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RESEARCH ARTICLE

CHALLENGING ISSUES IN OSI AND TCP/IP MODEL.

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Abstract

A computer network is a connection of network devices to data communication. Multiple networks are connected together to form an internetwork. The challenges of Internetworking is interoperating between products from different manufacturers requires consistent standards. Network reference models were developed to address these challenges. Two useful reference models are Open System Interconnection (OSI) and Transmission Control Protocol and Internet Protocol (TCP/IP) serve as protocol architecture details the communication between applications on network devices. This paper depicts the OSI and TCP/IP models, their issues and comparison of them.

Introduction:-

Network reference models are called protocol architecture in which task of communication can be broken into sub tasks. These tasks are organized into layers representing network services and functions. The layered protocols are rules that govern end-to-end communication between devices. Protocols on each layer will interact with protocols on the above and below layers of it that form a protocol suite or stack. The most established TCP/IP suite was developed by Department of Defence's Project Research Agency DARPA based on OSI suite to the foundation of Internet architecture. On the other hand, the OSI protocol suite was never widely implemented. TCP/IP allows one application on one computer to talk to another application running on different computer.

The rest of this article is organized as follows: Section 2 details the needs of protocol architecture, layers and protocols of OSI and TCP/IP protocol suites which compared in Section 3. Section 4 describes briefly design issues of OSI and TCP, Finally Section 5 presents conclusion and future enhancements.

OSI and TCP/IP Layers and protocols:-

This section describes the important of protocol architecture and two useful network reference models consist of ISO and TCP/IP. The procedure involved for the data or file transfer can be quite complex as a single module. Instead, the task is separated into modules, are vertically stacked in protocol architecture. Each layer in the stack performs some of the related functions. It relies on the next lower layer to perform more primitive functions. It gives services to the next higher layer. The peer layers communicate using a set of rules or conventions known as a protocol [1].

The useful protocol architectures are OSI and TCP/IP suite. Open Systems Interconnection reference model is the oldest networking model, developed by International Organization for Standardization (ISO). The functions of OSI can internally be broken up into seven layers: Physical, Data Link, Network, Transport, Session, Presentation and

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Application Layer. TCP/IP protocol suite consists of five layers: Physical, Network Access, Internet (host-to-host) and Application layer as result of protocol research and development, conducted by ARPANET, funded by the Defense Advanced Research Projects Agency (DARPA). All of these layers restrain certain protocols which carry out a number of tasks in order to data communication. TCP/IP protocol architecture has come to dominate even if various useful protocols have been developed in the framework of OSI. Figure 1 illustrates OSI and TCP/IP layers and protocols.

TCP/IP	OSI Model	Protocols
Application Layer	Application Layer	DNS, DHCP, FTP, HTTPS, IMAP, LDAP, NTP, POP3, RTP, RTSP, SSH, SIP, SMTP, SNMP, Telnet, TFTP
	Presentation Layer	JPEG, MIDI, MPEG, PICT, TIFF
	Session Layer	NetBIOS, NFS, PAP, SCP, SQL, ZIP
Transport Layer	Transport Layer	TCP, UDP
Internet Layer	Network Layer	ICMP, IGMP, IPsec, IPv4, IPv6, IPX, RIP
Link Layer	Data Link Layer	ARP, ATM, CDP, FDDI, Frame Relay, HDLC, MPLS, PPP, STP, Token Ring
	Physical Layer	Bluetooth, Ethernet, DSL, ISDN, 802.11 Wi-Fi

Figure 1:- OSI and TCP/IP Layers and Protocols

Physical Layer:-

The physical provides the architecture for raw bits to be sent and received over a transmission medium. It details the mechanical, electrical and procedural network interface specifications and the physical transmission between two pieces of network devices. The physical layer decides the following [4]:

- Establishing and breaking of network connection
- Deals with physical transmission medium in both directions
- Electrical Specifications -Signal Level, Data rate
- Mechanical Specifications-Number of pins and roles of every pin in network connections.

