CN

U-1 Use of CN, N/w topologies, N/w HW : LAN, MAN, WAN
Connection oriented Vs connectionless
Reference Model : OSI
TCP/IP

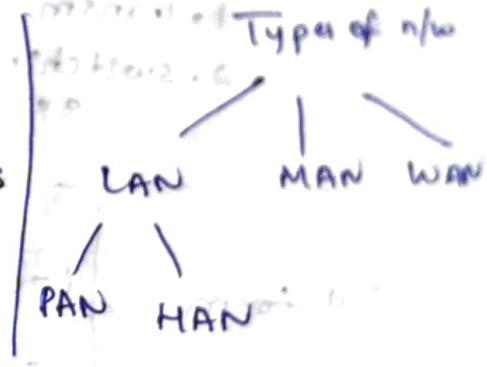
LAN, MAN, WAN → types of comp n/w
n/w architecture → client server
peer to peer

n/w communications tech → intranet
extranet
enternet

Local Area Network (LAN)

connects comp & devices in a limited geographically area
Ex: home,
school lab, office building
→ used to share resources
exchange info
→ restricted in size
→ have bounded worst case transmission time which simplifies n/w mgmt
✓ run at 10-100 Mbps
✓ Ring, bus, star
✓ high data rates with less errors

Types of LAN — PAN
— HAN



PAN Personal
used for communication among comp & diff" info technological devices close to one person
Ex: Bluetooth
IR
✓ ~10 m

HAN (House) within close vicinity of a home

MAN Metropolitan

covers a larger geographical area than LAN ranging from several blocks of buildings to entire city

may be, no. of LANs connecting into a larger n/w.

A standard has been adopted for MAN i.e. IEEE 802.6 or DQDB (Distributed Queue Dual Bus)

→ ✓ run at 34 – 155 Mbps

✓ 30 km long (can be up to)

WAN Wide

✓ country or entire continent

✓ slow speed

✓ long distance transmission of data, voice & video info } WAN

✓ collection of hosts connected by subnet

✓ 2 components :

1. transmission lines (moves bits b/w machines)
2. switching elements (connects 3/more transmission lines)
   ex: Routers

	LAN	MAN	WAN
full form	Local Area N/w	Metropolitan	Wide
geographic span	Same building or campus	city	country or continent
ownership	private	private/public	not private
transmission speed	high	average	low
propagation delay	short	moderate	long
congestion	less	more	most
design & maintenance	easy	difficult	complex

N/w Topology

Topology : way of "layoing out" the network

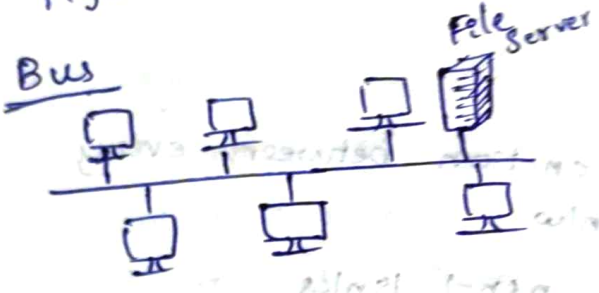
→ Topology can be either physical or logical

↑ Say how cables are run

↑ how the sigs travel

Bus
Star
Ring
Mesh
Hybrid
} Various topologies

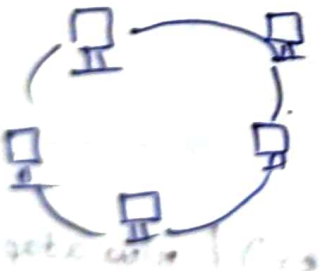
Bus



adv
- ✓ simplest
- ✓ 2 ends never touch to form loop
- ✓ also known as multidrop / linear bus / horizontal bus
- ✓ cheap
- ✓ require less cable

disadv
- ✓ difficult to troublesheet
- ✓ single break will prevent system from accessing n/w
- ✓ n/w disruptions when comps are added or removed

Ring

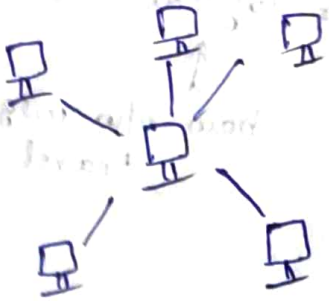


- ✓ loop
- ✓ every devi - 2 neighbors
- ✓ msgs travel in 1 dire ↻ or ↺

adv
- ✓ cable faults - easily located - troubleshooting easy
- ✓ easy to install

disadv
- ✓ single break can disrupt
- ✓ expansion to n/w can cause n/w disruption

