04/07/2017

DATA COMMUNICATION AND COMPUTER NETWORKS

Interconnecting Devices

A communication link (either wired or wireless) is used to establish a link between different devices.

Types of Links → Wired/Guided.
→ Coaxial Cables fibre optics.
→ Wireless/Unguarded radio waves.

Interconnecting.
- Bridge / Switch. → Layer - 2
- Router → 2 Different Layers
- Gateway. → Wifi ISPs.

Devices → Host, End Systems.
- Applications (games, Social media).

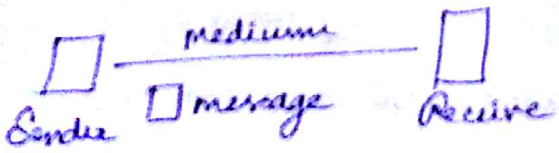
The Internet is a globally large Computer Network.

A route or a path is a set of links that send packets/data/information from source end system to destination end system. The process of a finding a route is called Routing.
↳ Interconnecting devices.

Internet Service Provider (ISP) provides an interface in the form of an interconnecting device to provide access to the end user.

Standard organisations related to DCN are RFC, IEEE, ITOT, ISO.

Components of Data Item



A protocol is a set of Rules that governs data transmission

Protocol defines the order, format and actions for data transmissions. Standard protocols are HTTP, FTP, UDP, TCP.

Line Configuration.

a devices interconnection. Deciding how many ways they can be connected.

① Point-to-Point. 

② Multipoint 

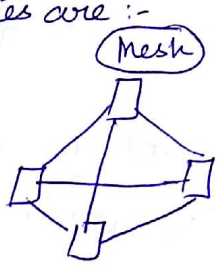
Transmission Modes.

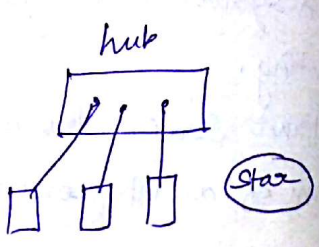
1) Simplex - transmission can happen only in one direction
2) Half duplex - Transmission can happen to and fro but at any point in time only one direct is active.
3) Duplex
   ↳ Two way transmission simultaneously.

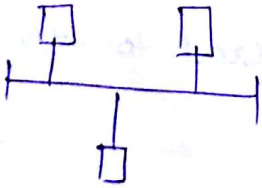
Network Topology.

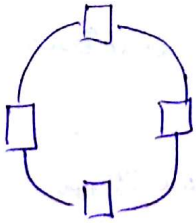
Topology describes how the physical structure of a network looks. The different topologies are :-

1) Mesh
2) Star
3) Ring
4) Bus.









In mesh every node is connected to every other node. The Network has $\frac{n(n-1)}{2}$ links and each system has $(n-1)$ ports. In mesh if a link fails alternate paths can be used. Cost is very high.

In Star network, there is a central hub. Each component has 1 link and 1 port. The presence of central hub makes the star network highly disadvantageous.

Bus is a type of multipoint and signal interferance is a major drawback. The main bus is the backbone cable and the connection of a system to a bus is called dropline and the point of contact is called Tap.

In Ring topology each component is connected to two of its neighbours. Dual Ring evolves to and fro to avoid failure of Rings due to path faults.

The MAC address is specified for the NIC for the system. IPV4 has 32-bit IP address. IPV6 has 128 bits. IEEE holds one half of the MAC address while the other half can be given by the manufacturer.

Network Architecture :-

It provides a framework/Blueprint for designing a network. There are 2 models for Network Architecture.

1) ISO/OSI 2) TCP/IP (Internet).

Both models follow a layered approach. OSI has 7 and TCP has 5.

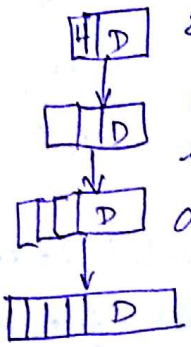
OSI	TCP/IP
Application	Application
Presentation	
Session	
transport	transport
Network	Network
Data Link	Data Link
Physical.	Physical.

Every layer has its own goal and its own set of functions. Lower layer provides access to its immediate layer above. Two layers communicate via Service Interface. Between two Systems it becomes peer-to-peer Interface.

Two Interfaces for layer communication :-

1) Service - Communication between 2 consecutive systems.
2) peer - peer Interface - Communication at the same level.

At the application layer, data is called message.



Each layer adds its own header after the processing is over. On reaching the transport layer the message is called a segment, at data link it is a frame, at network its a packet and at the physical layer it encodes based on medium of transmission. During transmission only the data is sent and not the header. The layered approach supports Encapsulation and Abstraction. Every layer has protocols within it.

