Internet Protocol Suite

The Internet protocol suite provides end-to-end data communication specifying how data should be packetized, addressed, transmitted, routed, and received.

The foundational protocols in the suite are.

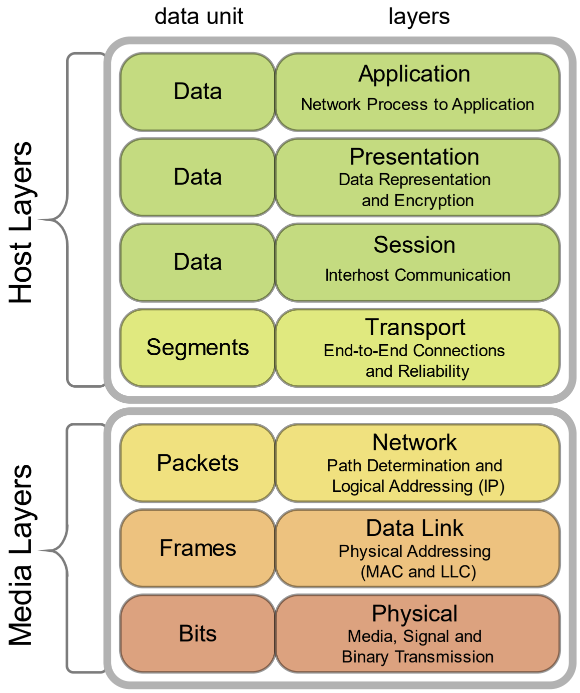
TCP - Transfer Control Protocol

UDP - User Datagram protocol

IP - Internet Protocol

(Early version of this networking model were known as the Department of Defence DOD model because the research and development were funded by us department of defence)

Protocol Stack of OSI model


data unit
layers
Host Layers
Data
Application
Network Process to Application
Data
Presentation
Data Representation and Encryption
Data
Session
Interhost Communication
Segments
Transport
End-to-End Connections and Reliability
Media Layers
Packets
Network
Path Determination and Logical Addressing (IP)
Frames
Data Link
Physical Addressing (MAC and LLC)
Bits
Physical
Media, Signal and Binary Transmission

General Layers of TCP/IP models explained.

1. **Link Layer (Data link layer)**
    1. Operates within the local network.
    2. Responsibilities:
        1. Controls the direct data link between two devices on the same network.
        2. Transmits and receives frames, prepare data for transmission, and handles framing.
        3. Handles hardware-specific details, such as MAC (Media Access Control) addresses.
    3. Protocols: Ethernet, Wi-fi, PPP (Point-to-Point Protocol).

2. **Internet Layer (Network layer)**
    1. Responsible for routing data across different networks.
    2. Responsibilities:
        1. Routes data between devices on different networks.
        2. Manages logical addressing and identification using IP (Internet Protocol) addresses.
        3. Supports various protocols for network layer functions, like ICMP and IGMP.
    3. Protocols: IP (IPv4, IPv6), ICMP (Internet Control Message Protocol), IGMP (Internet Group Management Protocol).

        IP - Addressing and data routing.
        ICMP - Network diagnostics and reporting.
        IGMP - Multicast group management.

3. **Transport Layer**
    1. Manages end-to-end communication between devices.
    2. Responsibilities:
        1. Establishes and terminates connections between devices.
        2. Segments, resembles, and manages data flow.
        3. Provides error checking, flow control and reliability.
    3. Protocols: TCP (Transfer Control Protocol), UDP (User Datagram Protocol), SCTP (Stream Control Transmission Protocol)

        TCP - Connection oriented, reliable, error handled, (web browsing, email, file transfer)

UDP - Connectionless, un-reliable, no error handling, (Online gaming, video streaming)

SCTP - Connection oriented, reliable, error handled, (media streaming, signalling, multi-homed servers) (multi-homed servers means servers having multiple connection to internet through different providers)

4. Application Layer

a. Provides network services directly to end-users.

b. Responsibilities:

   i. Hosts application-specific communication protocols.

   ii. Supports user interfaces, file transfers, email, and other network-related services.

   iii. Encapsulates data into packets for transmission across the network.

c. Protocols: HTTP (Hypertext Transfer Protocol), FTP (File Transfer Protocol), SMTP (Simple Mail Transfer Protocol), DHCP (Dynamic Host Configuration Protocol).

