The Layered Protocols

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Standards are documented agreements containing technical specifications or other precise criteria that stipulate how a particular product or service should be designed or performed. Without it, it would be very difficult to design a network because one could not be certain that the software or hardware from different manufacturers would work together.

The Need for Standards

- Over the past couple of decades many of the networks that were built used different hardware and software implementations, as a result they were incompatible and it became difficult for networks using different specifications to communicate with each other.
- To address the problem of networks being incompatible and unable to communicate with each other, the International Organization for Standardization (ISO) researched various network schemes.
- The ISO recognized there was a need to create a NETWORK MODEL that would help vendors create interoperable network implementations.

Institute of Electrical and Electronics Engineers (IEEE)

- It is an international society composed of engineering professionals. It aims to promote development and education in the electrical engineering and computer science fields.
- It also maintains a standard board that establishes its own standards and electronics and computer industries and contributes to the work of standards-setting bodies such as ANSI.
- In Data Communications, the IEEE is probably best known for the standardization of the LAN technologies. IEEE's Project 802 aided in the standardization of Ethernet (802.3), token-ring (802.5) and Wireless LAN's (802.11). Project 802 further divided OSI's Data-Link Layer into sub-layers – the LLC (Logical Link Control) Sub-Layer and the MAC (Media Access Control) Sub-layer.

American National Standards Institute (ANSI)

- It is an organization composed of more than one thousand representatives from industry and government who together to determine standards for electronics, industry and other fields such as chemical and nuclear engineering, health and safety, and construction.
- This organization is known for published standards such as American Standard for Code Information Interchange (ASCII) and Small Computer System Interface (SCSI).

Electronic Industries Alliance (EIA)

- It is a trade organization composed of representatives from electronics manufacturing firms across the United States.
- This organization do not only set standards for its members, but also write ANSI standards and lobbies for legislation favorable to the growth of the computer and electronic industries.

Telecommunications Industry Association (TIA)

- It focuses on standards for information technology, wireless, satellite, fiber optics, and telephone equipment.
- The best known standards to come from the TIA/EIA alliance are its guidelines for how network cable should be installed in commercial buildings, known as the "TIA/EIA 568 – B Series".

Internet Engineering Task Force (IETF)

- It is an organization that is responsible for the overall development of the internet and the standardization of internetworking technologies. In short, the IETF is the one who sets standards for how systems communicate over the Internet – in particular, how protocols operate and interact.
- The IETF hierarchy consists of the following major groups below:
    - **Internet Society (ISOC)** – This oversees the overall development on the Internet.
    - **Internet Engineering Steering Group (IESG)** – This oversees the activities of IETF and manages the process used to introduce or update Internet standards.
    - **Internet Architecture Board (IAB)** – This serves as the technology advisory group to the Internet Society and is responsible for the overall development of the protocols and architecture (design and management) associated with the Internet.
    - **Internet Assigned Numbers Authority (IANA)** – This oversees Internet naming and addressing; they are in charge of all "unique parameters" on the Internet including IP (Internet Protocol) addresses. Each domain name is associated with a unique IP address, a numerical name consisting of four (4) blocks of up to three (3) digits each, e.g. 204.146.46.8, which systems use to direct information through the network.

Organization for Standardization (ISO)

- The International Organization for Standardization (ISO) is an International standards organization responsible for a wide range of standards, including many that are relevant to networking.
- **Advantages of ISO**:
    - All your processes are evaluated, standardized and explained to personnel.
    - Training new employees is much easier.
    - Problems are detected more quickly and solutions are improved.
    - Improved customer satisfaction.
    - Better understanding of customer needs.
    - Better perception of your company
    - Suppliers become more partners.
    - Overall communication is improved.
    - Better knowledge of company by employees.
    - Improved participation of employees.

The OSI Reference Model

- The Open Systems Interconnection (OSI) reference model is a descriptive network scheme. It ensures greater compatibility and interoperability between various types of network technologies.
- The OSI model describes how information or data makes its way from application programs (such as spreadsheets) through a network medium (such as wire) to another application program located on another network.
- The OSI reference model divides the problem medium into seven (7) smaller and more manageable problems

A Layered Network Model

- The OSI Reference Model is composed of seven (7) layers, each specifying particular network functions.
- The process of breaking up the function or tasks of networking into layers reduces complexity.
- Each layer provides a service to the layer above it in the protocol specification.
- Each layer communicates with the same layer's software or hardware on other computers.

