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DCN:

Data comm^n:- are exchange of data b/w two devices via some form of transmission medium such as a wire cable.

Characteristics:-

1) Delivery:- system must deliver data to the correct destination.

2) Accuracy:- system must deliver the data accurately.

3) Timeliness:- system must deliver data in a timely manner. timely delivery means delivering data as they are produced, in the same order that they are produced, and w/o significant delay.

4) Jitter:- refers to variation in packet arrival time. it is uneven delay in delivery of audio or video packets.

Components:-

1. Message:- is the information to be communicated. Popular forms of info include text, numbers, audio etc.
2. Sender:- is the device that sends data message; can be computer, workstation etc.
3. Receiver:- is the device that receives the message, computer, workstation etc.
4. Transmission medium:- physical path by which a message travel from sender to receiver. Eg. coaxial cable, fiber optic cable,
5. Protocol: is a set of rules that govern data communications. represents an agreement b/w the comm. devices

Simplex

→ commun is unidirectional. only one of the two devices on a link can transmit, the other can only receive. Eg keyboards, trad monitors

→ can use the entire capacity of the channel to send data in one dirn.

Half-duplex

→ each station can both transmit and receive, but not at the same time, when one device is sending, the other can only receive.

→ used in cases where there is no need for communication in both directions at same time; entire capacity of the channel can be utilized for each direction.

Full duplex:

→ both stations can transmit and receive simultaneously.

→ signals going in one direction share the capacity of the link with signals going in other direction.

→ Eg. telephone network

→ capacity of the channel, however, must be divided b/w the two directions.

Networks :-

→ network is the interconnection of a set of devices capable of communication.

Criteria :-

1) Performance :- can be measured in many ways, including transit time and response time.

Transit time → time required for a msg to travel from one device to another

Response time → elapsed time b/w inquiry and response.

→ performance depends on no. of users, type of transmission medium, efficiency of software.

→ metrics : throughput, delay. (↑ throughput, ↓ delay)

2) Reliability:

→ measured by frequency of failure, the time it takes a link to recover from a failure, and the network's robustness in a catastrophe.

3) Security:

→ includes protecting data from unauthorized access, protecting data from damage and development, & implementing policies and procedures for recovery from breaches and data losses.

Physical Structures :-

A link is a comm^n's pathway that transfers data from one device to another.

1) P2P

→ provides a dedicated link b/w two devices, the entire capacity of the link is reserved for transmission b/w those two devices.

→ most p2p connections use an actual length of wire/cable to connect the two ends, but microwave/satellite links are possible

2) Multipoint:-
→ is one in which more than two specific devices share a single link.
→ capacity of the channel is shared, either spatially or temporally.
→ if several devices use link simul. → spatially shared
if users must take turns → timeshared

Topology:-

1) Mesh: every device has dedicated point to point link to every other device

Adv
→ eliminates traffic problems due to link sharing
→ robust
→ privacy / security
→ makes fault identification and isolation easy.

Disadv
→ amnt of cabling and no. of I/O ports
→ installation / reconnection are difficult
→ hardware to connect each link can be expensive.

Eg telephone regional offices.

2) Star: each device has a dedicated p2p link only to a central controller, usually a hub.
→ does not allow direct traffic b/w devices.

Adv → less expensive than mesh
→ easy to install & reconfigure
→ robustness
→ easy fault identification/isolation

Disadv
→ dependency of whole topology on single point, the hub.
→ used in LANs.

Bus topology: multipoint, one long cable acts as a backbone to link all the devices in a network.

Adv
→ ease of installation, uses less cabling
→ each drop line has to reach only as far as the nearest point on the backbone.

Disadv
→ difficult reconnection and fault isolation
→ signal reflection at the taps cause degradation in quality
→ fault / break in bus cable stops all transmission, even b/w devices on same side of problem.

