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A Survey on Network Layers

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A B S T R A C T

Computer networking is a data transmission method that allows for the efficient exchange of data and resources between two physical devices at the physical layer. The Open Systems Interconnection model (OSI model) is a creation of the International Organization for Standardization's Open Systems Interconnection endeavour. It is a method of breaking down a transmission system into smaller pieces known as layers. Seven layers make to a layered architecture (Physical, Data Link, Network, Transport, Session, Presentation, and Application). The OSI Reference Model, which is divided into seven levels. Each layer is responsible for its own tasks. The Internet and related computer networks use a computer networking concept and set of transmission protocols. The Transmission Control Protocol (TCP) and the Internet Protocol (IP), its two most essential protocols, are commonly referred to as TCP/IP (IP).

Keywords: Networks, Layers, Protocol

1. Introduction

The Open System Interconnection (OSI) reference model is a framework for specifying the standards and tasks that network systems must follow in order to communicate with one another. The International Organization for Standardization (ISO) and the International Telegraph and Telephone Union started working on the OSI model in the late 1970s, primarily independently. The term "open systems" refers to the fact that everyone has access to the identification. The OSI model was created to help manufacturers and communications software developers create compatible network systems. The OSI model is built on layering, a commonly used organising technique. Each layer performs a set of linked functions, utilising and improving the services supplied by the layer below it. The layering strategy was created to addressThe layering approach was developed to address the following goals:

- Logically decompose a complex communications network into smaller, more user-friendly, and viable components.
- Ensure that network functions and modules have standard interfaces.
- Provide a common language for network designers, managers, vendors, and users to describe network functions.

PHYSICAL LAYER

 This is the OSI model's lowest layer. They specify the data connection's electrical and physical parameters. It establishes the connection between a device and a transmission medium (e.g., a copper or fibre optical cable). Bits of information are stored in the physical layer. It is in charge of sending individual bits from one node to another. When this layer receives data, it converts the signal received into 0s and 1s and sends them to the Data Link layer, which reassembles the frame. It may also describe a flow control protocol for establishing and terminating a connection between two directly connected nodes via a communications medium.

The functions of the physical layer are :

- Bit synchronization: The physical layer provides the synchronization of the bits by providing a clock. This clock controls both sender and receiver thus providing synchronization at bit level.
- Bit rate control: The Physical layer also defines the transmission rate i.e. the number of bits sent per second.
- Physical topologies: Physical layer specifies the way in which the different, devices/nodes are arranged in a network i.e. bus, star, or mesh topology.
- Transmission mode: Physical layer also defines the way in which the data flows between the two connected devices. The various transmission modes possible are simplex, half-duplex and full-duplex.n Hub, Repeater, Modem, Cables are Physical Layer devices. Network Layer, Data Link Layer, and Physical Layer are also known as Lower Layers or Hardware Layers

2. Data Link Layer

The data link layer is implemented on top of the physical layer's raw and unreliable bit transmission service to offer reliable data (frames) transmission between nearby nodes. When two end systems are not physically coupled, their communication is carried out through numerous data links, each of which operates independently. Higher levels are responsible for providing dependable end-to-end transmission through the data connection layer. This layer is where bridges join two comparable or distinct local area network segments.Logical Link Control (LLC)

- Media Access Control (MAC)

Depending on the frame size of the NIC, the packet received from the Network layer is further broken into frames (Network Interface Card). The MAC addresses of the Sender and Receiver are likewise encapsulated in the header by DLL. The MAC address of the receiver is retrieved by sending an ARP (Address Resolution Protocol) request across the wire, asking "Who owns that IP address?" and receiving the MAC address from the destination host. The Data Link layer has the following functions:

- **Framing:** The data link layer is responsible for framing. It allows a sender to deliver a set of bits to a receiver that are relevant to them. Attaching unique bit patterns to the beginning and end of the frame will do this.
- **Physical addressing:** After creating frames, the Data link layer adds physical addresses (MAC address) of the sender and/or receiver in the header of each frame.
- **Error control:** Data link layer provides the instrument of error control in which it detects and retransmits injured or lost frames.
- **Flow Control:** The data rate must be same on both sides else the data may get corrupted thus; flow control coordinates the amount of data that can be sent before receiving acknowledgement.
- **Access control:** When many devices share a single communication channel, the data link layer's MAC sub-layer assists in determining which device has control over the channel at any particular time. A frame is a packet in the Data Link layer. The NIC (Network Interface Card) and device drivers of host machines handle the Data Link layer. Data Link Layer devices include switches and bridges.

3. IDS

The input/actions in the proposed system come from a variety of sensors. Sensors and control devices are available in the network connections of this embedded-based system. An intrusion detection system (IDS) is a security tool that primarily operates at the network layer of the Internet of Things [6]. The intrusion detection system is critical in preventing fault data from reaching the network connections' control devices. The prominent machine learning approaches can be used to investigate the data analysis. Random forest Brainstorm optimization, Support Vector Machine (SVM), J 48, CART, Navie Bayes, and Filtering & Forwarding techniques are some of the common machine learning algorithms that interact with Intrusion Detection System principles (IDS). IDS and analysis could help avoid unauthorised attacks The precision, accuracy, and recall of system performance metrics have been tested with assaults such as DoS, Probe, R2L, and U2R. The software portion of the system will be implemented using MATLAB. Every machine learning method's performance measures were discussed, as well as the development of a suitable algorithm for this proposed system. The IDS towards random forest brain storm optimization algorithm generates decision trees on data samples, obtains predictions from each

of them, and then votes on the optimal solution[7]. In IDS[8, the SVM technique is appropriate for classification and regression testing. J 48 is a statistical classifier that generates decision trees. CART is also a decision tree algorithm alternative [9]. Navie bayes is a set of classification algorithms in which each pair of features can be classified independently of one another. The statistical algorithms of filtering and forwarding are equally significant. These algorithms are important in IDS because they prevent control device fault attacks in IoT-based embedded networks.

4. Conclusion

In essence, network layers help us comprehend how data flows from a human-readable format to a computer-readable format, then to a broadcast signal, and back again. Computer networking has revolutionised infrastructure around the world. The OSI Model's concept simplified and structured the networking system, which not only aids in the comprehensiveness of the overall system, but also in business dealings between network developers and users. TCP/IP is utilised for the recovery of good failures and for the addition of networks without excessive error handling, independent platform, and low data overhead.

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