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Group Term Paper on - TCP/IP Model

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Submitted To:

Dr. S M Salim Reza
Assistant Professor, ICT
Bangladesh University Of Professionals

Submitted By:

Tasmia Binte Monzoor
Id: 2154901048
Saif Jamil
Id: 2154901050

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ABSTRACT

A group of protocols known as the TCP/IP paradigm are often used for online communication. Because of the hierarchical structure of this paradigm, lower-level

protocols must support higher-level protocols. It is made up of four layers: the data connection layer, network/internet layer, application layer, and transport layer. This paradigm is also thought to include the physical layer.

The layer that handles apps that communicate via networks is known as the application layer. Using the TCP or UDP protocol, the transport layer is in charge of ensuring dependable data delivery between applications. The IP protocol is used to transmit packets over the network by the network/internet layer. The physical network must interact with the data connection layer for the transmission to be possible.

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CHAPTER 1 | INTRODUCTION

What Is TCP/IP?

One of the fundamental protocols that makes up the Internet protocol family is Transmission Control Protocol/Internet Protocol, or TCP/IP. TCP and IP are the two main protocols in the suite, however there are other ones as well. The two main IP suite protocols each have a specific function to perform. It offers end-to-end communications that specify how data should be addressed, transported, routed, and packaged. It describes how data transfers via the internet should be carried out, sent, and received at the destination. Internet applications and the routing and switching fabric are separated from one another by the protocol suite. Examples of significant internet applications that rely on TCP include the World Wide Web, email, remote administration, and file transmission.

The two main IP suite protocols each have a specific function to perform. TCP describes how software may create channels for networked communication. Also, it manages the procedure for dividing a message into smaller packets before transmitting them over the internet and reassembling them in the correct order at the destination address. It manages how a message is broken up into smaller packets before being transmitted over the internet, and how those packets are subsequently reassembled in the right order at the destination address.

IP defines how to address and route each packet to guarantee that it gets to its destination. Each network gateway machine checks this IP address to determine where to send the message. TCP/IP is designed to make networks trustworthy with a minimum amount of central management required since it has the ability to automatically recover from the loss of any network component. The majority of TCP/IP communication is point-to-point, meaning that each communication occurs between two network nodes, host computers, or other hosts.

The History Of TCP/IP Model

Data is sent between devices via a network using a set of protocols and standards called the TCP/IP architecture. It was created in the 1970s for usage in the ARPANET by the Defense Advanced Research Projects Agency (DARPA), a research branch of the U.S. Department of Defense.

An early wide-area network called ARPANET linked numerous American colleges and research centers. TCP/IP was created expressly to make sure that data could be reliably transported between these various networks. Researchers at Bell Laboratories also developed the Unix operating system in the 1970s, for which TCP/IP was initially designed. TCP/IP, however, has been included into each succeeding operating system throughout time.

TCP/IP and its related protocols are now managed and developed by the Internet Engineering Task Force (IETF). The Internet Engineering Task Force (IETF) is a group of network designers, operators, suppliers, and academics who collaborate to create and advance open internet standards.

Most Common TCP/IP Protocols

TCP/IP protocols are a collection of guidelines and requirements that control communication between online-connected devices. These protocols specify how information is sent, received, and processed by networked devices. A key protocol in this group is TCP (Transmission Control Protocol), which breaks up big messages into smaller chunks that are sent across the network and then put back together at the other end to allow reliable data transmission. This guarantees accurate and efficient data transmission.

Another significant protocol is IP (Internet Protocol), which is in charge of allocating special numerical numbers, or IP addresses, to networked devices. These addresses make it possible for data packets to be routed to their desired locations, supporting internetworking and building the world wide web. In order to establish a virtual connection between a source and a destination and facilitate effective data transmission, IP and TCP are often used in conjunction**.**

The protocol used to transport online pages and other information between web servers and web clients like Firefox and Chrome is called HTTP (Hypertext Transfer Protocol). In order to make it simpler for users to access web pages and other resources, this protocol uses URLs (Uniform Resource Locators). Moreover, HTTP enables web servers to send clients extra data, such cookies, for the purpose of customizing the user experience.

Email communication is supported by the simple mail transmission technology known as SMTP (Simple Mail Transfer Protocol). It enables users to utilize a number of email applications, such Outlook or Google, to send emails and files to other email accounts. SMTP is in charge of transmitting messages from the email server of the sender to the email server of the receiver.