Electronics Industries Association (EIA) developed variety of physical layer protocols such as RS-232C, RS-449 standards. The physical layer is in all probability the easiest layer to troubleshoot other than difficulty to construct or repair it.

Data Link Layer:-

The data link layer is called Link Layer, separated into two sub layers based on the architecture used in the IEEE 802 Project: logical link control (LLC) and media access control (MAC). It define many wired and wireless local area networking (LAN) technologies such as Ethernet, Token Ring, FDDI and 802.11 ("wireless Ethernet" or "Wi-Fi')[5].

The following functions are performed at the Data Link Layer:

- Establishment and control of logical links between local devices on a network
- Devices control access to the network medium
- Error Detection and Handling
- Encapsulation of higher-level messages into *frames* transferred over the network at the physical layer.
- Addressing information to be sent to a particular destination location

In TCP/IP, the data link layer is called Network interface layer. It implements network at local level and interface between the hardware oriented physical layer, and the ore abstract, software oriented function of the network layer and the above it [6]. As a result of the development of internet, the internet protocol is to be lack of unreliability and best effort delivery. This lack of reliability causes many effects. Data corruption, Packet loss, Duplicate arrival, Out-of-order packet delivery are raised due to the reliability of data delivery, called connection-less protocol.

Network Layer:-
Network Layer describes functions of internetworks. It controls the function of the subnet; make a decision which physical path the data should take based on network conditions, priority of service, and other factors [7]. It makes the traffic decisions, traffic control, fragmentation and logical addressing. Internet Protocol (IP), Internet Control Message Protocol (ICMP) and Internet Group Message Protocol (IGMP) [8]. It also breaks up the outgoing messages into packets and to pull together incoming packets into messages for higher levels.
Network layer performs the following jobs:

- Fragment a frame for transmission and re-assembly at the destination station
- Mapping logical addresses into physical addresses concerned with circuit, message or packet switching.
- Error handling and diagnostics
- Encapsulate messages received from higher layers into packets in a network layer header.
- routes datagram among networks

Internet layer of TCP/IP model is similar to network layer in OSI protocol architecture, helps the packets to travel independently and order them to the receiver. Packet switching network is based on connection less protocol (Internet Protocol).

Transport Layer:-
The network layer protocols provide best effort communications, and do not guarantee delivery of data. The transport layer ensures that reliable and efficient communication between network devices. It has connection-oriented and connectionless protocols, are Transmission Control Protocol (TCP) User Datagram Protocol (UDP) respectively.TCP provides reliability and data management services while UDP does not.

The transport layer encompasses the following related jobs:

- Lost transmission detection and handling, and
- Managing the rate at which data is sent to ensure that the receiving device is not overwhelmed
- End-to-End data transport
- Message segmentation, message reordering to ensure message sequence and acknowledgement
- Traffic control and session multiplexing
- End-to-End Error control through retransmission and Flow control

In TCP/IP, the transport layer function like OSI suite encapsulation or adds header information to the data, multiplexing, splitting and segmenting on the packets which are arranged in sequence to the destination.

Presentation Layer:-
The presentation layer deals with the syntax and semantics of the information transmitted. It formats the data into particular type of application with file extensions. Examples of Presentation layer formats are RTF, ASCII, EBCDIC (text), GIF, JPG, TIF (images), MIDI, MP3, WAV (audio) and MPEG, AVI, MOV (movies) [10].
The presentation layer provides:

- Compression and decompression of the data as well
- Encapsulate the data effectively

Session Layer:-
Session Layer establishes a session between two application processes on different machines.
Session Layer provides the following responsibilities:

- Establish and terminates a connection
- Manage and maintain a connection
- Handles authentication and authorization
- Verifies of data delivery

Application Layer:-
The application layer acts as the window for users and application to access network services. There are various familiar protocols to internet user: File Transfer Protocol (FTP), Domain Name Service (DNS), Hypertext Transfer Protocol (HTTP) and Simple Mail Transfer Protocol (SMTP).

