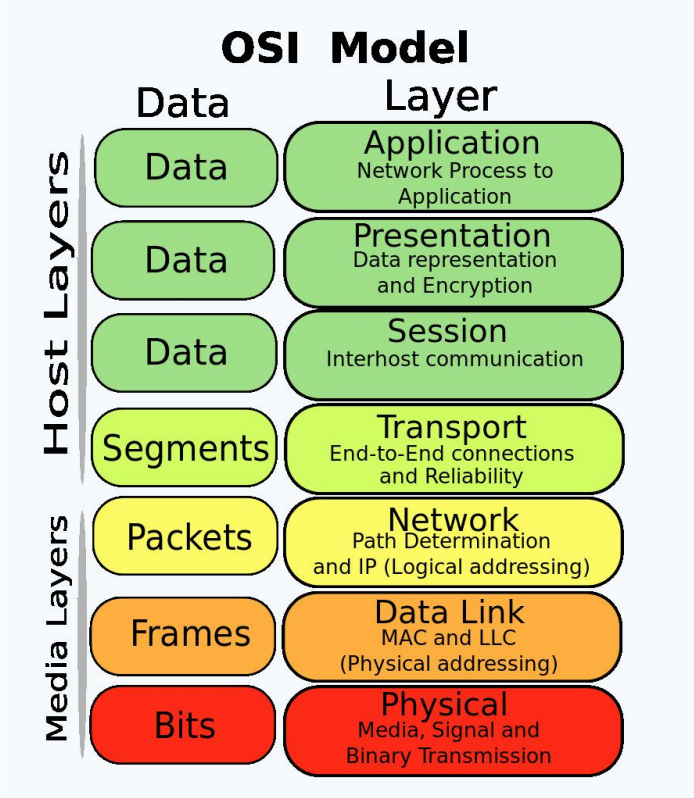
Basics

Network Types

- Based on Distance, the network types are:
  - PAN: Personal Area Network
  - LAN: Local Area Network
  - CAN: Campus Area Network
  - MAN: Metropolitan Area Network
  - WAN: Wide Area Network
- As distance increases, the number of devices used also increases, and we also have to put repeaters or network extenders to ensure the signal is strong enough to reach the destination.
- As distance increases, the error rates & maintainence cost also increases.

OSI Model



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Why?

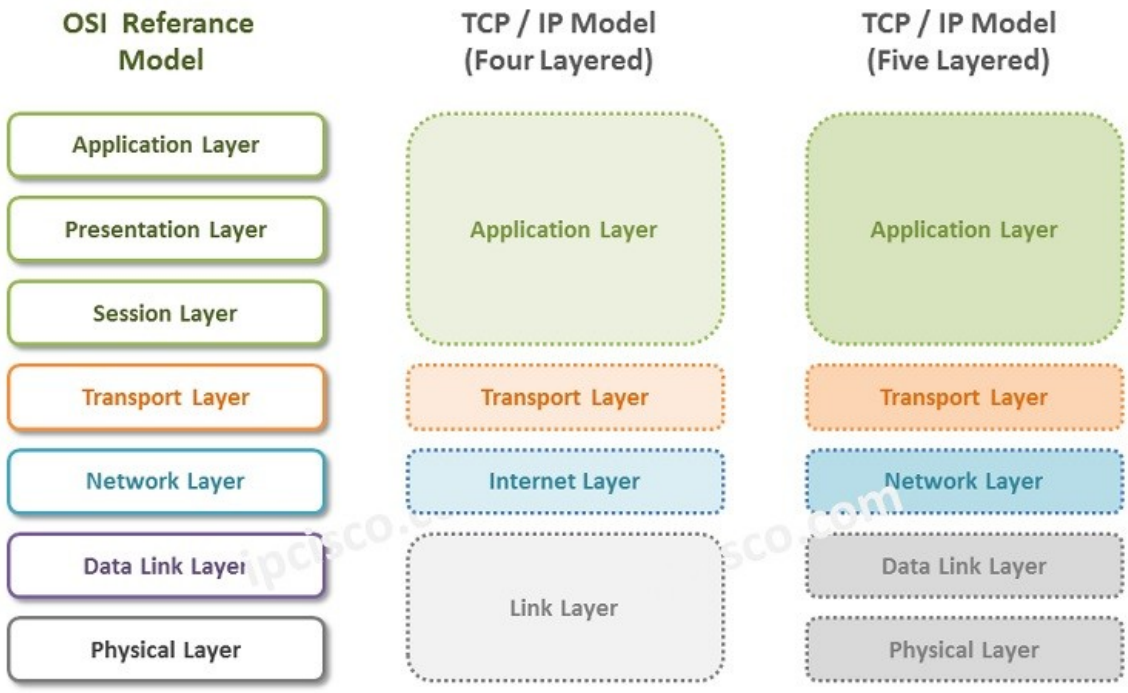
- There are a lot of functionalities and protocols that are necessary to send data from the client to the server, or vice versa.
- OSI is a theoritical model, ie it is not implemented in real life. But, using this model, all the other models are developed.
- OSI Model defines the layers in a network system, how the protocols are implemented in each layer, and how they work together to achieve it's primary purpose of moving data from Point A to Point B.

