 7 - Application

To further our bean dip analogy, the Application Layer is the one at the top - it's what most users see. In the OSI model, this is the layer that is the "closest to the end user". Applications that work at Layer 7 are the ones that users interact with directly. A web browser (Google Chrome, Firefox, Safari, etc.) or other app - Skype, Outlook, Office - are examples of Layer 7 applications.

Layer 6 - Presentation

The Presentation Layer represents the area that is independent of data representation at the application layer - in general, it represents the preparation or translation of application format to network format, or from network formatting to application format. In other words, the layer "presents" data for the application or the network. A good example of this is encryption and decryption of data for secure transmission - this happens at Layer 6.

Layer 5 - Session

When two devices, computers or servers need to "speak" with one another, a session needs to be created, and this is done at the Session Layer. Functions at this layer involve setup, coordination (how long should a system wait for a response, for example) and termination between the applications at each end of the session.

Layer 4 – Transport

The Transport Layer deals with the coordination of the data transfer between end systems and hosts. How much data to send, at what rate, where it goes, etc. The best known example of the Transport Layer is the Transmission Control Protocol (TCP), which is built on top of the Internet Protocol (IP), commonly known as TCP/IP. TCP and UDP port numbers work at Layer 4, while IP addresses work at Layer 3.

Layer 3 - Network

Here at the Network Layer is where you'll find most of the router functionality that most networking professionals care about and love. In its most basic sense, this layer is responsible for packet forwarding, including routing through different routers. You might know that your Boston computer wants to connect to a server in California, but there are millions of different paths to take. Routers at this layer help do this efficiently.

Layer 2 – Data Link

The Data Link Layer provides node-to-node data transfer (between two directly connected nodes), and also handles error correction from the physical layer. Two sublayers exist here as well - the Media Access Control (MAC) layer and the Logical Link Control (LLC) layer. In the networking world, most switches operate at Layer 2.

Layer 1 - Physical

At the bottom of our OSI bean dip we have the Physical Layer, which represents the electrical and physical representation of the system. This can include everything from the cable type, radio frequency link (as in an 802.11 wireless systems), as well as the layout of pins, voltages and other physical requirements. When a networking problem occurs, many networking pros go right to the physical layer to check that all of the cables are properly connected and that the power plug hasn't been pulled from the router, switch or computer, for example.

OSI Layer Functions

Application	Network services to applications
Presentation	Data representation
Session	Inter-host communication
Transport	End-to-end connection reliability
Network	Addresses and best path
Data Link	Access to media
Physical	Binary transmission (Wires, connectors, voltages data rates etc.)

Application	User Interface
Presentation	Encrypt, decrypt
Session	Oversee process
Transport	Data delivery
Network	Packets
Data Link	Frames
Physical	Bytes

Application	HTTP
Presentation	MIME
Session	SSL, NetBIOS
Transport	TCP, UDP
Network	IP, ICMP
Data Link	PPP, HDLC
Physical	Ethernet

To memorize the layers, here are a few sentences (mnemonic tricks) to help remember them in order.

From Application to Physical (top down):

- All People Seem To Need Data Processing

From Physical to Application (bottom up):

- Please Do Not Throw Sausage Pizza Away

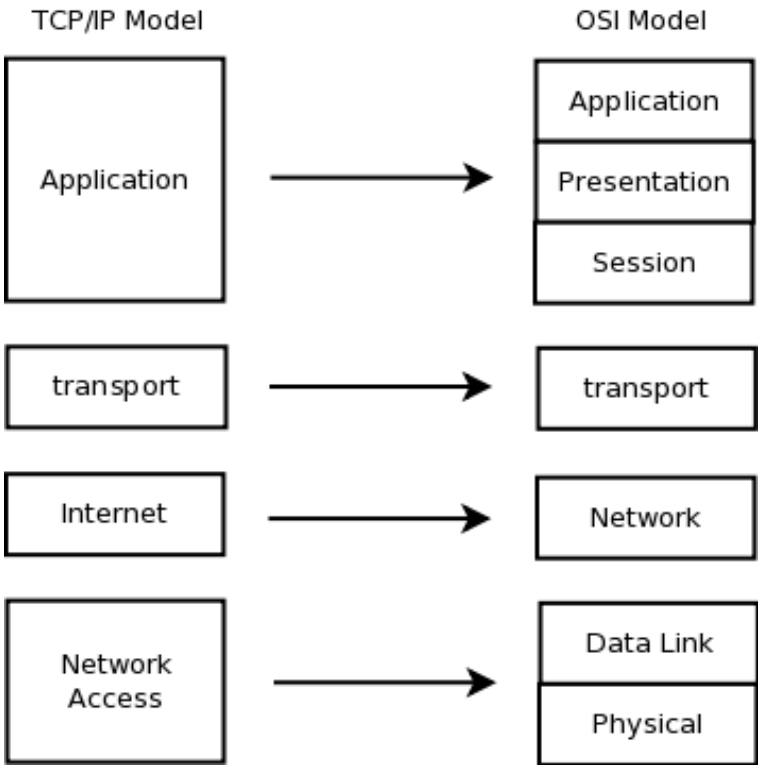
OSI model acts as a reference model and is not implemented in Internet because of its late invention. Current model being used is the TCP/IP model.

