5. Network model

What is a networking model ?

Networking model categorize and provides a structure for networking protocols and structure.

What is protocols?
A set of rules (logical rules not physical) defining how network device and software should work.

Network without standardization :
If del make of networking model and i mac own so they can't communicate to each other.

- OSI model : used for research purpose
- TCP/IP mode : develop to meet the need of internet design.
  HTTP, FTP, TCP, IP these are the protocol used on respective layers.

Routing : is process of sending a ip packet from one network to another network it not down in local network. Routing is done because ARP can't provide mac address of another device because its not in same network.
if device is in same network ARP Request is sent.
7. IPv4, Ipv6 > routing

OSI model

OSI stand for **Open system interconnection** model.
OSI model created by **international organization for standardization** (ISO) IN later 17es.

> **Encapsulation :** The data is processed through the OSI stack from top to bottom , each layer adding something to original data this is called Encapsulation.

> **De-Encapsulation :** As the additional information is removed as the data is processed bottom to up the stack is called De-Encapsulation.

Summary of OSI Model

- **Layer 1**: Physical – Transmits raw bits
- **Layer 2**: Data Link – Frames and error detection
- **Layer 3**: Network – Routing and addressing
- **Layer 4**: Transport – End-to-end communication
- **Layer 5**: Session – Managing sessions
- **Layer 6**: Presentation – Data translation and encryption
- **Layer 7**: Application – User interface and application services

Let's discuss all one by one.

7. Application

- This is closes to **end user.**
- Interacts with software applications
- HTTP , HTTPS , FTP, IRC, SSH, DNS **are Layer 7 Protocols.**

> The communication between the application layer of the two different system is called **Same layer interaction.**

6. Presentation

- In short, The presentation layer translates data to appropriate format.
- Data in the application layer is in `application format`.It need to be `translated` to a different format to be send over the network.
- The presentation layer job is to translate between application and network formats.
- EX: encryption of data as it is send, and decryption of data as it is received.

5. Session

- control dialogues (sessions) between communicating hosts.
- Establish, manage and terminate connection between local application and the remote application.

• Network engineers don't usually work with the top 3 layers.
• Application developers work with the top layers of the OSI model to connect their applications over networks.

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4. Transport

- Segments and reassembles data for communications between end hosts.
- Breaks large pieces of data into smaller segments which can be more easily sent over the network and are less likely to cause transmission problems if errors occur.

> **Provide host-to-host communication.**

> Functions: it manage Flow control , error control , **sizing the packets.**

3. Network

- Provides connectivity between end hosts on different networks (ie. outside of the LAN).
- Provides logical addressing (IP addresses).
- Provides path selection between source and destination.
- Routers operate at Layer 3.

> Function : Logical addressing , routing , path determination.

2. Data Link

- Provides node -to -node connectivity and data transfer (for example, PC to switch, switch to router, router to router).
- Defines how data is formatted for transmission over a physical medium (for example, copper UTP cables)
- Detects and (possibly) corrects Physical Layer errors.
- Uses Layer 2 addressing, separate from Layer 3 addressing.