Ring topology: each device has dedicated p2p connection with only two devices on either side of it.
each device in the ring incorporates a repeater

Adv
→ easy to install, reconfigure
→ fault isolation is simplified

Disadv
→ unidirectional traffic

Network Types :-

LAN: usually privately owned & connects some hosts in a single office, building or campus.
Each host in a LAN has an identifier, an address, that uniquely defines the host in the LAN.
Today, most LANs use a smart connecting switch, which is able to recognize the destination address of the packets and guide the packet to its destination without sending it to all other hosts.

WAN:

→ Interconnection of devices capable of communication.
→ WAN has a wider geographical span
→ normally created and run by commu companies & leased by orgⁿ that uses it.
→ 2 types → p2p WAN → Connects devices through transmⁿ media
→ switched WAN
- → network with more than 2 ends.
- → circuit switched
- → packet switched

Internet :-

→ two or more networks that can communicate with each other.

Brief history :-

packet switched networks → 1961, MIT

ARPANET → Advanced Research Projects Agency Network
- → each computer attached to interface msg processor
- → Network Control Protocol provided commⁿ b/w hosts.

Internetting Project → 1972, Vint Cerf, Bob Kahn

TCP/IP →
↓
1973

MILNET → Military Network → 1983

CSNET → Computer Science Network → 1981

NSFNET → National Science foundation Net → 1986

Internet today :- WWW, → Tim-Berners-Lee
Multimedia, P2P applications

Standards :-

→ Internet standard is a thoroughly tested specification thats useful to and adhered to by those who work with the Internet.

→ Internet draft is a working document with no official status and 6month lifetime.

Maturity lvls :-

1) Proposed standard :- specification is stable, well understood, and of sufficient interest to Internet community.

2) Draft standard :- proposed standard is elevated to draft standard status after atleast 2 successful independent and interoperable implementations.

3) Internet standard :- after demonstrations of successful implementations.

4) Historic
↓
significant
om historical
perspective

5) Experimental
↓
work related
to experimental
situation

6) Informational.
↓
contains general, historica
or tutorial information.

Admin :-

1) ISOC (Internet Society) international, nonprofit (1992)
→ provide support for Internet standards process.
→ promotes research

Date:

2) IAB: (Internet Architecture Board)

→ technical advisor to ISOC

→ oversee continueing development of TCP/IP Protocol Suite

→ Internet Engineering Task Force (IETF)

Internet Research Task Force (IRTF)

focuses on long term research topics

responsible for identifying operational problems and proposing solutions

Network Models :-

Protocol layering :- When comm^n is complex, we may need to divide the task b/w different layers, in which case we need a protocol at each layer, or protocol layering.

Principles :-

1) if we want bidirectional communication, we need to make each layer so that it is able to perform 2 opposite tasks, one in each dir^n

2) the two objects under each layer at both sites should be identical.

TCP/IP Model :-

Layers :-

Application
Transport
Network
Data Link
Physical

Physical :-

→ responsible for carrying individual bits in a frame across the link.

→ commⁿ b/w 2 devices at physical layer is logical commⁿ.

→ logical unit b/w 2 physical layers in 2 devices is a bit.

Data-link layer:-

→ routers are responsible for choosing the best links, but when the next link to travel is determined by router, data link layer is responsible for taking datagram and moving it across link.

Data link layer

→ TCP/IP supports all std. and proprietary protocols

→ it takes datagram and encapsulates it in a packet called frame.

Network :-

→ responsible for creating connⁿ b/w source computer and destination computer.

→ responsible for host-to-host comms and routing packet through possible routes.

→ includes main protocol, IP, that defines format of packet called datagram.

→ IP is a connectionless protocol that provides no flow control, no error control, and no congestion control services.

→ includes unicast & multicast routing protocols.

→ auxilliary protocols → ① Internet Control Msg Protocol (ICMP) report problems in routing

② Internet Group Mngment Protocol (IGMP) help in multitasking

③ Dynamic Host Config Protocol (DHCP) helps IP to get network-layer address for host

④ Address Resolution Protocol (ARP) helps IP find link-layer address of host.