TCP/IP Model

The OSI Model we just looked at is just a reference/logical model. It was designed to describe the functions of the communication system by dividing the communication procedure into smaller and simpler components. But when we talk about the TCP/IP model, it was designed and developed by Department of Defense (DoD) in 1960s and is based on standard protocols. It stands for Transmission Control Protocol/Internet Protocol. The TCP/IP model is a concise version of the OSI model. It contains four layers. The layers are:

1. Process/Application Layer
2. Host-to-Host/Transport Layer
3. Internet Layer
4. Network Access/Link Layer

The diagrammatic comparison of the TCP/IP and OSI model is as follows:



Application Layer

The Application Layer of the TCP/IP Model consists of various protocols that perform all the functions of the OSI model's Application, Presentation and Session layers. This includes interaction with the application, data translation and encoding, dialogue control and communication coordination between systems.

The following are few of the most common Application Layer protocols used today:

Telnet – Telnet is a terminal emulation protocol used to access the resources of a remote host

HTTP – The Hypertext Transfer Protocol is foundation of the World Wide Web. It is used to transfer Webpages and such resources from the Web Server or HTTP server to the Web Client or the HTTP client. When you use a web browser such as Internet Explorer or Firefox, you are using a web client. It uses HTTP to transfer web pages that you request from the remote servers.

FTP – File Transfer Protocol is a protocol used for transferring files between two hosts.

SMTP – Simple Mail Transfer Protocol is used to send e-mails. When you configure an email client to send e-mails you are using SMTP.

TFTP – Trivial File Transfer Protocol is a stripped down version of FTP. Where FTP allows a user to see a directory listing and perform some directory related functions, TFTP only allows sending and receiving of files. It is a small and fast protocol, but it does not support authentication. Because of this inherent security risk, it is not widely used.

DNS – Every host in a network has a logical address called the IP address. These addresses are a bunch of numbers. When you go to a website such as www.cisco.com you are actually going to a host which has an IP address, but you do not have to remember the IP Address of every WebSite you visit. This is because Domain Name Service (DNS) helps map a name such as www.cisco.com to the IP address of the host where the site resides. This obviously makes it easier to find resources on a network. When you type in the address of a website in your browser, the system first sends out a DNS query to its DNS server to resolve the name to an IP address. Once the name is resolved, a HTTP session is established with the IP Address.

DHCP – As you know, every host requires a logical address such as an IP address to communicate in a network. The host gets this logical address either by manual configuration or by a protocol such as Dynamic Host Configuration Protocol (DHCP). Using DHCP, a host can be provided with an IP address automatically. To understand the importance of DHCP, imagine having to manage 5000 hosts in a network and assigning them IP address manually! Apart from the IP address, a host needs other information such as the address of the DNS server it needs to contact to resolve names, gateways, subnet masks, etc. DHCP can be used to provide all these information along with the IP address.

Transport Layer

The protocols discussed above are few of the protocols available in the Application layer. There are many more protocols available. All of them take the user data and add a header and pass it down to the Transport layer to be sent across the network to the destination. The TCP/IP transport layer's function is same as the OSI layer's transport layer. It is concerned with end-to-end transportation of data and setups up a logical connection between the hosts.

