Briefly Discuss TCP/IP Reference Model and OSI Reference Model? And Explain below points keeping both Models

What is Protocol Stack?

TCP/IP

A protocol stack is a group of protocols that all work together to allow software or hardware to perform a function.

Layer 1(Network Interface): This layer combines the Physical and Data layers and transmit the data between devices on the same network. It also manages the exchange of data between the network and other devices.

Layer 2(Internet): This layer corresponds to the Network layer. The IP uses the consisting of a Network Identifier and a Host Identifier, to determine the address of the device it is communicating with.

Layer 3(Transport Layer): Corresponding to the OSI Transport layer, this is the part of the protocol stack where the TCP can be found. TCP works by asking another device on the network if it is willing to accept information from the local device.

Layer 4(Application Layer): It combines the Session, Presentation and Application layers of the OSI model. Protocols for specific functions such as email Simple Mail Transfer Protocol and file transfer File Transfer Protocol reside at this level.

OSI Model

Layer 1(Physical): Defines the characteristics of the network hardware.

Layer 2(Data Link): Handles the transfer of data across the network media.

Layer 3(Network): Manages data addressing and delivery between networks.

Layer 4(Transport):
Manages the transfer of data. Also assures that the received data are identical to the transmitted data.

Layer 5(Session):
Manages the connections and terminations between cooperating computers.

Layer 6(Presentation): Ensures that information is delivered to the receiving machine in a form that the machine can understand.

Layer 7(Application): Consists of standard communication services and applications that everyone can use.

History of both Models?

TCP/IP

The TCP/IP protocols were initially developed as part of the research network developed by the United States Defense Advanced Research Projects Agency (DARPA or ARPA). Initially, this fledgling network, called the ARPAnet, was designed to use a number of protocols that had been adapted from existing technologies. However, they all had flaws or limitations, either in concept or in practical matters such as capacity, when used on the ARPAnet. The developers of the new network recognized that trying to use these existing protocols might eventually lead to problems as the ARPAnet scaled to a larger size and was adapted for newer uses and applications.

In 1973, development of a full-fledged system of internetworking protocols for the ARPAnet began. What many people don't realize is that in early versions of this technology, there was only one core protocol: TCP. And in fact, these letters didn't even stand for what they do today; they were for the Transmission Control Program.

The first version of this predecessor of modern TCP was written in 1973, then revised and formally documented in RFC 675, Specification of Internet Transmission Control Program, December 1974.

OSI Model

In the late 1970s, two projects began independently, with the same goal: to define a unifying standard for the architecture of networking systems. One was administered by the International Organization for Standardization (ISO), while the other was undertaken by the International Telegraph and Telephone Consultative Committee, or CCITT (the abbreviation is from the French version of the name). These two international standards bodies each developed a document that defined similar networking models.

In 1983, these two documents were merged together to form a standard called The Basic Reference Model for Open Systems Interconnection. That's a mouthful, so the standard is usually referred to as the Open Systems Interconnection Reference Model, the OSI Reference Model, or even just the OSI Model. It was published in 1984 by both the ISO, as standard ISO 7498, and the renamed CCITT (now called the Telecommunications Standardization Sector of the International Telecommunication Union or ITU-T) as standard X.200.

Working of each Layers in Both Models?

TCP/IP

Network Layer

Network Access Layer is the first layer of the four-layer TCP/IP model. Network Access Layer defines details of how data is physically sent through the network, including how bits are electrically or optically signaled by hardware devices that interface directly with a network medium, such as coaxial cable, optical fiber, or twisted pair copper wire. The most popular LAN architecture among those listed above is Ethernet. Ethernet uses an Access Method called CSMA/CD (Carrier Sense Multiple Access/Collision Detection) to access the media, when Ethernet operates in a shared media. An Access Method determines how a host will place data on the medium.

Internet Layer

Internet Layer is the second layer of the four-layer TCP/IP model. The position of Internet layer is between Network Access Layer and Transport layer. Internet layer pack data into data packets known as IP datagrams, which contain source and destination address (logical address or IP address) information that is used to forward the datagrams between hosts and across networks. The Internet layer is also responsible for routing of IP datagrams.

Transport Layer

Transport Layer is the third layer of the four-layer TCP/IP model. The position of the Transport layer is between Application layer and Internet layer. The purpose of Transport layer is to permit devices on the source and destination hosts to carry on a conversation. Transport layer defines the level of service and status of the connection used when transporting data.