Star topology



- ✓ each node connected directly to a central hub / switch / concentrator
- hub - controls all functions of n/w
  - acts as repeater for data flow

adv	disadv
✓ easily expanded	✓ requires more cable
✓ cable failure - single system	✓ diff to impl
✓ easy to troubleshoot	✓ if single pt failure - h

Mesh topology

- ✓ creates pt-to-pt cnction between every device on the n/w
- ✓ n nodes → $\frac{n(n-1)}{2}$ links
  each node → n-1 I/O ports / links

adv	disadv
✓ provides redundant paths between devices	✓ requires more cable
✓ easy expansion	✓ Complicated implementation

Hybrid topology: mixed topology

aim: share adv of diff topologies

NIC Network Interface Card (controller) / n/w adapter

a hlw component that connects a computer to a computer network.

Modern NIC functionalities

- ✓ support for I/O interrupt
- ✓ DMA interfaces
- ✓ data transmission, n/w traffic eng and partitio

- to convert data into digital signal
- NIC uses physical layer to transmit signals
  n/w layer to transmit data packets
- middleware between comp/server and data n/w
- operates on physical
  datalink layer of OSI model

Types of NIC — Ethernet NIC (LAN, MAN, WAN)
— Wireless N/W NICs (wifi connections)

adv

- comm" speed is high
- not expensive
- share bulk data among many users

disadv

- needs proper config to work efficient
- not secure, so data inside NIC not safe.

Types of Services

- Connection-Oriented (Ex: telephone)
  - Reliable
    - msg sequence
    - byte stream
  - Unreliable
- Connection-less (Datagram) (Ex: postal system)
  - Reliable
    - ack
    - request-reply
  - Unreliable

connection-oriented	connectionless
✓ first est connection, use it, then release it.	each pkt is routed through system independent of others
✓ connection = water-pipe	msg2 can arrive before msg1
✓ path setup before data is sent	✓ complete address on each pkt. It decides next hop at each routing pt
✓ data need not have address circuit number is sufficient	
✓ virtual circuits - multiple circuits on one wire	

visualization anatomy - data presentation

... data - involves thinking about

Problems ... might be incl in own

N/w ... used h/w & s/w implementation

1. incompatibility
2. diff to communicate to each other with different specifications.

Reference model: — OSI — TCP/IP

conceptual layout that describes how communication between devices should occur.

adv:

1. defines stds for building n/w component
2. defines each layer functionality.

ISO - OSI

Open Systems Interconnection was approved as an international standard for communications architecture.

→ it is a descriptive network scheme.

→ ensures greater compatibility, interoperability → ability of comp systems or s/w to exchng and make use of info

→ OSI describes how data from one appl" makes it way through a n/w medium to another appl" prog located on another n/w.

OSI layers lower to upper

layers	
Please	Physical
do not throw	Datalink
	Network
	Transport
Sausage	Session
Pizza	Presentation
Away	Application

PDU Types (lower to upper)

Best	Bits
Friends	Frames
Put	Packet
Sausage	Segment
Down	Data

TCP/IP layers (lower to upper)

Not	Network access
In	Internet
This	Transport
Analogy	Application

OSI - 1983 Day and Zimmerman

Physical layer

- provi physical if for transmission of info
- to transmit bits over a medium (physical)
- defines rules by which bits are passed
- covers mechanical
  electrical
  functional
  procedural aspects of physical communication
- voltage levels
  timing of voltage changes
  physical data rates
  max transmission distances
  physical connectors are defined by physical layer specifications

Data link layer :

- provides reliable communication over physical bfer if.
- breaks outgoing data → frames (framing)
  reassemble received frames
- create & detect frame boundaries
- error handling : acknowledgement
  retransmission scheme | hamming code, CRC, checksum
- flow control (generally observes proper flow of data from sender to receiver)
- supports pt-to-pt
  broadcast communi

→ Medium access control sublayer : deals with problems of access control of shared channel.

Network layer : (Routing algos : Shortest path, flooding, LSR)

- implements routing of pkts through n/w
- defines most optimum path for pkt (src → dest)
- " logical addressing (to id. endpt)
- congestion and QoS handling
- facilitates internetworking
- can split pkt into smaller pkts
- traffic control (congestion control)

Transport layer (segments)

→ provide reliable mechanism for exchange of data between 2 processes in different computers

↳ ensures data units are 1. delivered error free
2. delivered in sequence
3. no duplication or loss

✓ segmentation, ack and multiplexing

Session layer :

→ provides mechanism for controlling the dialogue between the two end systems.