The SNMP (Simple Network Management Protocol) architecture uses the TCP/IP protocol to manage internet-connected devices. It enables network administrators to monitor, administer, and troubleshoot servers, switches, and routers.

The DNS (Domain Name System) converts domain names into IP addresses, making it easier for users to navigate the internet. Users prefer to utilize domain names like google.com rather numeric IP addresses like 172.217.9.206. DNS servers provide better internet navigation by translating domain names to IP addresses.

TELNET (Terminal Network) is a protocol that establishes a connection between nearby and far-off computers, enabling users to replicate their local system elsewhere. It is a helpful tool for remote administration and troubleshooting since it lets users to access distant systems and resources as if they were local.

A popular technique for exchanging data between computers is FTP (File Transfer Protocol). Users may use it to share data and make backups and to upload and download files from distant servers. Due to its effectiveness and widespread adoption, FTP has remained a crucial protocol in the TCP/IP stack.

CHAPTER 2 | PROTOCOL ARCHITECTURE

Protocol Architecture

The foundation of the Internet is TCIP/IP: This Model is a better-optimized and more widely used model. It used the OSI Model as a reference and placed a strong emphasis on accuracy. The four-layer TCP/IP architecture serves as a foundation for the several protocols.

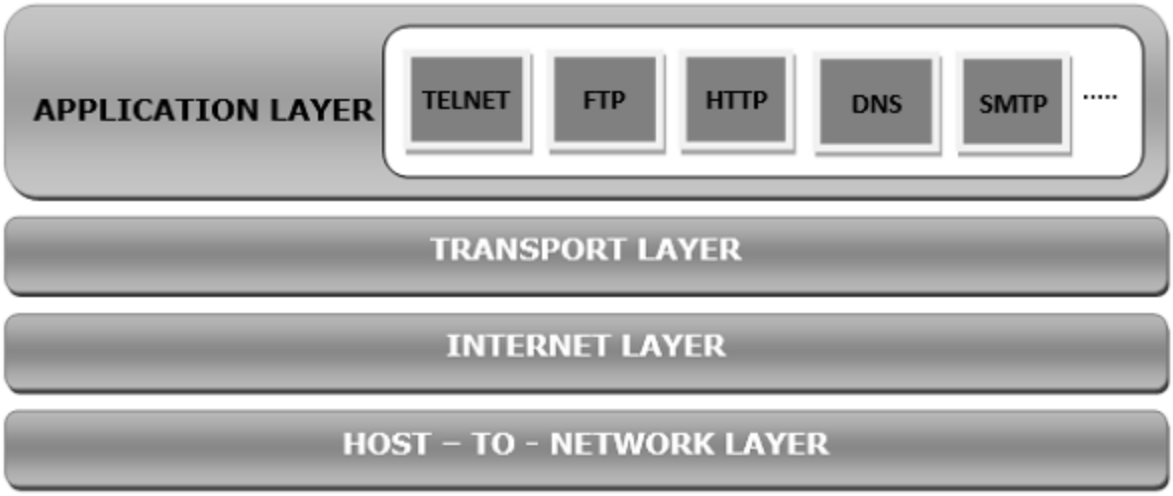
Introducing the layers below:

- Internet Layer
- Network Interface
- Application Layer
- Transport Layer

Application Layer

It is the layer closest to the end user in the OSI model, suggesting direct contact with the software program.

Many application protocols exist here and most provide user services, and new services are continually being introduced to this layer. Several well-known and used application protocols are as follows:



The Function Of The Application Layers Are:

- It has the ability to access cloud-based storages, offer mailing services, and give customers the option to forward multiple emails.
- • The virtual terminal, which is really an abstract data structure, is present. The OSI solution to the terminal standardization issue takes the abstract state of the physical terminal and manipulates it using both the keyboard and the computer.. Hence, it reflects the current state of the data structure on the display utilizing monitor.

Transport Layer

The TCP/IP protocol suite, which includes the Transport Layer, is essential for providing accurate and dependable data delivery across networks. This layer provides applications with end-to-end communication services and is positioned between the Application Layer and the Network Layer.