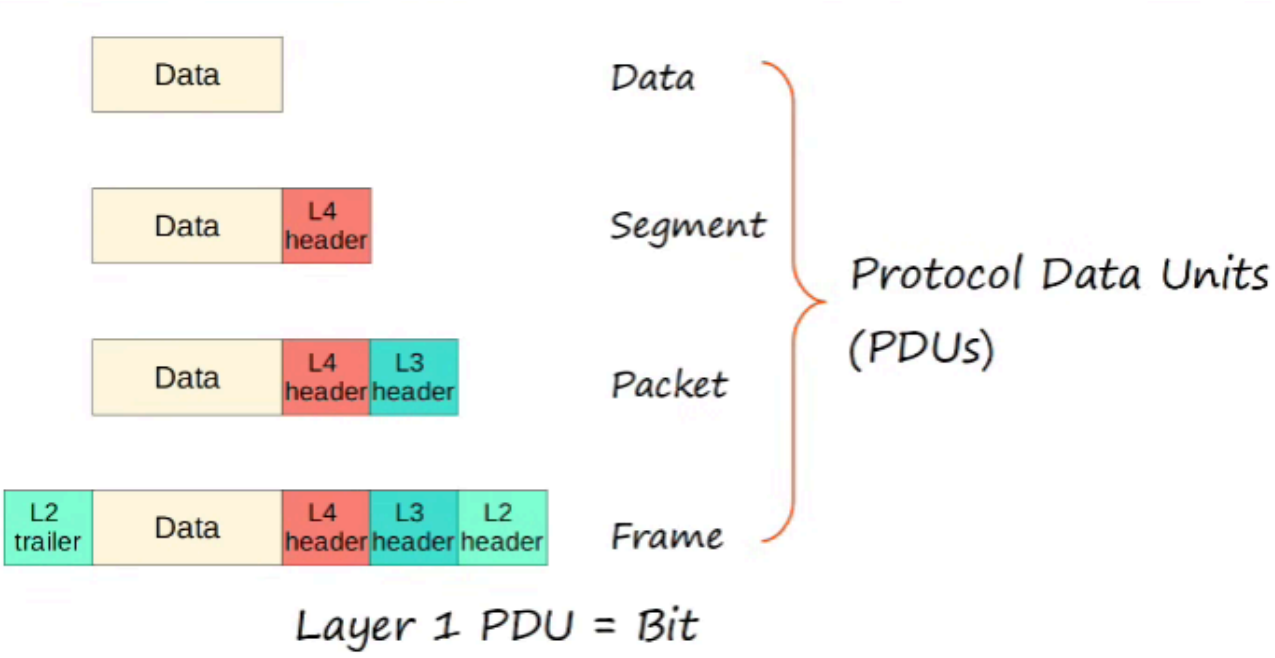
1. physical

- Defines physical characteristics of the medium used to transfer data between devices. For example, voltage (eve(S) maximum transmission distances, physical connectors, cable specifications, etc.
- Digital bits are converted into electrical (for wired connections) or radio (for wireless connections) signals.

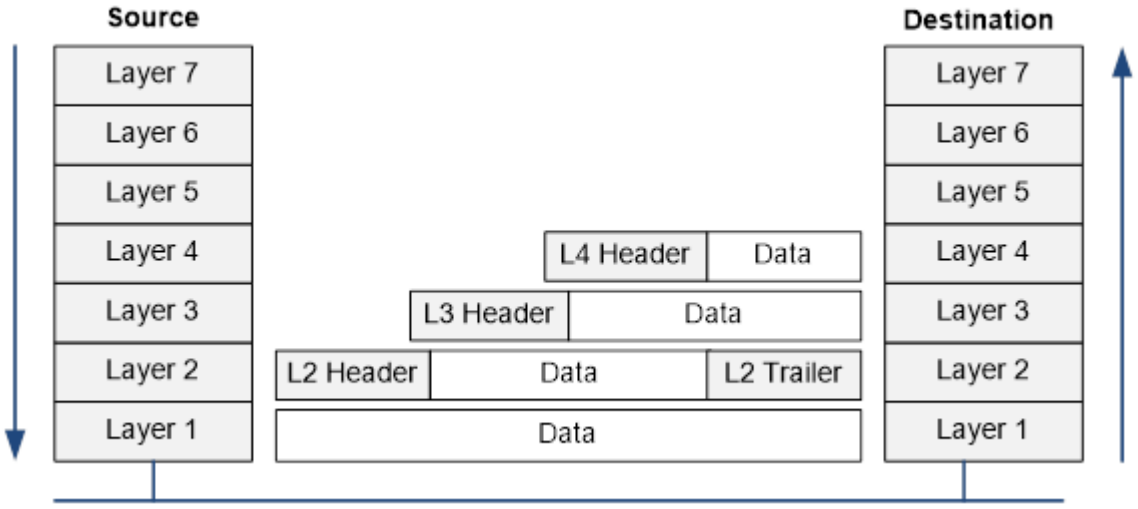
PDUs

0. Data or payload or packet (all is same) = is created by top 3 layer.
1. **L4 header = Layer 4 header** is called Segment. Segment is a term for L4 PDU.

