OSI Model

	Protocol
Application Layer	HTTP, HTTPS, FTP, DNS, SNMP, Telnet
Presentation Layer	SSL, TLS
Session Layer	NetBIOS, PPTP
Transport Layer	TCP, UDP
Network Layer	IP, ARP, ICMP, IPSec
Datalink Layer	MAC, PPP, ATM
Physical Layer	RJ-45, Ethernet Cable, Optical Fiber

Functions of Physical layer:

It is used to define electrical, mechanical, functional and procedural characteristic of physical link.
(physical Link)
Copper
Fiber
Wireless comm.
2. It defines transmission mode:
a. Simplex
b. Half duplex
c. Full duplex
3. It defines topology configuration:
Bus topology
Star topology
Mesh Topology
Tree Topology
4. It is totally Hardware layer.
5. It defines link configuration:
i Point to Point Link
ii Broadcast Link
6. It defines Encoding.
7. Bits Synchronization.
8. Bit rate control.

Functions of Data Link Layer

1. Flow control
2. Error control
3. Access control
4. Framing
5. Physical Addressing

Functions of Network Layer

1. Host to Host connectively
2. Logical Addressing
3. Switching
4. Routing
5. Fragmentation
6. Congestion control

Functions of Transport Layer

1. End to end connectively
2. Service point Addressing
3. Flow control
4. Error control
5. Segmentation and Reassembly
6. Congestion control
7. Connection Control
8. Multiplexing and Demultiplexing.

Functions of Session Layer

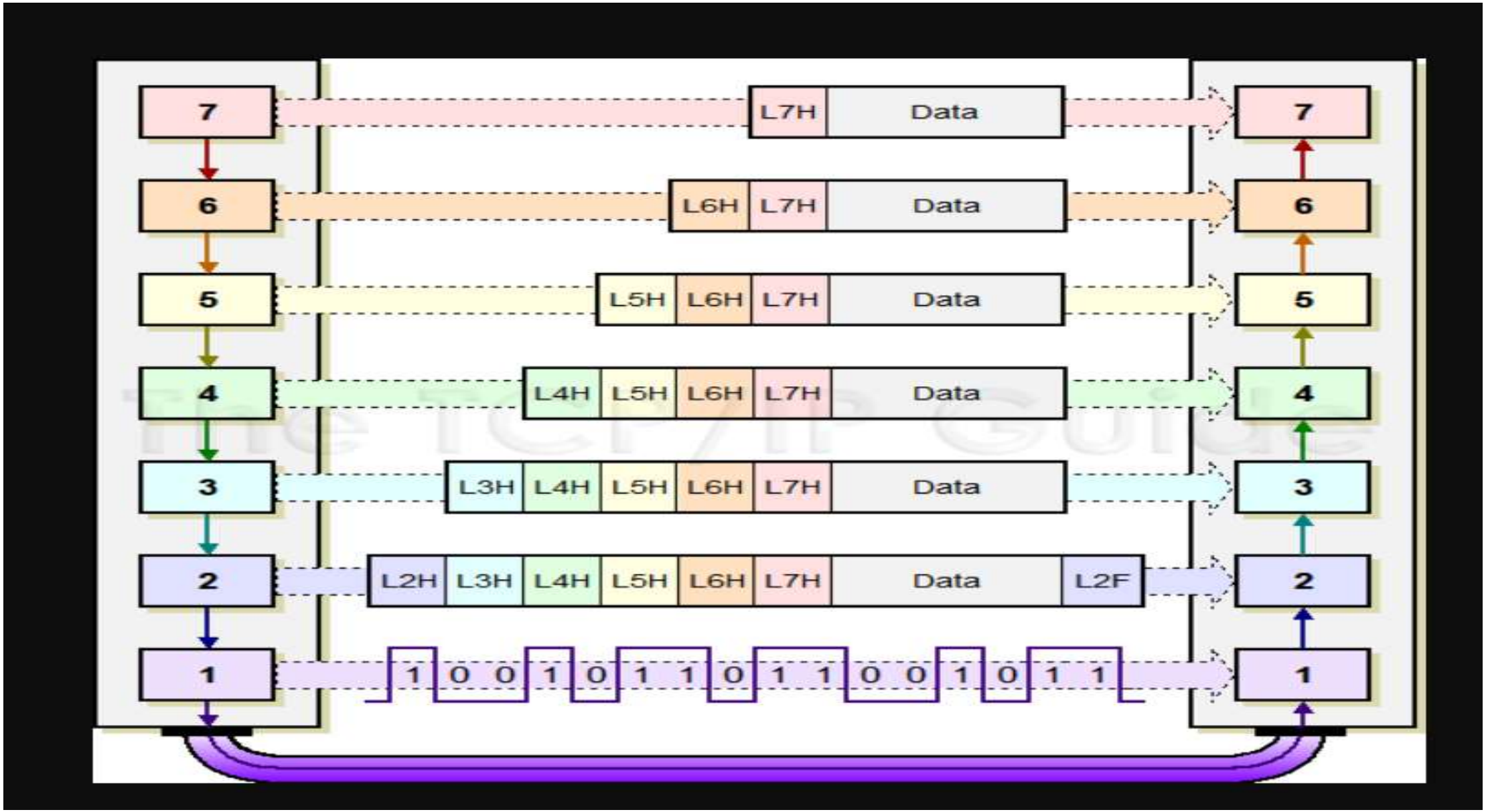
1. Authentication & Authorization
2. Check point or synchronization
3. Dialog control

