An Era of TCP/IP in Computer Network and Communication

Dr. Dinesh Jain
Associate Professor
Department of Information Technology
Acropolis Institute of Technology and Research, Indore, India

Abstract— There is a significant of protocol in the communication and networking like transmission control protocol and internet protocol, to send and receive the data like text message, audio, video and image across the globe. The Internet is the most demanding and useful medium through which all the businesses, surfing and communication is possible and it is possible by TCP/IP layered model and different types of protocols are used on it. It was the first protocol defined in ARPANET and is also known as Internet Model.

Keywords: TCP, IP, TCP/IP, OSI, Layer, Network

I. INTRODUCTION

This was the first networking model because it consists of two important protocols like TCP (transmission control Protocol) and IP (Internet Protocol) used in ARPANET to send the data form one place to other. It provides end to end connectivity, data packetization, addressing, transmission of data in network. There are four layers of TCP/IP model; it is condensed model of OSI reference model [1]. In this, the upper layer handles the message assembling into small packets while the lower layer is taking care of packet addressing. TCP/IP communication is primarily point-to-point, meaning each communication is from one point in the network to another point or host computer. Any Internet users are familiar with the even higher layer application protocols that use TCP/IP to get to the Internet [2].

II. TCP/IP LAYERED MODEL

There is condensed version of OSI model which is practically implemented in the system for communication. It uses the client and server model of communication in which a computer user requests and is provided a service by another system in the network [3]. The communication in TCP/IP is point-to-point, means each communication is from one point to another point in the network. There are four layers model as shown below [4].

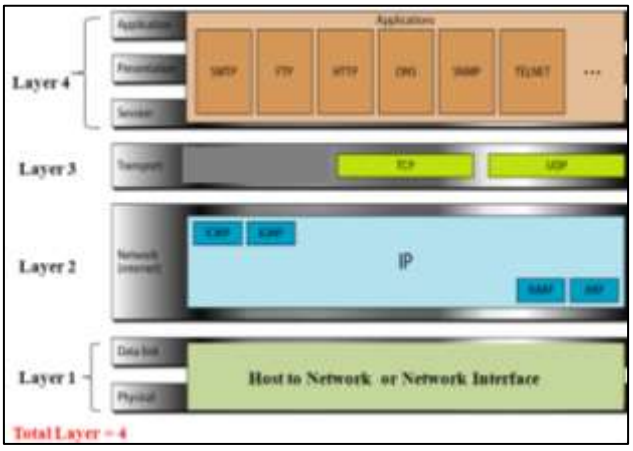

Fig. 1: TCP-IP Protocol Suite

A. *Layer1 (Host to Network or Network Interface)*

- This layer also known as the link layer or the data-link layer.
- This is the lowest layer and provides the interface to the actual network hardware.
- It is responsible for all the functions that are needed to carry the bit stream/packets from source to destination over a physical medium like Ethernet and PPP.
- In this layer, the bit streams are organized into a data units and this data units are also known as Frame.
- In this frames are delivers to an adjacent system for example WiFi, SLIP.

B. *Layer2 (Network Layer)*

- This layer also known as Internet layer.
- At this layer, data is converted in the form of packets which contains the IP address of source and destination.
- It is responsible for sending and receiving TCP/IP packets on the network medium like IP (IPv4, IPv6).
- This layer consists of IP, ICMP, IGMP, ARP and RARP protocols.
- This layer helps the packet to travel independently to the destination.
- IP provides a routing function that attempts to deliver transmitted messages to their destination.
- In this layer internet protocol is the most important protocol and it is a connectionless protocol.
- This layer exchanges the datagram across network boundaries.
- It provides a uniform networking interface that hides the actual topology of the underlying network connections.

C. *Layer3 (Transport Layer)*

- This layer provides the end-to-end data transfer by delivering data from an application to its remote peer.
- It supports multiple applications simultaneously.
- The Transport Layer performs host-to-host communications on either the same or different hosts and on either the local network or remote networks separated by routers
- This layer consists of TCP (Transmission Control Protocol), which provides connection-oriented reliable data delivery, duplicate data suppression, congestion control, and flow control and UDP (User Datagram Protocol), which provides connectionless, unreliable services.
- This layer is concerned with process-to-process delivery of information.
- Functions such as multiplexing, segmenting or splitting on the data is done by transport layer.
- Transport layer breaks the message (data) into small units so that they are handled more efficiently by the network layer.