2. **L3 header = Layer 3 header** is called packet. Packet is a term for L3 PDU.
3. After adding L2 as well whole it is called FRAME.
   this Frame is sent through cables to other system and then De-Encapsulated.



OSI model header structure



OSI Model tables

[Cyberattacks On The OSI Layers]

LAYERS	USE	Attacks	
APPLICATION	end user layer http, ftp, irc, ssh, dns	EXPLOIT	host layers

LAYERS	USE	Attacks	
PRESENTAION	syntax layer SSL , SSH, IMAP, FTP, JPEG	PHISHING	host layers
SESSION	synch & send to port API, sockets, winSock	HIJACKING	host layers
TRANSPORT	end to end connection TCP, UDP	RECONNAISSANCE, DOS	medium layers
NETWORK	packet IP, ICMP, IPSec, IFMP	MITM	medium layers
DATA LINK	FRAMS Ethernet, PPP, Switch, Bridge	SPOOFIND	medium layers
PHYSICAL	Physical structure Coax, Fiber, Wireless, Hubs, Repeaters	SNIFFING	medium layers

Layer	Use	Attacks	Attack Controls
Layer 1: Physical Layer	Transmission of raw bits over physical mediums	Eavesdropping, Signal Jamming	Encryption, Shielding, Physical Security
Layer 2: Data Link Layer	Error detection, framing, MAC address communication	MAC Spoofing, ARP Spoofing	MAC Filtering, Port Security, ARP Spoofing Detection
Layer 3: Network Layer	Routing and logical addressing	IP Spoofing, ICMP Attacks (e.g., Ping Flood, Smurf Attack)	Access Control Lists (ACLs), IP Spoofing Prevention, ICMP Rate Limiting
Layer 4: Transport Layer	Reliable data transfer between devices	DDoS Attacks, SYN Flooding	Load Balancing, SYN Cookies, Rate Limiting
Layer 5: Session Layer	Establishing, maintaining, and terminating connections	Session Hijacking, Man-in-the-Middle (MitM) Attacks	Encryption (e.g., HTTPS), Digital Signatures, SSL/TLS
Layer 6: Presentation Layer	Data formatting, compression, and encryption	Malicious Code Execution, Data Injection	Data Validation, Encryption, Input Validation
Layer 7: Application Layer	Facilitating user interactions with applications	Cross-Site Scripting (XSS), SQL Injection	Input Sanitization, Web Application Firewalls (WAFs),

Layer	Use	Attacks	Attack Controls
			Regular Security Audits

TCP/IP MODEL

- **TCP/IP Model**: A framework for the communication protocols used in the Internet and various networks.
- Known as TCP/IP because those are two of the foundation protocols in the suite.
- **Development**: Created by the U.S. Department of Defense through DARPA (Defense Advanced Research Projects Agency). and OSI is created by ISO.
- **Layer Structure**: Similar to the OSI model but with fewer layers.
- **Current Use**: The primary model in modern networking.
- **Influence**: The OSI model still shapes discussions and practices among network engineers.