Two protocols available in this layer are,

- Transmission Control Protocol (TCP)
- User Datagram Protocol (UDP)

TCP is a connection oriented and reliable protocol that uses windowing to control the flow and provides ordered delivery of the data in segments. On the other hand, UDP simply transfers the data without the bells and whistles. Though these two protocols are different in many ways, they perform the same function of transferring data and they use a concept called port numbers to do this.

Internet Layer

Once TCP and UDP have segmented the data and have added their headers, they send the segment down to the Network layer. The destination host may reside in a different network far from the host divided by multiple routers. It is the task of the Internet Layer to ensure that the segment is moved across the networks to the destination network.

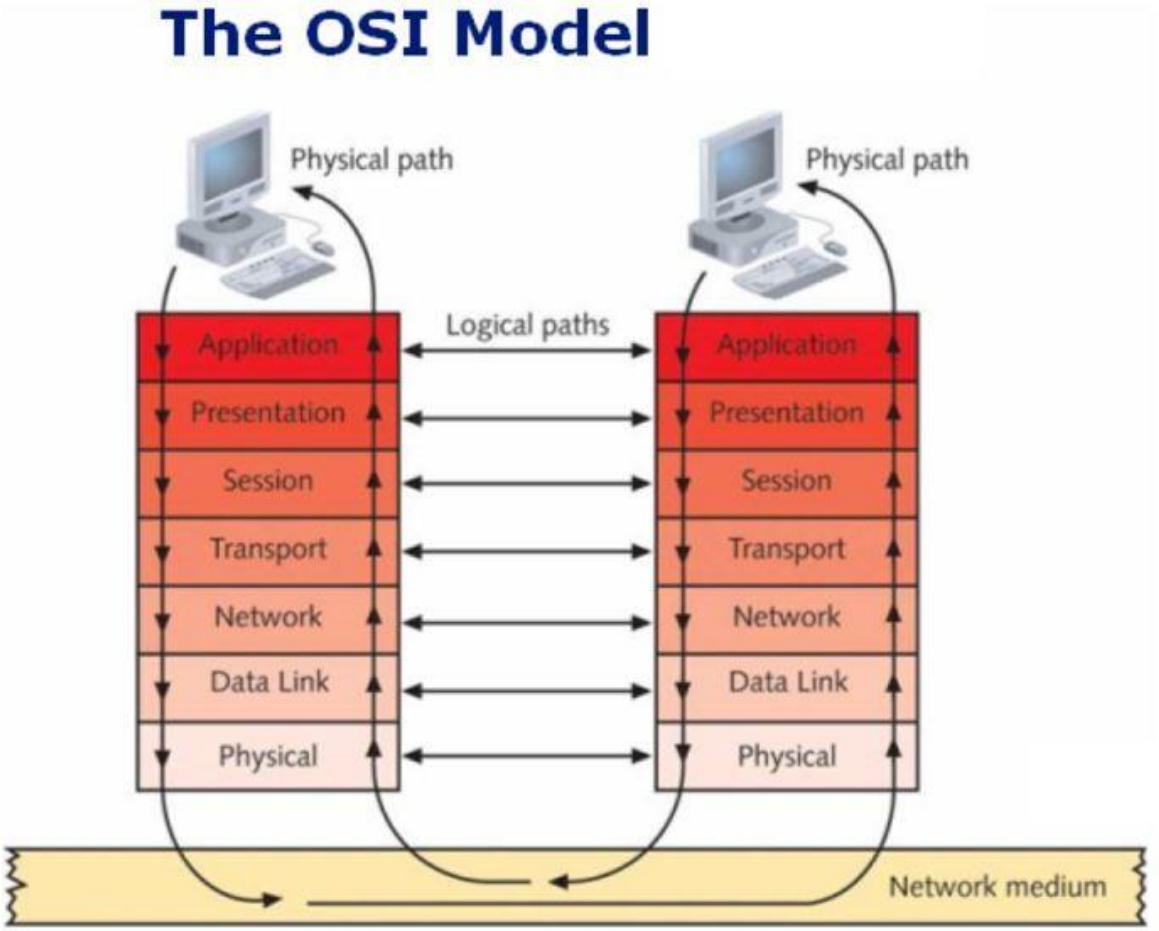
The Internet layer of the TCP/IP model corresponds to the Network layer of the OSI reference model in function. It provides logical addressing, path determination and forwarding.