- Data is Encapsulated with the necessary protocol information as it moves down the layers before network transit.

LAYER 7: APPLICATION

- The application layer is the OSI layer that is closest to the user.
- It provides network services to the user's applications.
- It differs from the other layers in that it does not provide services to any other OSI layer, but rather, only to applications outside the OSI model.
- Examples of such applications are spreadsheet programs, word processing programs, and bank terminal programs.
- The application layer establishes the availability of intended communication partners, synchronizes and establishes agreement on procedures for error recovery and control of data integrity.

LAYER 6: PRESENTATION

- The presentation layer ensures that the information that the application layer of one (1) system sends out is readable by the application layer of another system.
- If necessary, the presentation layer translates between multiple data formats by using a common format.
- Provides encryption and compression of data.
- Examples: JPEG, MPEG, ASCII, EBCIDIC, HTML.

LAYER 5: SESSION

- The session layer defines how to start, control and end conversations (called sessions) between applications.
- This includes the control and management of multiple bi-directional messages using dialogue control.
- It also synchronizes dialogue between two (2) hosts' presentation layers and manages their data exchange.
- The session layer offers provisions for efficient data transfer.
- Examples: SQL, ASP (AppleTalk Session Protocol).

LAYER 4: TRANSPORT

- The transport layer regulates information flow to ensure end-to-end connectivity between host applications reliably and accurately.
- The transport layer segments data from the sending host's system and reassembles the data into a data stream on the receiving host's system.
- The boundary between the transport layer and the session layer can be thought of as the boundary between application protocols and data-flow protocols. Whereas the application, presentation, and session layers are concerned with application issues, the lower four (4) layers are concerned with data transport issues.
- Layer 4 protocols include TCP (Transmission Control Protocol) and UDP (User Datagram Protocol).

LAYER 3: NETWORK

- Defines end-to-end delivery of packets.
- Defines logical addressing so that any endpoint can be identified.
- Defines how routing works and how routes are learned so that the packets can be delivered.

- The network layer also defines how to fragment a packet into smaller packets to accommodate different media.
- Routers operate at Layer 3.
- Examples: IP, IPX, AppleTalk.

LAYER 2: DATA LINK

- The data link layer provides access to the networking media and physical transmission across the media and this enables the data to locate its intended destination on a network.
- The data link layer provides reliable transit or data across a physical link by using the Media Access Control (MAC) addresses.
- The data link layer uses the MAC address to define a hardware or data link address in order for multiple stations to share the same medium and still uniquely identify each other.
- Concerned with network topology, network access, error notification, ordered delivery of frames, and flow control.
- Examples: Ethernet, Frame Relay, FDDI.

LAYER 1: PHYSICAL

- The physical layer deals with the physical characteristics of the transmission medium.
- It defines the electrical, mechanical, procedural, and functional specifications for achieving, maintaining, and deactivating the physical link between end systems.
- Such characteristics as voltage levels, timing of voltage changes, physical data rates, maximum transmission distances, physical connectors, and other similar attributes are defined by physical layer specifications.
- Examples: EIR/TIA-232, RJ45, NRZ.

Network Topologies

Types of Network Topology

Network Topology is a schematic description of a network arrangement, connecting various nodes (sender and receiver) through lines of connection.

Bus Topology – is a network type in which every computer and network device is connected to single cable. When it has exactly two (2) endpoints, then it is called **Linear Bus Topology**.

Ring Topology – it forms a ring as each computer is connected to another computer, with the last one (1) connected to the first. Exactly two (2) neighbors for each device.

Star Topology – in this type of topology, all the computers are connected to a single hub through a cable. This hub is the central node and all other nodes are connected to the central node.

Mesh Topology – it is a point-to-point connection to other nodes or devices. All the network nodes are connected to each.

Types of Mesh Topology

- **Partial Mesh Topology** – in this topology, some systems are connected in the same fashion as mesh topology but some devices are only connected to two (2) or three (3) devices.
- **Full Mesh Topology** – each and every nodes or devices are connected to each other.

Tree Topology – it has a root node and all other nodes are connected to it forming a hierarchy. It is also called hierarchical topology. It should at least have three (3) levels to the hierarchy.

Hybrid Topology – is a two (2) different types of topologies which is a mixture of two (2) or more topologies.

Note: Network Topologies will be further discussed on Network Topology topic.

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