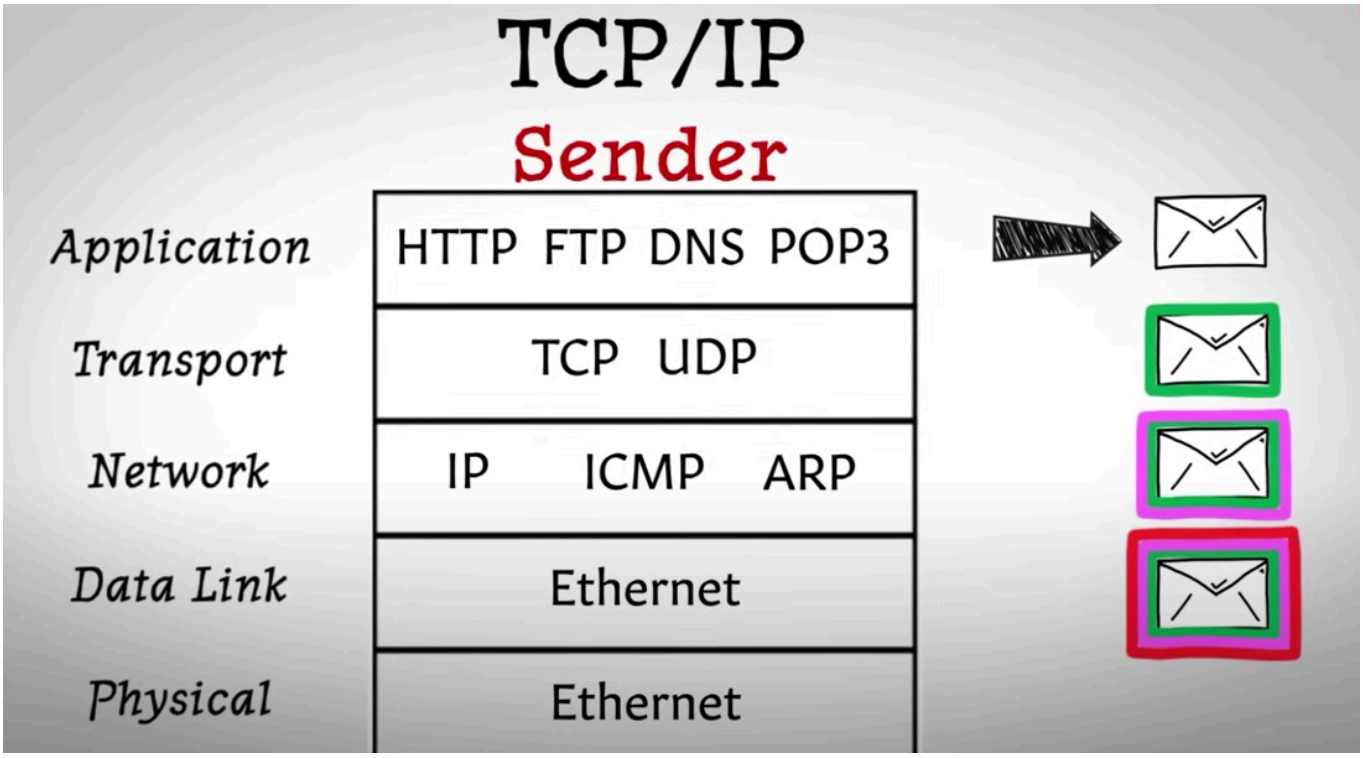
https://www.youtube.com/watch?v=2QGgEk20RXM