- It decides if data transmission should be on parallel path or single path.
- The applications can read and write to the transport layer and adds header information to the data.

D. Layer4 (Application Layer)

- This is the top layer of TCP/IP model.
- The application layer is provided by the program that uses TCP/IP for communication
- An application is a user process cooperating with another process usually on a different host.
- The interface between the application and transport layers is defined by port numbers and sockets.
- This layer provides and user interface to access the services and applications like internal representation,
- and peer-to-peer networking anything else that the user requires like HTTP, FTP, SMTP, SSH, POP3, TLS/SSL, DNS.
- The communications partners are characterized by the application architecture, such as the client-server model.
- This layer consists of higher level protocols like SMTP, FTP, SSH, HTTP, TELNET, SNMP, DNS [5].

III. What Actually is TCP/IP?

There is a big confusion among students and learners they know about TCP/IP model and its different layers functions, how the layers play a vital role towards the communication and networking across the globe but few of them know about the TCP/IP model like where it resides inside the computer systems? Is there requirements to install this model to work properly and if yes, how to install, configure & its settings? So, these types of question come into mind of every student [6]. The answer is, TCP/IP model is software which runs on computers with an operating system to manage resources like peripheral devices and provide the solution for everything that require to networking and communication. Operating systems provide support for concurrent processing even on machines with a single processor, they give the illusion that multiple programs can execute simultaneously by switching the CPU among them rapidly [7].

As we know operating systems of digital gadget manage main memory that contains executing programs, as well as secondary storage, where file systems reside.

Basically, TCP/IP software resides in the operating system, where it can be shared by all application programs running on the machine. The operating system contains a single copy of the code for a protocol like TCP, and multiple programs can invoke that code. Each invocation must operate independently so that data transferred by one program does not affect the data transferred by another [8].

IV. How to Configure TCP/IP?

Following are the steps used to configure the TCP/IP model into computer system.

- Step1: Control Panel and select Network and internet connections go to Network Connections.
- Step2: Select Local Area Connection and choose Internet Protocol (TCP/IP) then go to Properties.

Fig. 2.1: Configuration of TCP/IP

- Step 4: There are two ways to configure as shown below
  - 1st Way (Obtain an IP address automatically):
- Step 5: Select Obtain an IP address automatically and Obtain DNS Server address automatically, as shown in the figure and then click OK to save setting.

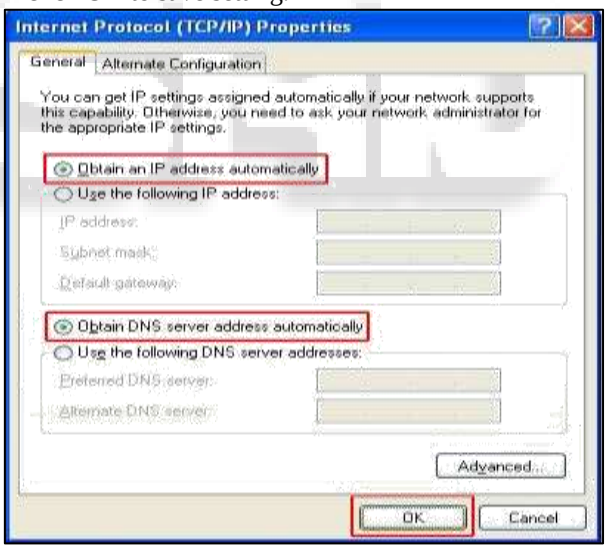

Fig. 2.2: Configuration of TCP/IP

- 2nd Way (Assigned Manually IP address): In this, we have to assigned IP address manually and then click OK to save the settings.

V. TCP/IP vs. OSI Model

TCP/IP model is an implemented model for the communication and networking across the globe [9]. All the communication happens via this model while the OSI model is a reference model or theoretical model and taken as a reference for the study. There are many differences in TCP/IP and OSI but few important differences are shown into the table below [10].

Criteria	OSI Model	TCP/IP Model
Definition or Meaning	It is a theoretical model which is used for computing system	It is a client server model which is used for transmission over the Internet
Developed by	ISO (International Standard Organization)	DoD (Department of Defense)
Protocol	Generic Protocol	Standard Protocol
No. Layers	Seven Layers	Four Layers
Approach	Follows vertical approach.	Follows horizontal approach.
Type of Model or Application	It is a conceptual model which is not practically used for communication	It is used for establishing a connection and communicating through the network.
Utilization	Never Used	Mostly Used

Fig. 3: OSI vs. TCP/IP Model

VI. PROTOCOLS AND HEADER FORMAT

There are three types of protocols are used in this like TCP, IP and UDP which plays a significant role towards the communication [11].