TCP and UDP are two essential protocols that the Transport Layer uses to let devices communicate with one another. Before sending data, TCP's connection-oriented protocol creates a fictitious link between the devices. Moreover, it has functions like flow control and error

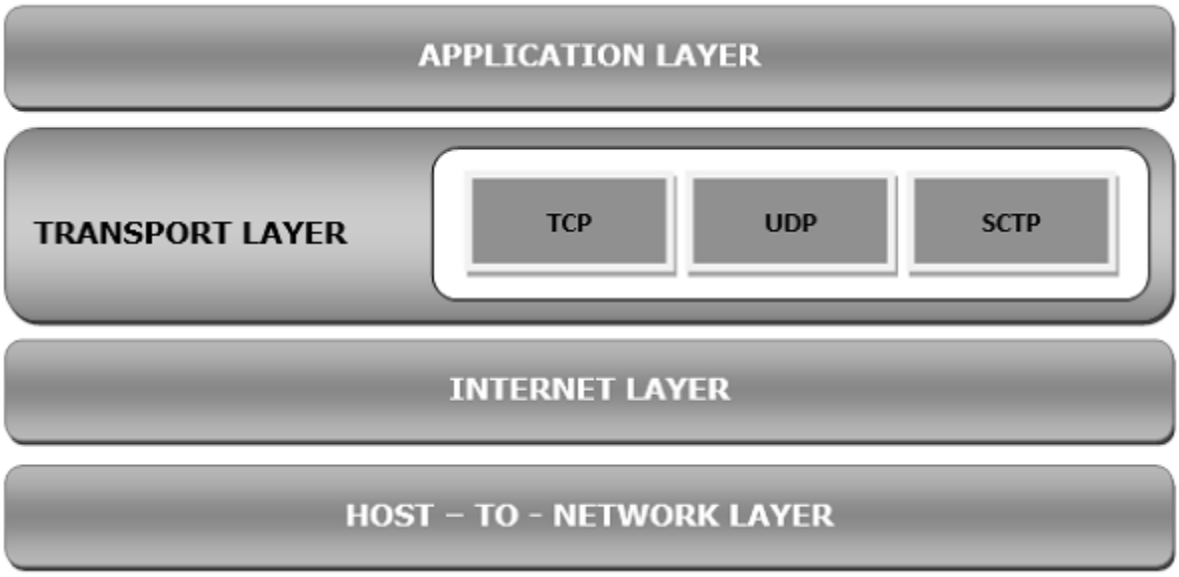
checking to guarantee the timely and accurate transmission of data packets. UDP, in contrast, does not create a virtual connection between the devices since it is a connectionless protocol. Although UDP is quicker than TCP, it does not provide the same degree of accuracy checking or dependability.

One of the most significant advantages of the Transport Layer is its ability to handle multiplexing, which allows multiple applications to communicate simultaneously over the same network connection. The Transport Layer accomplishes this by using port numbers to identify different applications and their associated data streams.

Overall, the Transport Layer plays a critical role in ensuring the efficient and reliable transmission of data across networks. It provides a robust and flexible framework for communication between devices and allows multiple applications to coexist on the same network connection.

Important Functions Of Transport Layers:

- It divides messages into a particular segment and checks if the data are sent to the destination or not. If the destination is not arrived then the data got replaced.
- End-to-end flow control and error control are carried out by the transport layer to ensure a dependable, error-free communication link between the sender and recipient. This guarantees error-free transmission of the full message. Retransmission is used to repair faults in cases of errors.



The protocols are being described below:

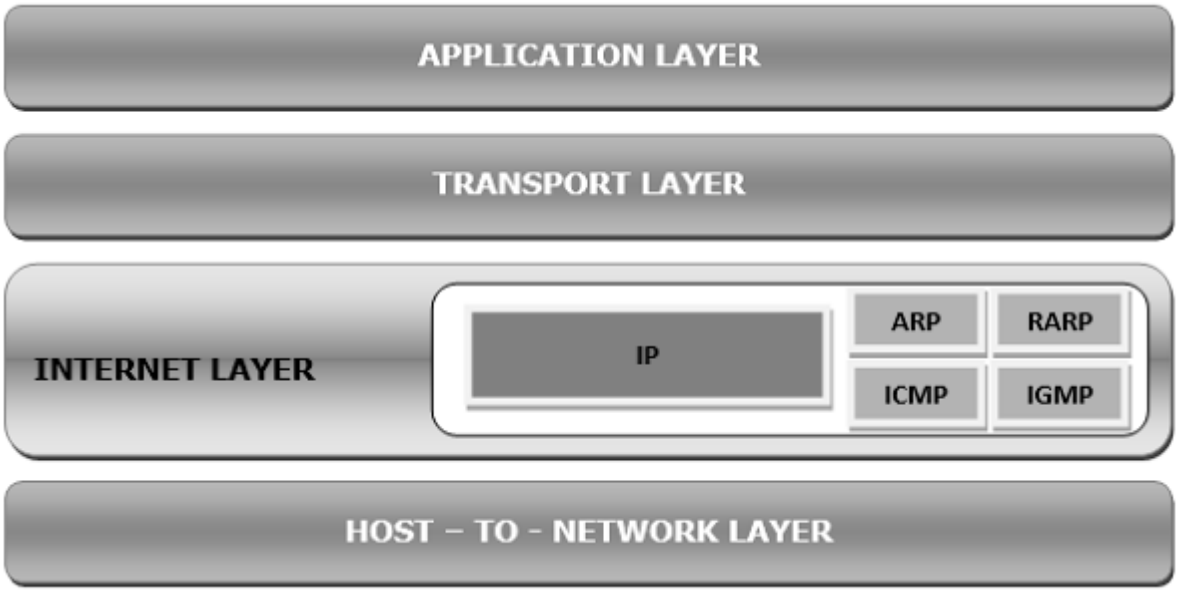
- It is a connection-oriented communications protocol. This protocol is especially helpful for message exchanging between various devices and also defines methods which are being used in transferring between computers.
- SCTP − Stream Control Transmission Protocol. It has a wide spread of usage from staring to carry signals and receiving. It is known as the basic transport in the internet.
- UDP − User Datagram Protocol, This protocol is important for sending data into the network. It requires IP to identify the networks, so it is known as one of the fundamental protocol of internet.

Internet Layer

Network packets from the originating host are transported over network boundaries using a collection of internetworking techniques, protocols, and specifications known as the internet layer. This layer is in charge of directing packets across the network from one host to another.

Since it manages the transmission control and datagram reassembly necessary for communication to occur, this layer is regarded as the design's core.

This layer is very helpful in identifying the packets along with their source and destination into the network. It searches for host using the IP roaming around in the internet and finds for the header and destination portion.



The third layer in the TCP/IP protocol family, the Internet Layer, is in charge of facilitating network communication. It makes use of a number of protocols, including the following:

The most basic protocol of the Internet Layer, Internet Protocol (IP), manages the addressing and packet routing between devices. It is a connectionless protocol, thus data may be sent between devices without first creating a virtual connection.
Devices communicate error messages and operational data via the Internet Control Message Protocol (ICMP). Reporting issues such packet delivery faults and network congestion is its main purpose.

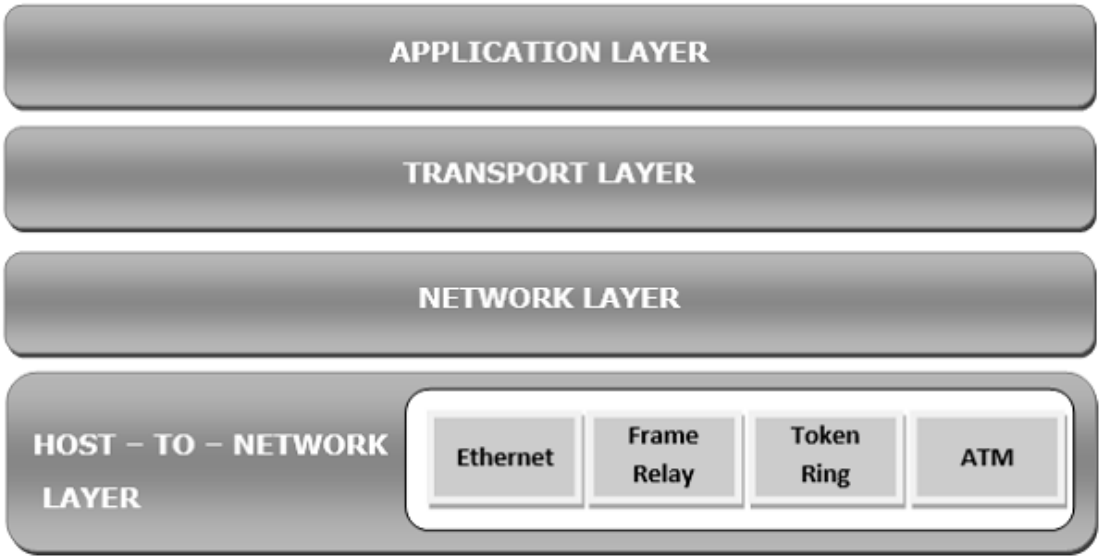
The Address Resolution Protocol (ARP) is in charge of translating a device's IP address into its MAC address on a network. For devices to connect with one another inside the same network, this mapping is necessary.
Reverse Address Resolution Protocol (RARP): This protocol functions in opposition to ARP by translating a device's MAC address, which serves as its physical address, to its IP address. Diskless workstations often utilize RARP to get an IP address.
Devices utilize the Internet Group Management Protocol (IGMP) to control multicast groups on a network. Devices may take part in and leave multicast groups as well as join and receive multicast data.