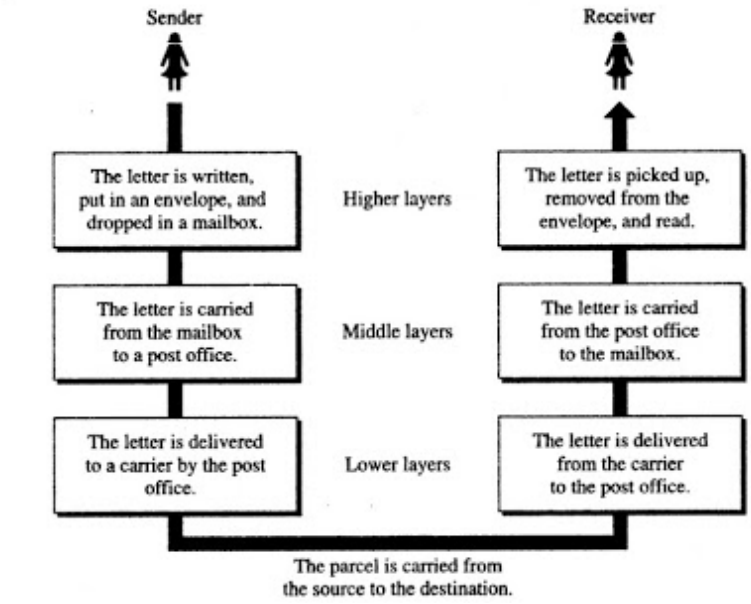
The Internet Protocol (IP) is the most common protocol that provides these services. Also working at this layer are routing protocols which help routers learn about different networks they can reach and the Internet Control Message Protocol (ICMP) that is used to send error messages across at this layer.

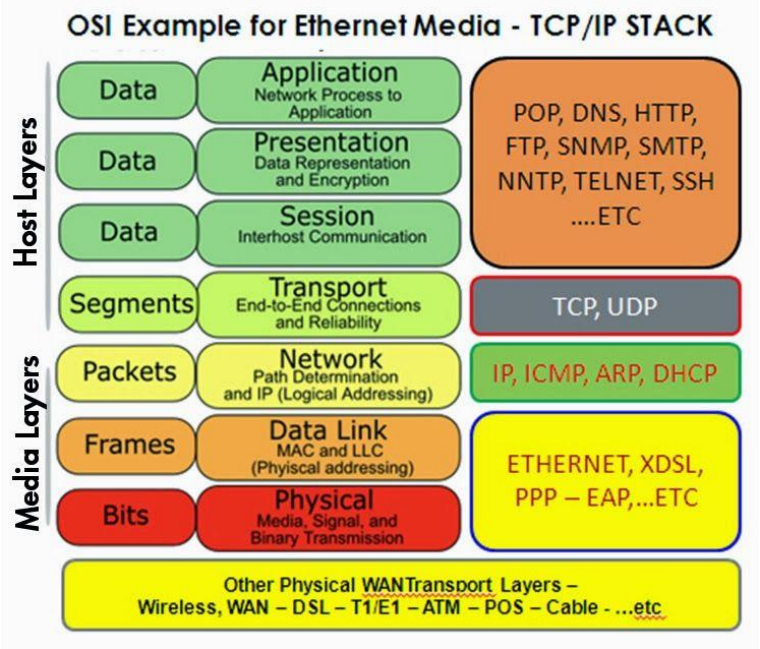
Network Access Layer

The Network Access layer of the TCP/IP model corresponds with the Data Link and Physical layers of the OSI reference model. It defines the protocols and hardware required to connect a host to a physical network and to deliver data across it. Packets from the Internet layer are sent down the Network Access layer for delivery within the physical network. The destination can be another host in the network, itself, or a router for further forwarding. So the Internet layer has a view of the entire Internetwork whereas the Network Access layer is limited to the physical layer boundary that is often defined by a layer 3 device such as a router.

The Network Access layer consists of a large number of protocols. When the physical network is a LAN, Ethernet at its many variations are the most common protocols used. On the other hand when the physical network is a WAN, protocols such as the Point-to-Point Protocol (PPP) and Frame Relay are common.







Reference

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https://www.geeksforgeeks.org/layers-osi-model/