Functions of Presentation Layer

1. Character translation
2. Encryption/Decryption
3. Compression

Application Layer is responsible for providing **services to users**. Users such as:

1. Mail services
2. File sharing
3. File transfer and many more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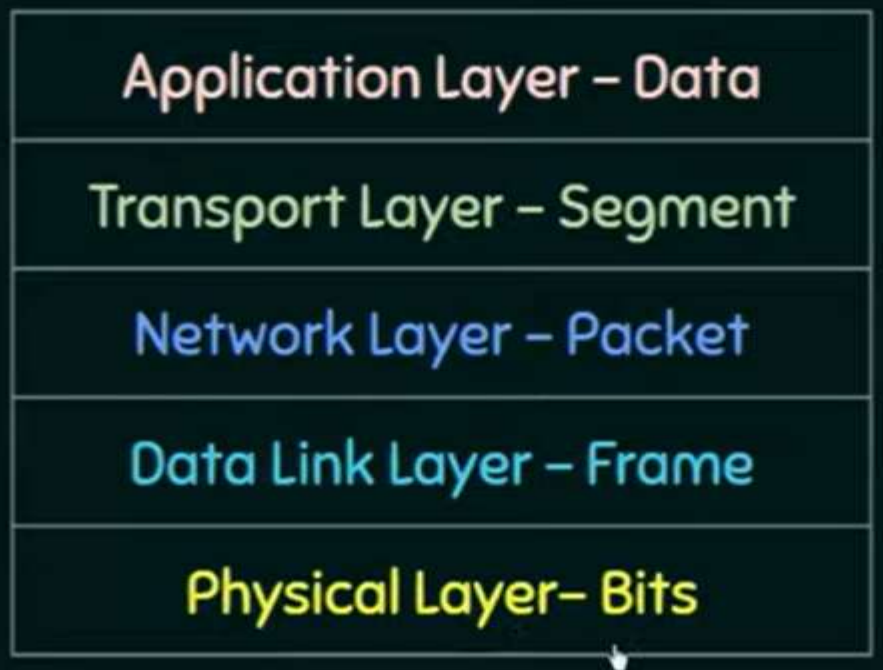
Protocol Data Unit (PDU)

Protocol Data Units (PDUs) are named according to the protocols of the TCP/IP suite: data, segment, packet, frame, and bits.