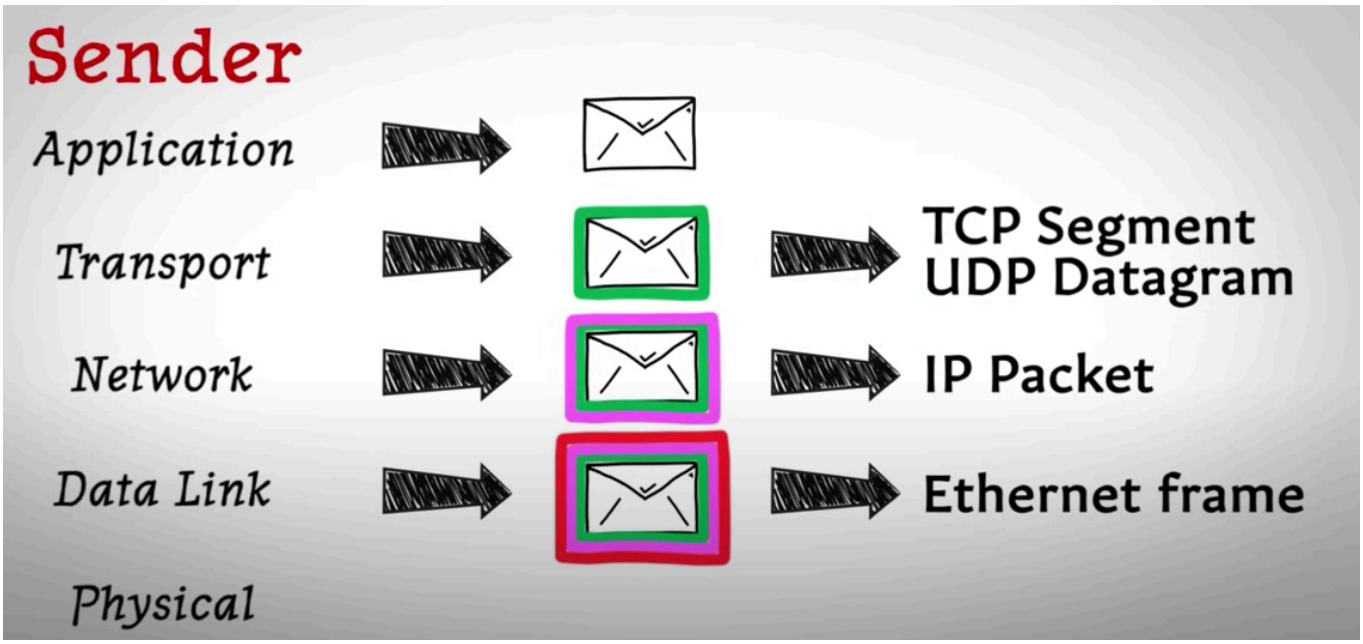
TCP IP Model Explained | TCP IP Model Animation | TCP IP...

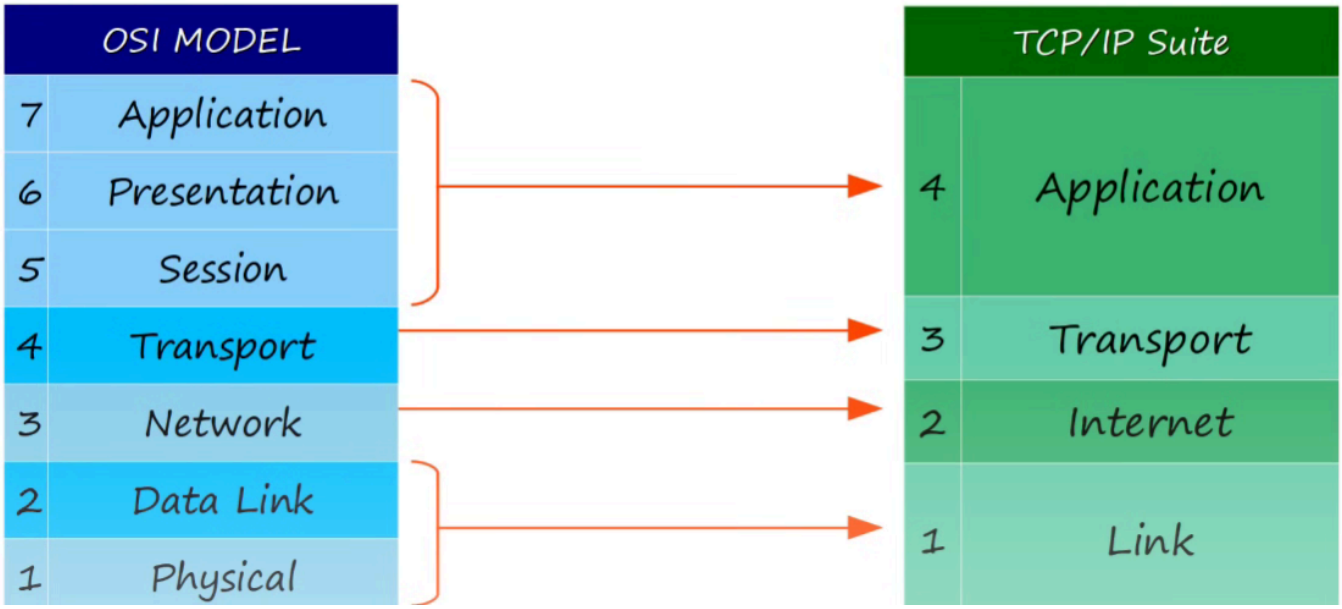
Learn TCP IP networking model or protocol suite in detail with animations. TCP IP layers are explained with examples. You will also learn tcp vs udp, tcp han...