Application Layer

Application layer is the top-most layer of four-layer TCP/IP model. Application layer is placed on the top of the Transport layer. Application layer defines TCP/IP application protocols and how host programs interface with Transport layer services to use the network.

OSI Model

Physical Layer

The main functionality of the physical layer is to transmit the individual bits from one node to another node. It is the lowest layer of the OSI model. It establishes, maintains and deactivates the physical connection. It specifies the mechanical, electrical and procedural network interface specifications.

Data link Layer

This layer is responsible for the error-free transfer of data frames. It defines the format of the data on the network. It provides a reliable and efficient communication between two or more devices. It is mainly responsible for the unique identification of each device that resides on a local network. It contains two sub-layers:

Logical Link Control Layer

It is responsible for transferring the packets to the Network layer of the receiver that is receiving. It identifies the address of the network layer protocol from the header. It also provides flow control.

Media Access Control Layer

A Media access control layer is a link between the Logical Link Control layer and the network's physical layer. It is used for transferring the packets over the network.

Network Layer

It is a layer 3 that manages device addressing, tracks the location of devices on the network. It determines the best path to move data from source to the destination based on the network conditions, the priority of service, and other factors. The Data link layer is responsible for routing and forwarding the packets. Routers are the layer 3 devices, they are specified in this layer and used to provide the routing services within an internetwork. The protocols used to route the network traffic are known as Network layer protocols. Examples of protocols are IP and Ipv6.

Transport Layer

The Transport layer is a Layer 4 ensures that messages are transmitted in the order in which they are sent and there is no duplication of data. The main responsibility of the transport layer is to transfer the data completely. It receives the data from the upper layer and converts them into smaller units known as segments. This layer can be termed as an end-to-end layer as it provides a point-to-point connection between source and destination to deliver the data reliably.

The two protocols used in this layer are:

Transmission Control Protocol

It is a standard protocol that allows the systems to communicate over the internet. It establishes and maintains a connection between hosts. When data is sent over the TCP connection, then the TCP protocol divides the data into smaller units known as segments.

User Datagram Protocol

User Datagram Protocol is a transport layer protocol. It is an unreliable transport protocol as in this case receiver does not send any acknowledgment when the

packet received, the sender does not wait for any acknowledgment. Therefore, this makes a protocol unreliable.

Session Layer

It is a layer 5 in the OSI model. The Session layer is used to establish, maintain and synchronizes the interaction between communicating devices.

Application Layer

An application layer serves as a window for users and application processes to access network service. It handles issues such as network transparency, resource allocation, etc. An application layer is not an application, but it performs the application layer functions. This layer provides the network services to the end-users.

What was the need of these both Models?

TCP/IP

It is known to provide reliable and error-free communication between end systems. It performs sequencing and segmentation of data. It also has acknowledgment feature and controls the flow of the data through flow control mechanism.

OSI Model

The purpose of the OSI reference model is to guide vendors and developers so the digital communication products and software programs they create can interoperate, and to facilitate a clear framework that describes the functions of a networking or telecommunication system.

Real Implementation of Both TCP/IP and OSI Reference Model?

TCP/IP

File Transfer Protocol (data and control), which is used in sending large files
Simple Mail Transfer Protocol: Relies on exchange of commands and can also send huge files across various machines.
Post Office Protocol; a protocol for e-mail message retrieval that uses TCP to exchange commands and data.

Telnet Protocol; An interactive session-based protocol that requires a similar platform to TCP.

Internet Message Access Protocol: also a protocol for retrieving e-mail messages.

OSI Model

Web browser serves as the user interface for accessing a website. The browser itself does not function at the Application layer. Instead, the web browser invokes the Hyper Text Transfer Protocol (HTTP) to interface with the remote web server, which is why http:// precedes every
web address.

• The Internet can provide data in a wide variety of formats, a function of the

Presentation layer. Common formats on the Internet include HTML, XML, PHP, GIF, and JPEG.

• The Session layer is responsible for establishing, maintaining, and terminating the session between devices, and determining whether the communication is half-duplex or full-duplex.

• HTTP utilizes the TCP Transport layer protocol to ensure the reliable delivery of data. TCP establishes and maintains a connection from the client to the web server, and packages the higher-layer data into segments.