HTTP/HTTPS – Transfer of web pages and files, port: 80, stateless (each request in independent), secure when combined with TLS/SSL, (for text, images, multimedia), web browsing, accessing website, (GET, POST, PUT, DELETE, etc)

FTP/FTPS - File transfer, port:21(control), 20(Data), stateful maintain a session for file transfer, secure combined with TLS/SSL, to transfer files, uploading and downloading of files.

SMTP - Email transmission, port: 25, stateless, use of STARTLS for secure communication, email messages, (HELO, MAIL, RCPR, DATA, QUIT, etc), sending a mail through a server.

DHCP - Automatic IP address configuration and management.

In addition to these layers OSI model has 3 more layers

1. Physical Layer
    1. The Physical Layer is concerned with the actual physical connection between devices. It deals with the transmission and reception of raw, unstructured data bits over a physical medium.
    2. Responsibilities:
        1. Handles the physical characteristics of the network, including cables, connectors, voltage levels, and the encoding of bits into electrical signals.
        2. Ensures the reliable transmission of raw bits across the physical medium.
        3. Specifies characteristics like the type of cable used, data transfer rates, and modulation techniques.
    3. Protocols: Ethernet for wired networks, Wi-Fi for wireless networks, USB, Bluetooth, etc.

2. Session Layer
    1. The Session Layer manages sessions or connections between applications on different devices. It establishes, maintains, and terminates these sessions.
    2. Responsibilities:
        1. Session establishment, maintenance, and termination for data exchange between applications.
        2. Dialog control: It manages and controls the dialog between two devices, allowing them to take turns in communication.
        3. Synchronization: Ensures proper synchronization and coordination between the sender and receiver.
    3. Protocols: NetBIOS (Network Basic Input/Output System), PPTP (Point-to-Point Tunnelling Protocol), SMB (Server Message Block).

        NetBIOS - NetBIOS is a protocol that provides services for communication over a local area network (LAN). It allows applications and computers on a network to communicate with each other.