https://www.youtube.com/watch?v=2QGgEk20RXM

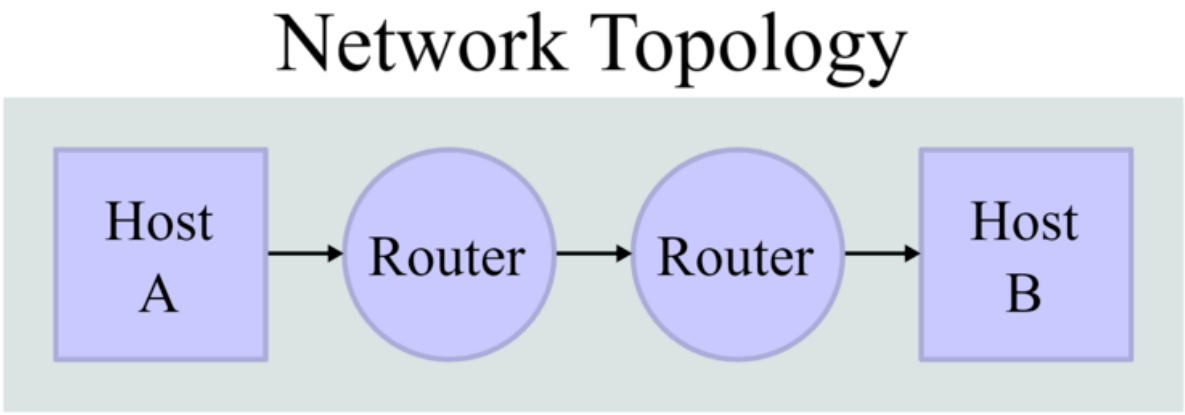
> HTTP, FTP, TCP, IP these are the protocol used on respective layers.