Encapsulation :- ~~(at source)~~

At source, only encapsulation,

1) At appⁿ layer, data to be enchanged is called msg. msg is passed to transport layer.

2) transport layer takes msg as payload. it adds transport layer header to payload, which contains identifiers of source and destination appⁿ programs + info needed for end-to-end delivery of msg. (in TCP)
result is transport-layer packet, called segment and user datagram (in UDP).
packet then passed to network layer.

3) network layers takes packet as payload and adds its own header. ~~result~~ header contains addresses of source and destination hosts.
result is network layer packet called datagram which is passed to data-link layer.

4) data link layer takes packet as payload and adds its own header, which contains link-layer addresses of host or next hop.
result is link-layer packet, called a frame
frame is passed to physical layer for transmission

Transport layer

→ responsible for giving services to appⁿ layer, to get msg from an appⁿ program running on source host and deliver it to the corresponding appⁿ program on destination host.

→ main protocol, Transmission Control Protocol (TCP), is a connⁿ oriented protocol, that first establishes a logical connection b/w transport layers at two hosts before transferring data.

It provides flow control, error control and congestion control to reduce loss of segments due to congestion in network.

→ other protocol, User Datagram Protocol (UDP) is connectionless protocol that transmits user datagrams w/o 1st creating a logical connection. Doesn't provide flow/error/congestion control.

Application layer :-

→ appⁿ layers exchange msgs b/w each other as though there were a bridge b/w them.

→ involves process-to-process communication.

→ HTTP is a vehicle for accessing WWW

→ SMTP is the main protocol used in e-mail service.

→ FTP used to transfer files from one host to another.

→ TELNET (Terminal Net) and SSH (Secure Shell) used to access site remotely.

→ SNMP (Simple Network Mngment P) used by admin to manage the Internet at global and local levels.

→ DNS (Domain Name System) used by other protocols to find network-layer address of computer.

Decap/Encap at Router :-

1) Set of bits delivered to data link layer, layer decapsulates the datagram from frame and passes it to network layer.

2) network layer only inspects source & destⁿ addresses in datagram header and consults its forwarding table to find next hop to which datagram is to be delivered.
datagram then passed to data-link layer of next link

3) data link layer of next link encapsulates datagram in frame and passes it to physical layer for transmission.

Decap at destination host :-

→ at destination host, each layer only decapsulates the packet received, removes the payload and delivers payload to next higher layer protocol until msg reaches appⁿ layer.

Addressing :-

→ Any commⁿ that involves 2 parties needs addresses, source address and destination address.

→ at appⁿ layer we use names to define the site that provides services.

→ at transport layer, addresses are called port numbers and these define appⁿ layer prgms at source and destination.

→ port numbers are local addresses that distinguish b/w several programs running at same time.

→ network layer address uniquely defines connⁿ of device to Internet.

→ link-layer addresses (MAC addresses) are locally defined

addresses, each of which defines a specific host or router in a network.

OSI Model

OSI → Open Systems Interconnection

→ open system is a set of protocols that allows any two different systems to communicate regardless of their underlying architecture.

→ is a layered framework for design of network systems that allows communications b/w all types of computer systems.

→ consists of 7 separate but related layers.

Application
Presentation
Session
Transport
Network
Data link
Physical

OSI v/s TCP/IP

→ session and presentation missing in TCP/IP suite

→ (R1) TCP/IP has more than one transport-layer protocol, some functionalities of session layer are available in some of the transport layer protocols.

→ (R2) appⁿ layer is not only one piece of software, many appⁿs can be developed at this layer.

Lack of OSI's success

1) OSI was completed when TCP/IP was fully in place
2) Some layers in OSI model were never fully defined.
3) When OSI was implemented, it didn't show high enough level of performance to entice the Internet authority to switch from TCP/IP to OSI model.