Layers

- Application
- Presentation
- Session
- Transport
- Network
- Data Link

- Physical

Difference vs TCP/IP Model



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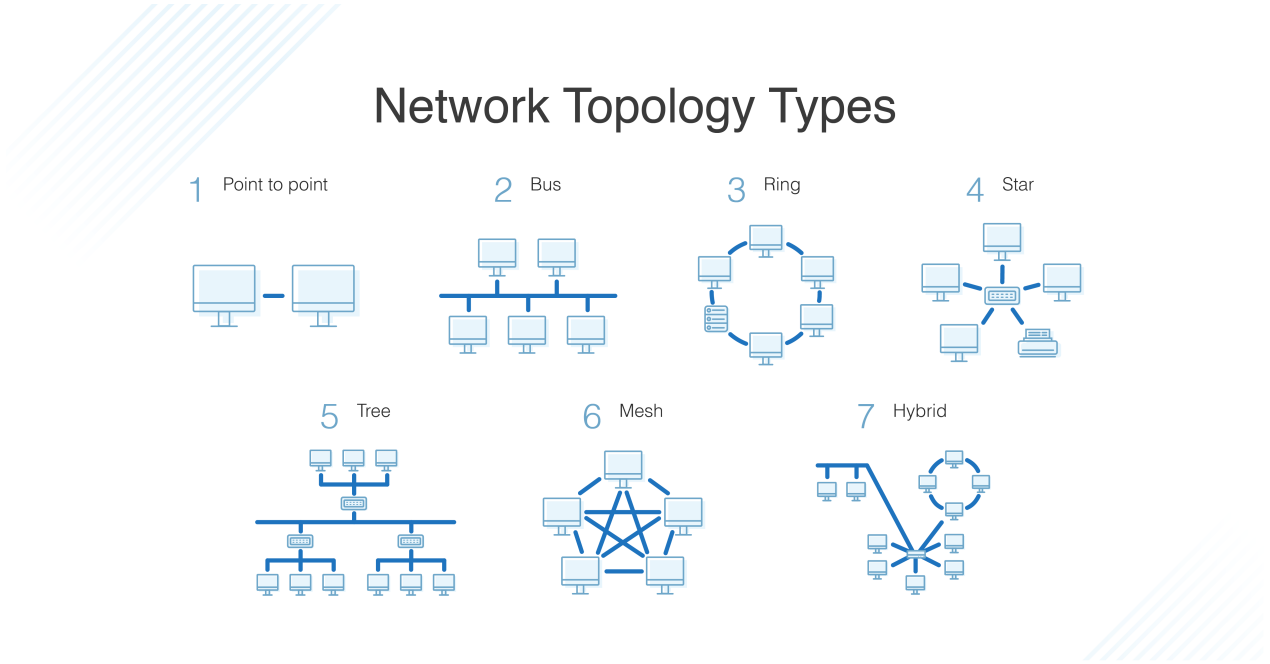
- TCP/IP layer is an implementable model.
- It was a protocol defined by ARPANET for use by them.
- It combines the `Application, Presentation` & `Session layer` into the `Application Layer`.
- The `Network Layer` is defined as the `Internet Layer`.
- It combines the `Data Link Layer & Physical Layer` into `Network Access Layer`.

Physical Layer

- Deals with hardware.
- Isn't concerned with security, that part is handled by the software.

Network Topologies



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Point-to-Point Topology

- Direct communication between two devices.
- Simple and easy to implement.
- Suitable for small networks.
- Efficient and reliable communication.

Mesh Topology

- Every device is connected to every other device.
- Redundant paths enhance reliability.
- High fault tolerance but expensive and complex.
- Common in critical applications where reliability is crucial.