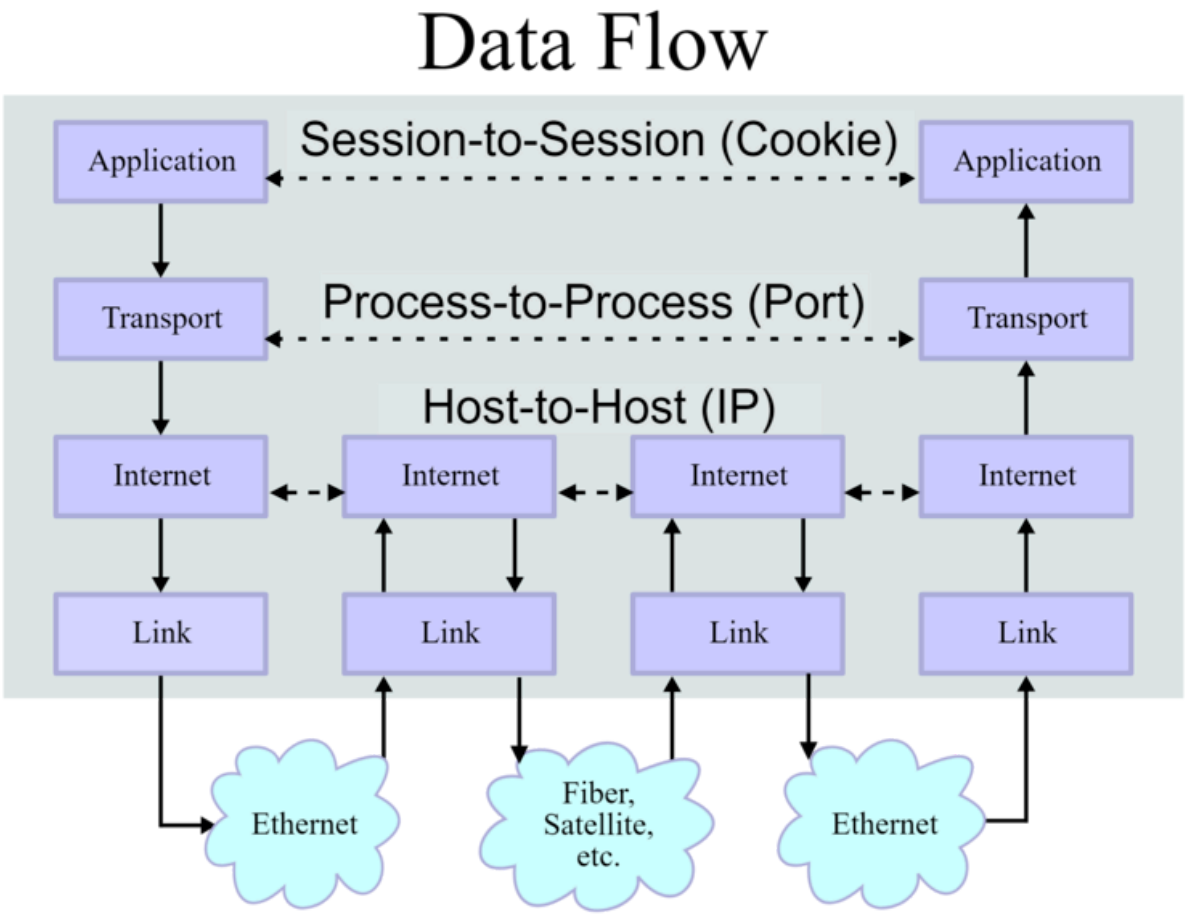

TCP/IP
Sender
Application
HTTP FTP DNS POP3
Transport
TCP UDP
Network
IP ICMP ARP
Data Link
Ethernet
Physical
Ethernet


Sender
Application
Transport
TCP Segment
UDP Datagram
Network
IP Packet
Data Link
Ethernet frame
Physical



- this chat show if their is 2 host A,B and 2 Router Between then so how data is Transport to A TO B.





OSI vs TCP/IP

OSI and TCP/IP both are logical models. One of the main similarities between the OSI and TCP/IP models is that they both describe how information is transmitted between two devices across a network. Both models define a set of layers. Each layer performs a specific set of functions to enable the transmission of data.

Real-World Application:

- The TCP/IP model is widely used in practical networking and forms the basis for the Internet.
- The OSI model serves as a theoretical guide but is less commonly implemented in its entirety.

Protocol Specification:

- **OSI Model**: Does not prescribe specific protocols; it provides a framework for different protocols to operate within each layer.
- **TCP/IP Model**: Includes specific protocols defined for each layer, such as:
  - **Application Layer**: HTTP, FTP, SMTP
  - **Transport Layer**: TCP, UDP
  - **Internet Layer**: IP (IPv4, IPv6)

Parameters	OSI Model	TCP/IP Model
****Full Form****	OSI stands for Open Systems Interconnection	TCP/IP stands for Transmission Control Protocol/Internet Protocol
****Layers****	It has 7 layers	It has 4 layers
****Usage****	It is low in usage	It is mostly used
****Approach****	It is vertically approached	It is horizontally approached
****Delivery****	Delivery of the package is guaranteed in OSI Model	Delivery of the package is not guaranteed in TCP/IP Model
****Replacement****	Replacement of tools and changes can easily be done in this model	Replacing the tools is not easy as it is in OSI Model
****Reliability****	It is less reliable than TCP/IP Model	It is more reliable than OSI Model
Protocol Example	Not tied to specific protocols, but examples include HTTP (Application), SSL/TLS (Presentation), TCP (Transport), IP (Network), Ethernet (Data Link)	HTTP, FTP, TCP, UDP, IP, Ethernet
Error Handling	Built into Data Link and Transport layers	Built into protocols like TCP
Connection Orientation	Both connection-oriented (TCP) and connectionless (UDP) protocols are	TCP (connection-oriented), UDP

Parameters	OSI Model	TCP/IP Model
	covered at the Transport layer	(connectionless)