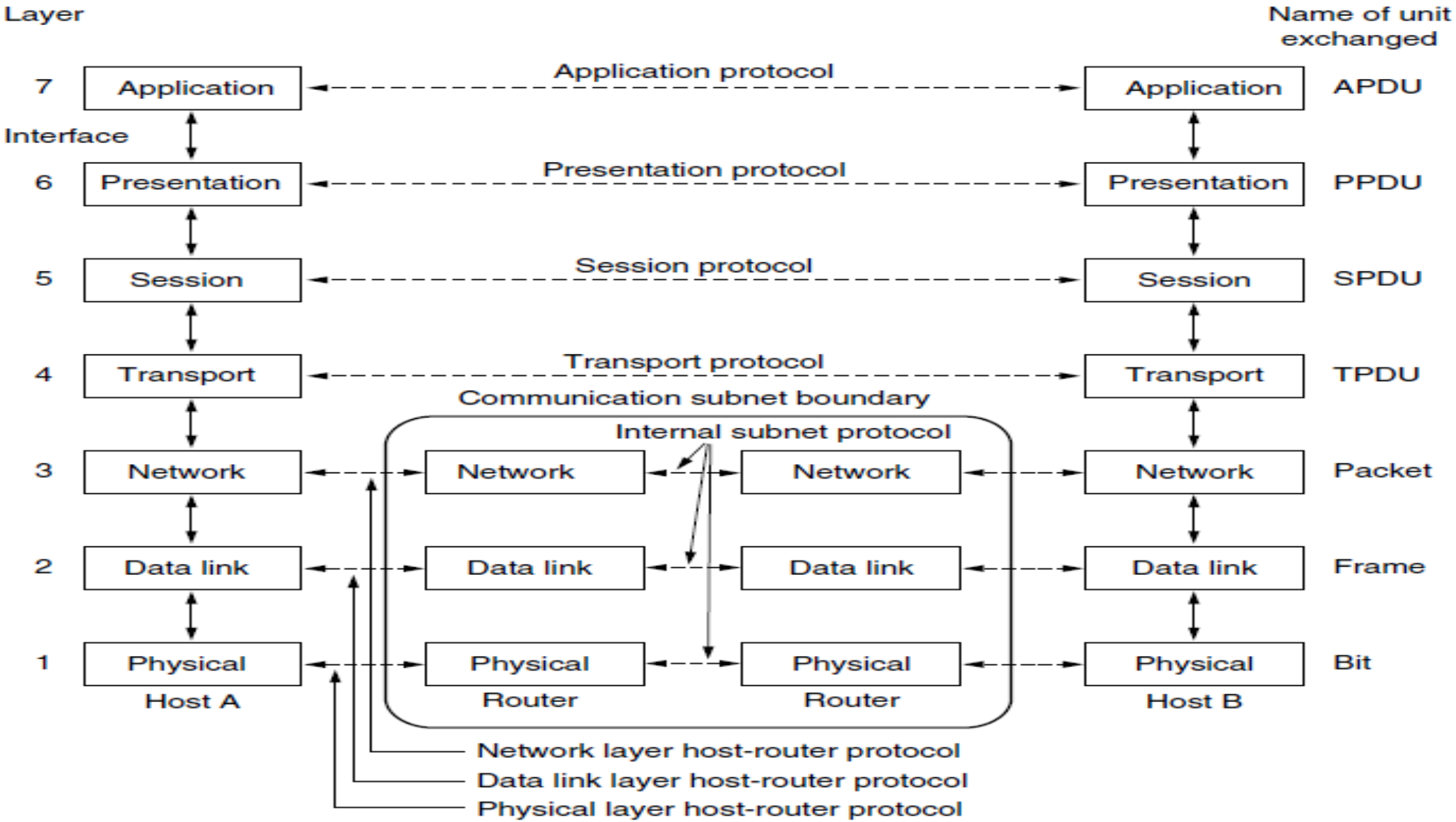


Figure 1-20. The OSI reference model.

Bandwidth

Informal: Maximum amount of data that can be transmitted per second.

Formal: The bandwidth of a network is given by the number of bits that can be transmitted over the network in a certain period of time.

Bandwidth in bps

Bandwidth = Capability.

Example: Gigabit Ethernet can provide a bandwidth of 1 Gbps.

Bandwidth in Hertz

A range of frequencies used to transmit signals which is measured in hertz.

Throughput

Informal: Actual amount of data that passes through the medium.

Formal: The throughput is a measure of how fast we can actually send data through a network.

Although bandwidth in bits per second and throughput seem the same,

they are different.

A link may have a bandwidth of 'B' bps, but we can only send 'T' bps through this link with T<B always.

Throughput

We may have a link with a bandwidth of 1 Mbps, but the devices connected to the end of the link may handle only 200 kbps. This means that we cannot send more than 200 kbps through this link.

Latency (Delay)

The latency or delay defines how long it takes for an entire message to completely arrive at the destination from the time the first bit is sent out from the source.