• The best path to route the data between the client and the web server is determined by IP, a Network layer protocol. IP is also responsible for the assigned logical addresses on the client and server, and for encapsulating segments into packets.

• Data cannot be sent directly to a logical address. As packets travel from network to network, IP addresses are translated to hardware addresses, which are a function of the Data-Link layer. The packets are encapsulated into frames to be placed onto the physical medium.

• The data is finally transferred onto the network medium at the Physical layer, in the form of raw bits.

Which Model is freely available and why?

OSI Model is freely available because OSI model gives guidelines on how communication needs to be done, while TCP/IP protocols layout standards on which the Internet was developed. So, TCP/IP is a more practical model.

Differences and Similarities between these two TCP/IP and OSI Reference Models?

Differences

OSI Layer model has seven layers while TCP/IP model has four layers. OSI Layer model is no longer used while TCP/IP is still used in computer networking. To define the functionality of upper layers, OSI uses three separate layers (application, presentation and session) while TCP/IP uses a single layer (application). Just like upper layers, OSI uses two separate layers (Physical and Data link) to define the functionality of bottom layers while TCP/IP uses a single layer (Link) for the same. To define the routing protocols and standards, OSI uses Network layer while TCP/IP uses Internet layer. In comparison of TCP/IP model, OSI model is well documented and explains standards and protocols in more details.

Similarities

Both are the logical models. Both define standards for networking. Both provide a framework for creating and implementing networking standards and devices. Both divide the network communication process in layers. In both models, a single layer defines a particular functionality and set standards for that functionality only. Both

models allow a manufacturer to make devices and network components that can coexist and work with the devices and components made by other manufacturers. Both models simplify troubleshooting process by dividing complex functions into simpler components. Instead of defining the already defined standards and protocols, both models referenced them. For example, the Ethernet standards were already defined by IEEE before creation of these models. So instead of defining them again both models used them as IEEE Ethernet standards.

Devices (Physical Devices) used in Each Model Layers.

TCP/IP

Hubs, Cables, Repeaters, Bridges, Modem, Network Interface Card, Routers, Gateways

OSI Model

Switch, Router, Multi-Layer Switch, HUB, Encryption Devices, Cables, Network Interface Card (NIC), Bridge

Basic Protocols used in Each Model layers at least 4 protocols or 3 at each layer should be briefly discussed.

TCP/IP

Physical Layer
Ethernet (IEEE 802.3) Token Ring, RS-232, others

Data Link
PPP, IEEE 802.2

Internet
IP, ARP, ICMP

Transport
TCP, UDP

OSI Model

Physical Layer
Ethernet (IEEE 802.3) Token Ring, RS-232, others

Data Link
PPP, IEEE 802.2

Internet
IP, ARP, ICMP

Transport
TCP, UDP

Application, Session, Presentation

NFS, NIS+, DNS, telnet, ftp, rlogin, rsh, rcp, RIP, RDISC, SNMP, and others

All access ISPs of Pakistan

PTCL, Storm Fiber , NayaTel, Wi-Tribe, Fiberlink, Worldcall, Wateen Telecom, Qubee, COMSATS Internet Services, Transworld

Regional ISP of Pakistan

PTCL, Cyber Net, Transworld

Tier 1 ISPs of world

A tier 1 Internet service provider (Tier 1 ISP) is a type of ISP that directly connects with and has access to the global Internet backbone in a specific region under the settlement-free peering agreement, where the flow of information between one or more networks is exchanged voluntarily.

1. AT&T
2. Verizon
3. Sprint (Softbank Broadband)
4. Century Link (Qwest)
5. Level 3 (with Global Crossing now)
6. NTT/Verio

Timeline of Internet in Pakistan

1992-93	ImranNet introduced first dialup email services from Lahore.
2001	First broadband, DSL launched by Micronet Broadband
2006	Transworld Associates launched Pakistan's first alternate submarine cable linking Karachi to UAE
2006	First FTTH launched in Islamabad by Nayatel (Pvt) Ltd

Pakistan Internet Capacity

Pakistan has about 76.38 million internet users, making it the 10th-largest population of internet users in the world. Information and communications technology (ICT) is one of the fastest growing industries in the country.

Pakistan’s Submarine Cables name

There are now 6 international submarine cable systems connecting Pakistan, including SMW3, SMW4, SMW5, IMEWE, AAE-1 and TW1. Additionally, Orient Express and PEACE cable systems are under construction.