A. Transmission Control Protocol (TCP):

It is a transport layer protocol used by most Internet applications, like telnet, FTP and HTTP.
It is connection-oriented protocol and provides reliability to the users.

It sends data (segments) with the help of Internet Protocol, each segment contains 20 bytes of header information with IP header [12].

source port number			destination port number
sequence number			
acknowledge number			
header	reserved	urg,ack ,psh,rst ,syn,fin	window size
TCP checksum			urgent pointer
options (if any)			
data (if any)			

Fig. 4: TCP Header Format

B. Internet Protocol (IP):

It plays a significant role in TCP/IP model to transmit the data over the network across the globe.

It is a connectionless protocol and its working is like a postal service to deliver a letter to the destination.

At the network layer segment converts into the Packet which contains the sources and destination address, routes one packet at a time to the destination and does not bother whether the packet reaches or not to destination [13].

version	length	type of service	total length	
identification			flags	fragment offset
time to live		protocol	header checksum	
source IP address				
destination IP address				
options (if any)				
Data				

Fig. 5: IP header format

C. User Datagram Protocol (UDP):

It is a connectionless and unreliable protocol.

It is used by protocol like the Simple Network Management Protocol (SNMP).

Due to unreliable, there is no mechanism for ensuring that data sent is received properly at the destination [14].

In this, the data is sent in the form of datagram as follows [15].

source port number	destination port number
UDP length	UDP checksum
Data	

Fig. 6: UDP Header Format

VII. CONCLUSION

With the increase of technology in the networking and communication from ARPANET to X.25 and then the Internet came into picture, due to changes in this technology the complexity of networks evolved rapidly. The TCP/IP model played a significant role to send and receive the message over the internet because it is the combination of most important protocols like transmission control protocol and internet protocol which provides the various functions and services to the users so they could easily be transfer and receive the message over the network and internet and we can call the TCP/IP model as a backbone on Internet and network. This model comes in all gadgets and mostly no need to put extra effort for installation and just plug in the Ethernet cable to enjoy the Internet on the system.

REFERENCES

[1] KarnatiHemanth, TalluriRavikiran, MaddipatiVenkat Naveen, Thumati Ravi, "Security Problems and Their Defenses in TCP/IP Protocol Suite", International Journal of Scientific and Research Publications, Volume 2, Issue 12, December 2012 1 ISSN 2250-3153.
[2] Shreya Gangane, Prof. Vinit Kakade," Base of the Networking Protocol – TCP/IP Its Design and Security Aspects", International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE), ISSN:2320-9801, Vol. 3, Issue 4, April 2015.

[3] Behrouz Forouzan and Firouz Mosharraf, Computer Networks: A Top-Down Approach, International Ed, Mc Graw Hill, USA, 2012.
[4] Douglas Comer, Internetworking With TCP/IP Volume1:Principles, Protocols, and Architecture", 5th Ed, Prentice Hall PTR, 2006.
[5] James Kurose and Keith Ross, Computer Networking: A Top-Down Approach, 5th Ed, Boston, MA: Addison Wesley, 2009.
[6] Postel, J. (1981), Transmission Control Protocol, RFC793.
[7] University of South California (1980), DOD StandardInternet Protocol, RFC 760.
[8] Cerf, V. , and R. Khan, "A Protocolfor PacketNetwork Intercommunication" (1974)
[9] The present and the future of TCP/IP, David Espina, DariuszBaha.
[10] W. R. Stevens, TCP/IP Illustrated Vol. 1 – The Protocols, Addison-Wesley, 1994.
[11] M.Anand Kumar, Security Model for TCP/IP Protocol Security, Karpagam University.
[12] Yongguang Zhang, A Multilayer IP Security Protocol for TCP Performance Enhancement in Wireless Networks, Member, IEEE.
[13] Huston G., Telstra (2000), The future of TCP, The internet protocol Journal, Cisco Systems, Vol.3, Nº3.
[14]] B. Qureshi, M. Othman,(2009),"Progress in Various TCP variants", IEEE, and N. A. W. Hamid.
[15] Wei D. et al, (2004), Fast TCP, Engineering & Applied Sciences, Caltech.