The responsibilities of application layers are:

- Remote file access and printer access
- Directory services and Resource sharing
- Network management and electronic messaging
- Inter-process communication and Network virtual terminals

Application layer of TCP/IP described about many applications same as OSI model. TELNET allows remote login, File Transfer protocol gives reliable and efficient file transfer, Simple Mail Transfer protocol allows electronic mail transfer. Domain Name System resolves an IP address into a textual address for host connected over internet [10].

Comparison of OSI and TCP/IP Models:-

The standard reference model is OSI, depicts how the protocols interact with one another. TCP/IP maps obviously into OSI model, however is well-situated to sense in terms of the OSI model when describing protocols.

The responsibilities of layers 5, 6 and 7 in the OSI model are handled by the application layer of TCP/IP. OSI model guarantees reliable delivery packet delivery at the transport layer, whereas UDP in TCP/IP suite does not guarantee. TCP/IP also offers an option called UDP that does not guarantee reliable packet delivery [2]. TCP/IP has few layers while the OSI model consists of 7 architectural layers.

TCP/IP gains creditability because TCP/IP protocols are the standards around which the internet was developed despite the fact that networks are not generally built concerning the OSI model, just used as a guidance tool [3].
The characteristics of session layer are provided by the TCP protocol in transport layer. Both architecture models employ all connection and connectionless models at transport layer. In OSI model, the network layer provides both connectionless and connection-oriented services while the internet layer provides entirely connectionless. The data link and physical layers of the OSI correspond *directly* to the subnet layer of the TCP/IP model.

The OSI model provides reliability while TCP/IP deals reliability as an end-to-end problem. Each layer of OSI architecture detects and handles error whereas in TCP/IP, transport layer handles all error detection and recovery.

TCP/IP intelligent hosts participate in most network protocols, carry out end-to-end verification, routing, and network control as a result the TCP/IP internet can be viewed as a data stream delivery system. On the contrary, Hosts on OSI suite do not handle such network operations.

Design Issues of Layered Protocols:-

The unique characteristics of wired and wireless networks require dynamic layered protocols to improve the performance of network functions. There exists the following major design challenging issues in development of efficient, reliable and dynamic layered protocol [11].

A variety of issues are explored to design a reliable transport protocol for wired and wireless network:-

- Optimizing transport layer protocols need to be done with the lower because the performance of the transport layer considerably depends on the lower layers
- Different wired and wireless networks requires TCP variants as a result it is not possible to design various transport layer, so there is a challenge to design dynamic adaptive transport protocol

To design the application layered protocols, the developer should consider the following issues:-

- Application protocols should integrate private and public networks
- New applications need to be deliberated according to special features and compensation of the Networks
- Lower layer protocols need to work interactively with the application layer in order to provide Quality of service (QoS) of the application

The following constrains should be accounted while designing Network layered protocols:-

- Routing information and Flow control
- New link metrics require to be accounted
- Network layer protocols should works together with Data Link layer protocols

The following issues are to be investigated while designing Data Link Protocols:-

- To network configuration changes, channel assignment schemes need to be adaptive
- Challenge in increasing or decreasing multiple physical data rates
- Advanced bridging functions should be designed in protocols for network integration

The following major challenging issues to be taken into account on the physical layer:-

- The physical layer needs to function with Higher-layer protocols to optimize the networking functions
- Cost of data transmission medium
- Characteristics of wired and wireless medium
- Sensing, spectrum, frequency, bandwidth, wave length of signal, and mobility

Conclusion:-

The present and future wired and wireless networks are promising advanced features and technology for a number of talented and commercially attractive applications such as broadband home and transport intelligent networking. These networks should become dynamically self – configured and self-organized to bring several advantages for end-user. Consequently, there exists demand to design and implement dynamic and reliable layered protocols to optimize the networking functions. In this paper, the major functions and design challenging issues of most important two OSI and TCP/IP architectures have been discussed. It helps the internet developers to design distributed, self-configured and large-optimized networks. In future, we plan to discuss challenges and issues in network devices.

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