Physical layer :-

Functions :- a) Physical characteristics of interfaces and media.
b) Representation of bits - c) The data rate or transmission rate.
d) Synchronisation.
e) Line Configuration.
f) Physical Topology (or) Transmission mode.

bit error, burst error, packet loss } errors in N/W comm

Data link layer :-

a) Major purpose is to ensure reliable communication.
b) Framing → how the data is converted.
c) Physical Addressing.
d) Flow Control.
e) Error Control
f) Access Control.

Network layer :-

a) Source - to - Destination delivery of data.

Functions :-

→ Logical Addressing.
→ Routing.

Syntax - Format for the message.
Semantics - giving info for each bit.

Transport Layer :-

Similar to data link, but functionality is between Networks. Reliable end-to-end delivery.

Functions :- a) Flow, error control.
b) Service-point Addressing.
c) Segmentation and Reassembling.

Application Layer

Access via applications for the end user.

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Translat Presentation Layer

→ Translation of message from system to system / layer to Layer.
→ Sender-dependant data ⇒ Common format ⇒ Receiver-Dependa Data.
→ Encryption.
→ Compression.

Session Layer (or) Networks Dialog Controller :-

→ Establishing & managing sessions across different computers / two communicating entities.
→ Helps in Synchronisation (Implemented via Checkpoints).

Performance Metrics :-

a) Throughput / Bandwidth :-
(Bits per second (bps))
→ No. of bits transmitted / unit time.

Duration of a bit with 1 Mbps = $\frac{1}{1 \times 10^6} = 0.1\ \mu s$.

* Latency / delay :-

Time taken to move data from one end to other end of the network.

Round trip time (RTT) is the time taken for one ~~to~~ and fro motion.

* Delay in Network :-

propagation delay + transmission delay + queueing delay + processing delay.

propagation delay :- Delay in travel from start to end. Dependant on travel medium / link. Varies between 2×10^8 m/s & 3×10^8 m/s. and 2.3×10^8 m/s for Copper Cables. (fibre optics, Vacuum).

$$\text{Propagation Delay } (T_p) = \frac{\text{Distance between Ends } (D)}{\text{Speed of Travel } (S)}.$$

Transmission Delay :-

Time taken to push the bits of the packet into the network. Depends on packet size, transmission capacity of the link.

Let packet size (L) and Capacity (BW).

$$\Rightarrow \text{Transmission Delay } (T_t) = \frac{L}{BW}.$$

Queueing Delay :-

Time that a packet spends waiting in a router's input/o/p queue.

Processing Delay :-

Time taken by a node to analyse a packet's purpose. A Router needs only Network, Physical and Data link layer and layers below. The only job for the Router is to forward the packets sent / received.

① Average Rat @ which traffic arrives in queue (a) (b/s).
② Transmission Rate of Link (R) (bps)
③ Nature of traffic [periodic / bursty]
} Queueing Delay Factors.
L - packet size.

Traffic Intensity $= \frac{a \cdot L}{R}$ = Transmission Delay.

When $\frac{a \cdot L}{R} > 1$, No. of packets that arrive is very much higher and hence queueing delay is large.

In other terms when $\frac{aL}{R} > 1$ Queueing Delay approaches ∞.

Also when $\frac{a \cdot L}{R} < 1$

a) periodic arrival $1 \rightarrow \frac{L}{R}$ secs.

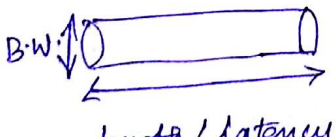
The Q.D. can be neglected as packets come and go regularly.

b) Bursty Arrival.

When 'N' packets come at (L/R) N sec.

Q.D. for 1st packet = 0 secs.
" 2nd " $= \frac{L}{R}$ secs
" 3rd " $= \frac{2L}{R}$ secs
⋮
" N^{th} " $= \frac{(N-1)L}{R}$ secs.

Delay B.W. product



Jitter:-
The variation in expected delay is called jitter. Multimedia apps get affected by jitters.

When we know delay and B.W., the no. of bits that can be transferred is given by Delay × BW.

Eg:- BW = 45 Mbps; Latency = 50 ms.

$\Rightarrow$ D × B.W. = 2.25 Mb.

Network Application Architecture :-

They are of two types.

1) Client - Server
2) Peer - to - Peer.
3) Hybrid.

1) Single Server to which the others connect and request services. Client Requests and Server Services.
2) Purely for file sharing.
3) Eg :- Chat.