Overall, the Internet Layer protocols work together to enable communication between different networks. The Internet Protocol provides the basic framework for addressing and routing packets, while ICMP, ARP, RARP, and IGMP provide additional functionality for managing network communication. These protocols are essential for enabling communication over the Internet and ensuring that data is transmitted accurately and efficiently.

The Network Interface Layer

This layer defines the connection into a network and establishes relation between the devices. It is mainly the interface which creates the scope of implementing physical layer and making a connection with the data link layer, It creates boundary for transport and requires hardware to deliver data into the network. It is known as host to host network as it can form the relation between the interface of physical and data link layer.

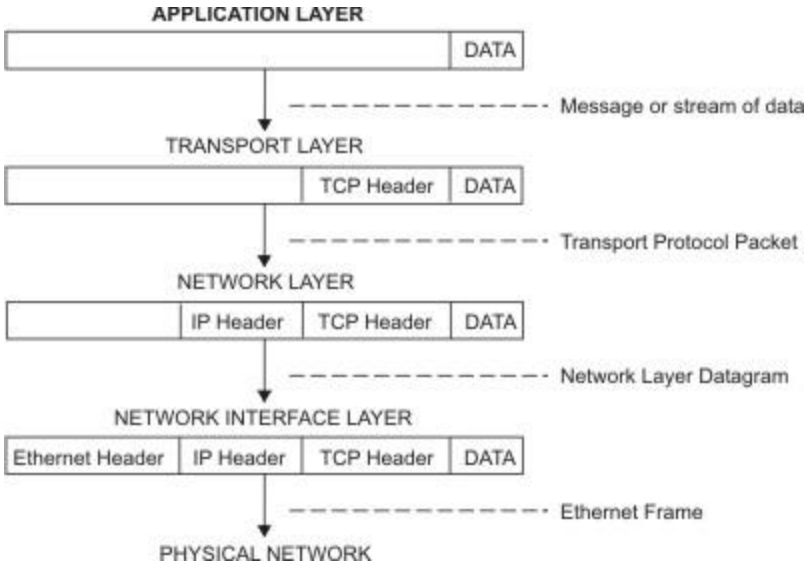
It selects the layers based on the transmission type and specifies a standpoint in the network. It also contents the networking capability idea to make an internet connection possible and makes sure that each packet is transmitted accordingly.



What is TCP Function? /IP's

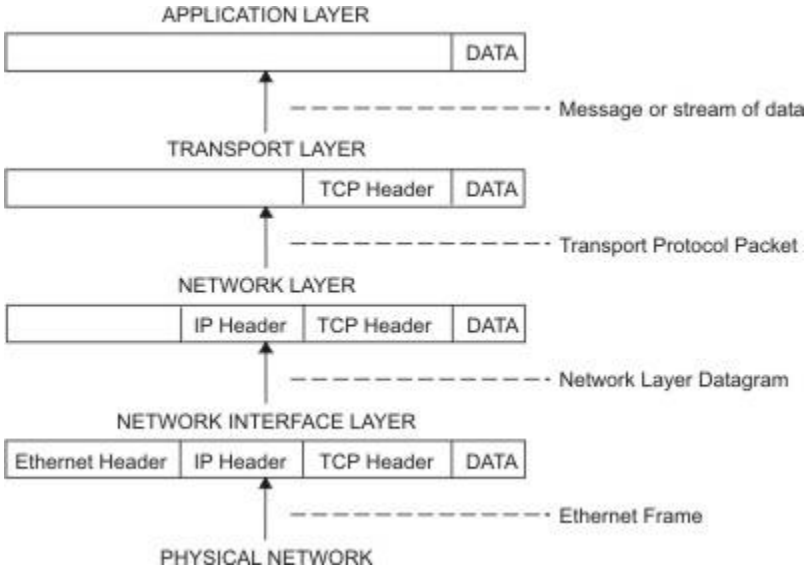
The client-server communication paradigm of TCP/IP. In it, a service is obtained by the user or device (the client) from a different computer (the server) connected to a network which enables the two-way transfer of information. This implies that computers using TCP for communication can send and receive data simultaneously.