Components of latency (delay)

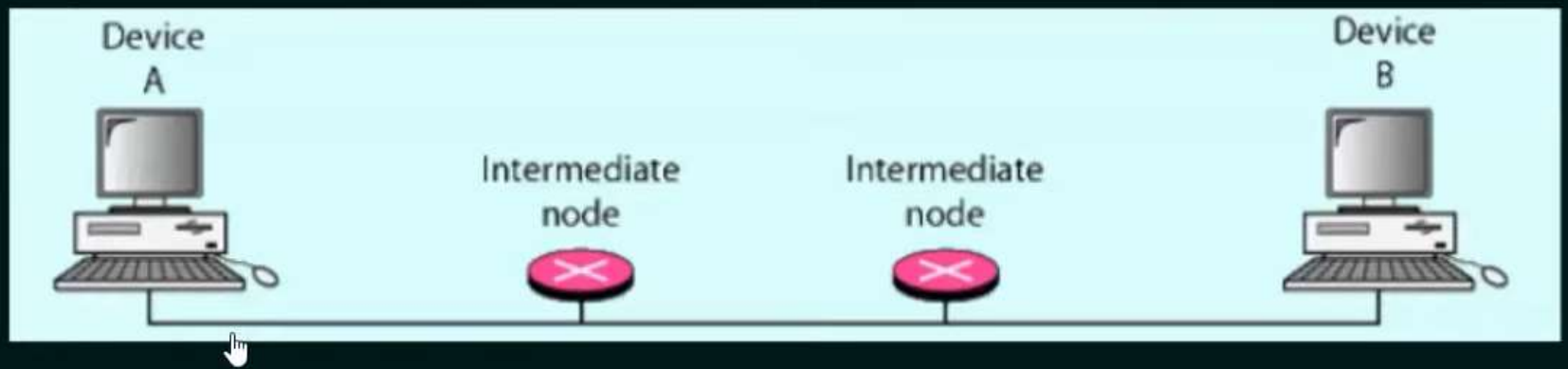
Latency is made of four components:

1. Transmission delay.
2. Propagation delay.
3. Queueing delay.
4. Processing delay.

Latency = Transmission delay + Propagation delay + Queuing delay + Processing delay.

Transmission delay

Time it takes to place the complete data packet on the transmission medium.



Transmission delay

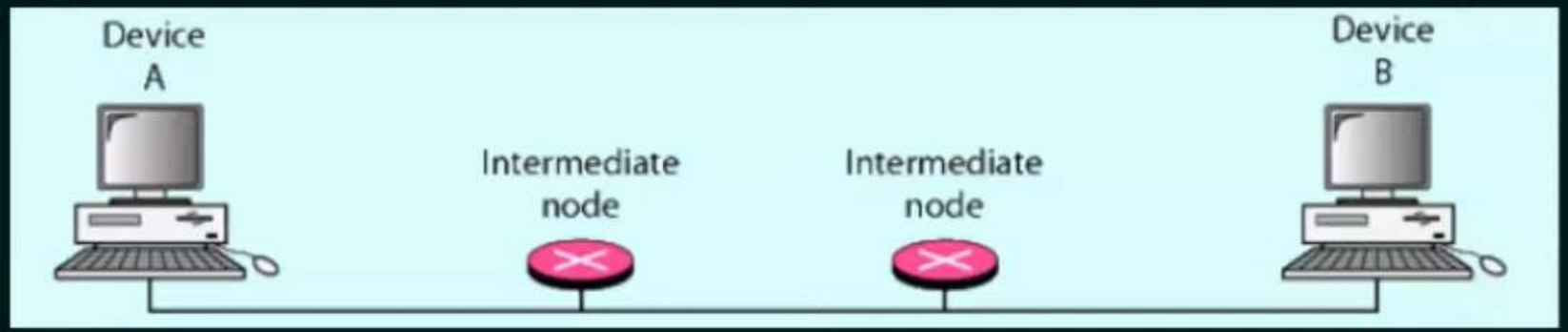
Time it takes to place the complete data packet on the transmission medium.

$$Transmission\ Time = \frac{Message\ size}{\mathbf{Bandwidth}}$$

Propagation delay

Time it takes for a bit to go from device A to device B.

The propagation time is calculated by dividing the distance by the propagation speed.



Propagation delay

Time it takes for a bit to go from device A to device B.

The propagation time is calculated by dividing the distance by the propagation speed.

$$Propagation\ Time = \frac{Distance}{\text{Propagation speed}}$$

Queuing delay

- ★ The third component in latency is the queuing time, the time needed for each intermediate or end device to hold the message before it can be processed.
- ★ The queuing time is not a fixed factor; it changes with the load imposed on the network.
- ★ When there is heavy traffic on the network, the queuing time increases.

Processing Delay

★ How much time the node takes to process the message?