Star Topology

- All devices are connected to a central hub or switch.
- Easy to install and manage.
- Failure in one device doesn't affect others.
- Centralized control and potential single point of failure.

Bus Topology

- Single central cable to which all devices are connected.
- Simple and inexpensive.
- Limited cable length and potential for collisions.
- Suitable for small networks with low traffic.

Ring Topology

- Devices connected in a circular fashion.
- Each device has exactly two neighbors for communication purposes.
- Unidirectional or bidirectional communication.
- Potential for data collisions and a failure in one device can disrupt the entire network.

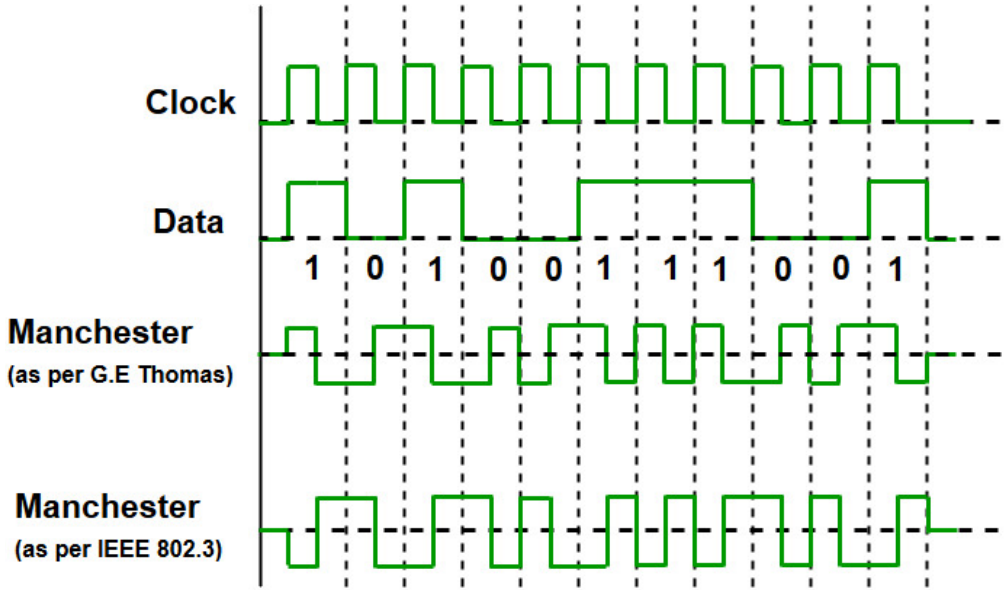
↓ Parameter | Topology →	Mesh	Star	Bus	Ring
Number of Cables	$(n(n-1))/2$	n	$n+1$	n
Number of ports	$n(n-1)$	n	n	$2n$
Reliability	high	low	low	low
Affected by noise?	no	no	yes	yes
Cost	high	low	low	low
Security	high	medium	low	low
P2P between devices	yes	no	no	yes
Multipoint	no	no	yes	no

- Reliability = **low** means there is a single point of failure.
- #reason-hub: The hub broadcasts messages to all devices by default.
- #reason-cable: The cable cannot filter or send data to only a specific device.

Manchester Encoding

- It is used to encode 1's and 0's.
- There are 2 variants: The one by G E Thomas, and the IEEE 802.3 version. By

default, IEEE 802.3 is used.



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Networking Devices

- Hardware only: Cables, Repeaters, Hubs
- Hardware + Software: Router, Gateway, Firewall, Modem
- Software only: IDS

Cable

- Used in Physical layer.
- Types:
  - Baseband: `Only 1` signal can be transmitted over the cable at any point of time.
  - Broadband: `>1` signals can be transmitted over the cable in parallel.
- Signal filtering/attenuation: Not possible, since it's purely hardware.
- Collision: A maximum of `n` collisions can occur, if there are `n` connected devices.
- **100BaseT**:
  - `100` : speed in Mbps

- `Base` : Type of cable, Baseband / Broadband
- `T` / `2` / `5` / `Fx` : 100/200/500 metres or Fiber Channel, range about 2km. The signal quality deteriorates beyond the range.

Repeater

Hub

Switch

Router

Gateway

IDS (Intrusion Detection System)

Firewall

Modem

Cables & Connectors

Networking hardware

Transmission modes

Multiplexing

Encoding