After establishing the connection the client device creates packets of the data and send it to the destination according to their IP addresses. After reaching the destination client receives the packets and examines them. It makes sure that the packets are at their wright place and if any packet is found missing, they will be sent again. If no more data is received then the connection will be end. Application layer and the top three OSI layers are extremely similar.



The collection of communication protocols used to link devices to the Internet is known as TCP/IP, or Transmission Control Protocol/Internet Protocol. To send data across the network, TCP/IP divides information into little packets that may be assembled at the destination.

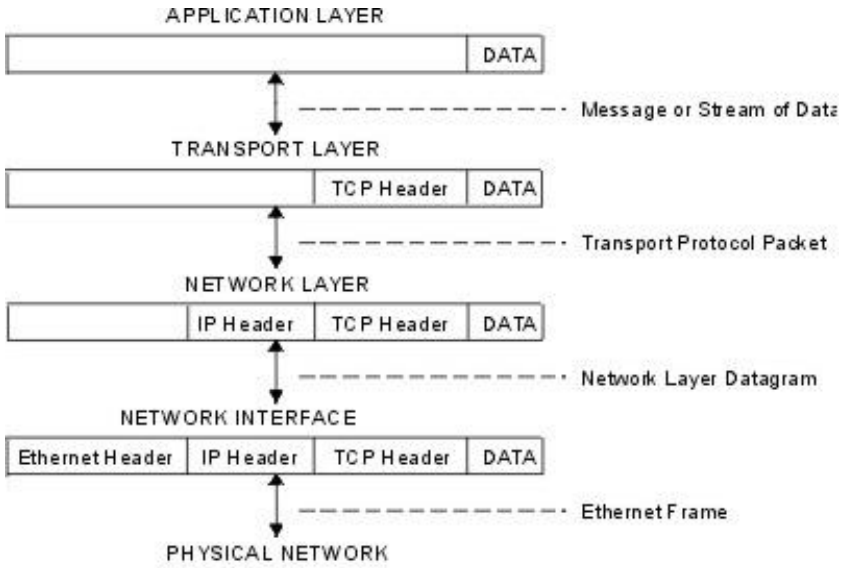
Here are the steps of how TCP/IP works:



- Data that has to be communicated across the network is generated by the application layer. Everything from a web page request to an email may constitute this information..

- The data is passed to the transport layer, which is responsible for breaking the data into packets that can be transmitted over the network. The transport layer uses TCP to ensure that the packets are transmitted in order and that no data is lost in the process.

- The information is broken up into packets and sent through the network, wireless or wired. The network layer at the receiving device verifies each packet's IP address to make sure it is meant for that device. The remaining packets are then sent to the transport layer, where TCP is used to put the original data back together in the proper sequence and make sure that no data was lost in the transmission process.



Note: Headers are added and stripped in each protocol layer as data is transmitted and received by a host

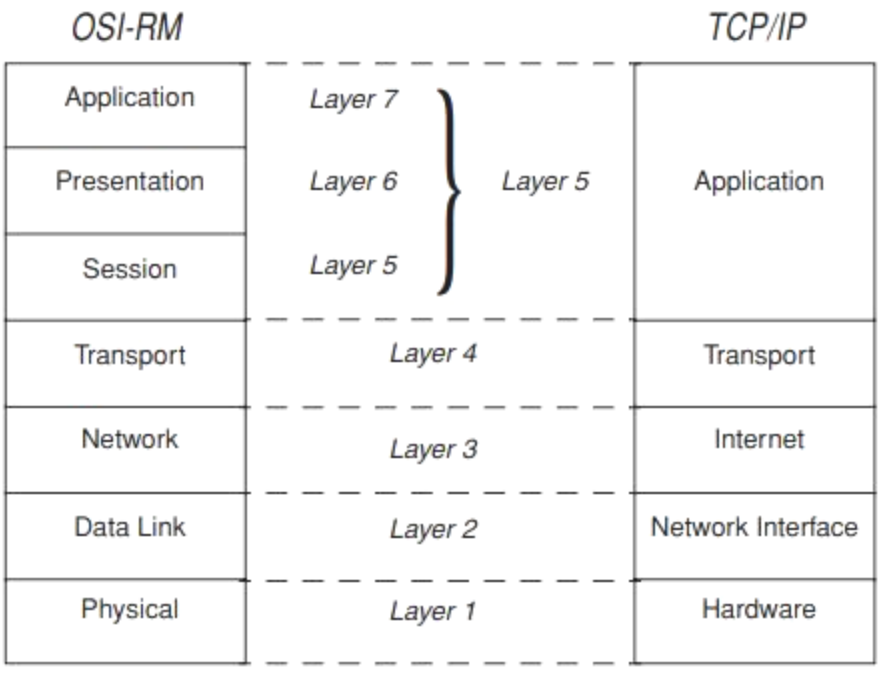
The application layer then receives the reconstructed data and provides it to the user in an understandable fashion.