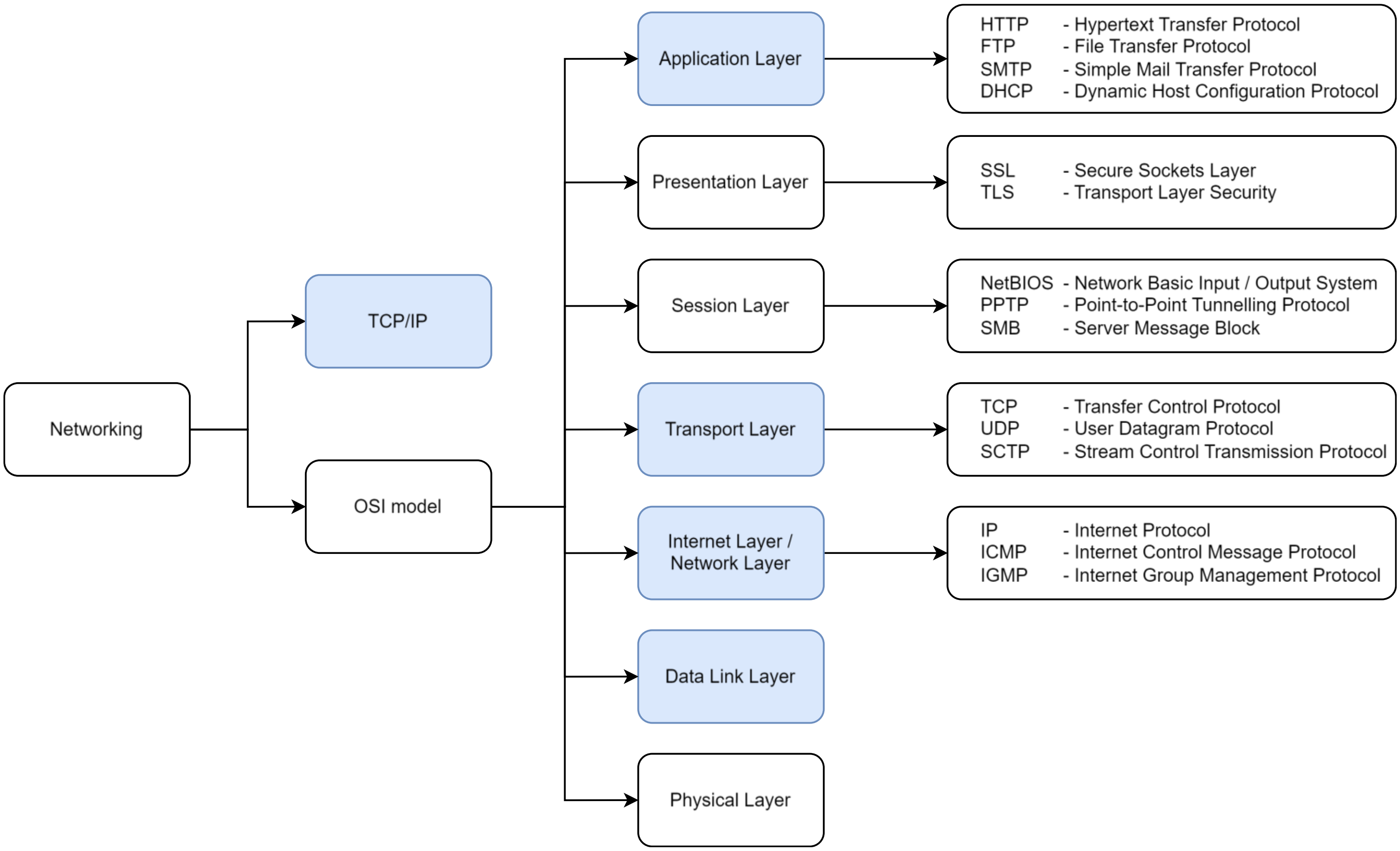
        PPTP - is a protocol for implementing virtual private networks (VPNs) and facilitating secure communication over the internet.

SMB - is a network protocol that enables shared access to files, printers, and other resources between devices on a network. Windows File and Printer Sharing feature.

3. Presentation Layer
    a. The Presentation Layer is concerned with data format translation and encryption/decryption, ensuring that data is presented in a readable format.
    b. Responsibilities:
        i. Translation of data between the application layer and the lower layers. It ensures that data is in a standardized format for transmission.
        ii. Encryption and compression of data for secure and efficient transmission.
        iii. Character set translation: Converts between different character sets to ensure compatibility between devices.
    c. Protocols: SSL/TLS (Secure Sockets Layer/Transport Layer Security) for secure data transmission, JPEG, GIF for image compression, ASCII, and EBCDIC for character set translation.

        SSL - Designed for encrypting the data, authentication, and data integrity.

        TLS - Successor of SSL since SSL had vulnerabilities with Forward secrecy feature.


Networking
TCP/IP
OSI model
Application Layer
Presentation Layer
Session Layer
Transport Layer
Internet Layer / Network Layer
Data Link Layer
Physical Layer
HTTP - Hypertext Transfer Protocol
FTP - File Transfer Protocol
SMTP - Simple Mail Transfer Protocol
DHCP - Dynamic Host Configuration Protocol
SSL - Secure Sockets Layer
TLS - Transport Layer Security
NetBIOS - Network Basic Input / Output System
PPTP - Point-to-Point Tunnelling Protocol
SMB - Server Message Block
TCP - Transfer Control Protocol
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SCTP - Stream Control Transmission Protocol
IP - Internet Protocol
ICMP - Internet Control Message Protocol
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