In conclusion, TCP/IP transmits data across a network by dividing it into packets, adding addressing information to each packet, and reassembling the packets at the destination. With the help of this procedure, data is reliably and precisely delivered via the Internet..

CHAPTER 3 | COMPARISON AND STANDERDS

TCP/IP Model Vs. OSI Model

Parameters	OSI Model	TCP/IP Model
No. of Layers	There are 7 layers.	There are 4 layers.
Acronyms	OSI stands for open system interconnection.	TCP/IP stands for transmission control protocol/internet protocol
Developed by	ISO	Department of Defense (DoD)
Layer Separation	OSI model has a separate Presentation layer and Session layer.	TCP/IP does not have a separate Presentation layer or Session layer.
Protocol implementation	Model was defined before implementation takes place.	Model defines after protocol were implemented.
Model Concept	based on three concept i.e. Service, interface and protocol.	It did not distinguish between service, interface and protocol.
Reliable delivery	It gives guarantee of reliable delivery of packet.	It does not give guarantee of reliable delivery of packet.



Similarities:

These are several instances when the TCP/IP model and OSI model are similar.

- They are both models of logic.
- It makes it possible for organizations to collaborate online. It can be applied to connect two computers together.
- The TCP protocol uses sequence numbers that are specific to each packet and is connection-oriented to ensure that data is sent without any error.
- TCP offers dependable communication between the network's communicating hosts.
- Segment flow is controlled by the TCP protocol.
- It is never guaranteed that a packet will be in perfect order when it reaches its host when it is sent. Before they reach the application, TCP takes the required measures to restore the order in case it was lost along the way.

Standards For TCP And IP

Layered protocols make up the TCP/IP suite of protocols.. The Internet protocol suite is powered by IP. FTP operates even if the remote computer doesn't have a UNIX-based operating system,

unlike rcp. During file transfers, security is provided through the ftp function. This protocol suit is a collection of different protocols like TCP, UDP, FTP etc that has a specific function and format that is constantly developing to implement the protocol. The Network Information Center assigns 32-bit numbers, each of which is globally unique, as IP addresses. It requires an open standard development and a secure established network for governing the rules across devices in the network.

Part of the network, FTP enables the user to enter host name in the command line and sends requests to the local host. It is deployed by the IP and is handled by ftp that enables a user to rename a remote host file. It specifies the functions in the network layer and makes a connection using the IP. It transfers files using argument commands in the network.

What Distinguishes TCP/IP And IP?

The TCP/IP suite of protocols consists of the two separate protocols TCP (Transmission Control Protocol) and IP (Internet Protocol). They operate at separate levels of the OSI model and serve different purposes, yet working together to make Internet communication possible.

IP is a network layer protocol that provides the basic framework for routing packets between devices. Addressing packets and sending them in the right direction is its main duty. IP is responsible for breaking down data into packets and adding headers containing source and destination addresses to each packet. TCP, on the other hand, operates at the transport layer and provides additional functionality on top of IP. Its primary function is to ensure the reliable and ordered delivery of packets between devices. Sequence numbers are used to make sure packets are received in the right order and create a virtual connection between devices to do this.CP also provides features such as flow control and error checking to ensure that packets are transmitted efficiently and accurately.

Here are the steps to describe the differences between TCP and IP:

Both TCP (Transmission Control Protocol) and IP (Internet Protocol) are used in computer networking, although they have distinct purposes.

Data packets are transported across a network using IP from one device to another. Since it is a connectionless protocol, data transmission between two devices does not first need the creation of a dedicated communication channel. Instead, it autonomously transmits data packets and depends on other protocols (like TCP) to make sure they get to their intended location.

The TCP protocol, on the other hand, enables error-checked, dependable, and ordered data transport between programs that are executing on various devices. Before transferring data, it creates a connection-oriented communication channel between the two devices and makes sure that data packets reach their destination in the right sequence and error-free. The TCP/IP protocol suite, as it is often known called, combines TCP and IP.

IP is in charge of transferring data packets over a network, while TCP is in charge of ensuring dependable and sequential data transmission between programs operating on various devices.

In summary, IP and TCP are two distinct protocols that work together to enable communication over the Internet. Although TCP is in charge of assuring the dependable and orderly delivery of those packets, IP is responsible for routing packets between devices. IP provides the basic framework for communication, while TCP provides the mechanisms necessary for reliable data transmission.

In summary, IP is responsible for addressing and routing packets between devices, while TCP provides additional functionality to ensure the reliable and ordered delivery of those packets. IP provides the basic framework for communication over the Internet, while TCP provides the mechanisms necessary for reliable data transmission. Together, these protocols form the foundation of the TCP/IP suite and enable communication across networks.

CHAPTER 4 | PROS AND CONS OF TCP/IP

TCP/Benefits IP's And Drawbacks

One advantage of the TCP/IP model is that it is an open and widely-used standard, making it interoperable with a wide variety of network devices and software. According to an article by Cisco, the TCP/IP model has been embraced by the technology industry as the primary communication protocol for the internet, which has led to its widespread adoption.

Another advantage is that the TCP/IP model is highly scalable, which means it can support a large number of devices and network traffic. As noted in an article by Network Computing, the TCP/IP model's hierarchical design allows for the creation of larger networks by breaking them down into smaller, more manageable pieces.

Another benefit of the TCP/IP model is that it allows for flexible and modular network design. According to an article by InfoSec Institute, the TCP/IP model's layered approach makes it easier to identify and troubleshoot problems, as each layer can be tested and diagnosed independently.

Another advantage of the TCP/IP model is that it is adaptable and can support a wide range of applications and services. As noted in an article by TechTarget, the model can accommodate a variety of different protocols, including those used for email, file transfer, and web browsing, as well as emerging technologies such as IoT devices and cloud computing.

Finally, the TCP/IP model has proven to be highly resilient, with the ability to route traffic around network failures and congestion. As noted in an article by Network World, the TCP/IP model's packet-switching approach allows for dynamic routing, which helps to ensure reliable delivery of data even in the face of network outages or congestion.

Some of the disadvantages of the TCP/IP model are being mentioned below:

- The TCP/IP model has the drawback of being a sophisticated protocol suite that can be challenging to manage and troubleshoot. The TCP/IP model contains numerous protocols and layers, which makes it challenging for network administrators to keep track of and

guarantee that each layer is operating correctly, according to an article published in Network World.

- Another drawback is that the TCP/IP model may not function as effectively on wireless networks because it was created for wired networks. As highlighted in an article by Cisco, wireless networks can pose challenges like as interference and signal degradation, which can lead to packet loss and delays in data delivery.

- Another major problem with the TCP/IP model is that security was not prioritized throughout development. The TCP/IP model lacks built-in security features, which can render it vulnerable to online attacks, according to an InfoSec Institute article. To ensure secure communication, additional security protocols like SSL and IPSec must be built on top of the TCP/IP model.

- Furthermore, the TCP/IP approach may be rigid when it comes to incorporating new features and protocols. The model was created in the 1970s, according to a TechTarget article, and has not seen any significant updates since. This might limit its utility in the future by making it difficult to adapt to new technologies and protocols as they develop.

CHAPTER 5 | CONCLUSION

Conclusion

The TCP/IP model is a theoretical framework used to standardize the internet's communication protocols.

Applications and programs communicate with the network at the application layer using protocols like HTTP, SMTP, and FTP. By employing protocols like TCP and UDP, the transport layer makes ensuring that data is transmitted between systems in a reliable manner. The internet layer is responsible for using IP protocols to route data packets across the internet. The network

access layer is ultimately in charge of handling the actual physical transfer of data across the network using Ethernet or Wi-Fi technologies.

The TCP/IP model serves as a crucial building block for internet communication and offers a standardized method for communication between various networks and devices. Almost all internet-connected devices use it, and it is continually changing to meet those changing needs.

Even though the model has flaws and detractors, it is still a vital tool for networking and communication. It has become the de facto norm for online communication and has had a huge impact on the development of the modern internet. The TCP/IP model is anticipated to keep changing as technology progresses in order to keep up with the demands of the ever-expanding internet.

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