→ defines how to start, control and end conversations (sessions) between applications

→ maintainance and termination of sessions

→ Token management (prevents 2 parties attempting same critical operation simultaneously)

→ Services : dialog discipline — full duplex
half duplex

→ check pointing mechanism

Synchronization

Presentation Application layer

defines the format in which data is to be exchanged between 2 communicating entities

→ deals with syntax
semantics of info transmitted

→ handles data compression
data encryption

→ responsible for protocol conversion
character conversion
data encryption / decryption
expanding graphics commands

Application layer – includes high level APIs, resource sharing

- is what user sees or does
- used for app. specially written to run over n/w
- allows access to n/w services that supports appln.
  - file transfer
  - email
- contains a variety of protocols that are commonly needed by users.
- {

TCP/IP – Internet Protocol Suite

initiated in 1969.

1968, DoD ARPA – began researching n/w tech – pkt switching (wartime)

- ARPANET → Internet

→ early 1980s → TCP/IP protocols developed

1983 → std protocols for ARPANET

Network Access Layer / link layer / data link layer (a Interface)

→ interface to the actual n/w hardware

→ may / may not provide reliable delivery

→ pkt / stream oriented

→ no protocol here
can use any n/w interface available

→ specifies how data is physically sent through n/w
1. how bits are electrically signaled by h/w

n/w medium: coaxial cable

TCP/IP

architecture layers

Application layer	Telnet	FTP	SMTP	DNS	RIP SNMP
Transport layer	TCP			UDP	
Internet layer	ARP	IP		IGMP/ICMP	
N/w access layer	Ethernet	Token ring	Frame relay	ATM	

Ethernet → comm protocol connects computers on a network over a wired connection. It is a widely used LAN protocol

- ✓ Inexpensive
- ✓ high security for data (firewalls)
- ✓ easy maintainance
- ✓ 1 - 100 Gbps speed

Internet layer IP datagram

- ✓ linchpin that holds whole architecture together
- ✓ connectionless protocol
  - does not provide reliability
    flow control
    error recovery
- ✓ provides routing function
- ✓ permit hosts to inject pkts into any n/w

ARP Address Resolution Protocol

- ✓ maps IP address with MAC (local ethernet) address
- ✓ supports pkging of IP data into ethernet frames

ICMP: Internet Control Message Protocol

function : ping

provides diagnostics and logical error reporting to help manage the sending of data between computers

IGMP Internet Group Management Protocol

supports multicasting

IPSec Internet Protocol Security

end-to-end security scheme for securing IP commn by authenticating and encrypting each IP packet of a commn session

IPv4 packages data into IP datagram

provides connectionless communication support

OSPF Open shortest Path First

internal routing protocol for use inside an organization

EIGRP = Enhanced Interior Gateway Routing Protocol

adv distance-vector routing protocol

shares internal organizational routing info.

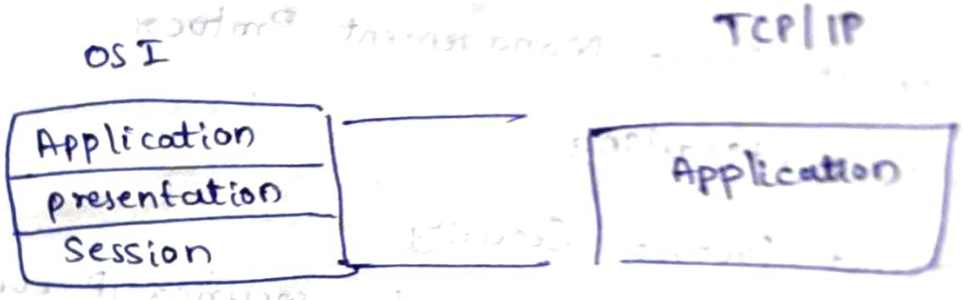
(3) Transport layer 2 protocols — TCP, UDP

TCP
- ✓ reliable
- ✓ connection oriented
- ✓ permits a byte stream originating on one machine to be transported without error or any machine on the Internet.
- ✓ handles flow control
- ✓ divides byte stream → discrete msg & passes each one to Internet layer

UDP

connectionless
Unreliable
used for client-server type request-reply queries
prompt delivery

Application layer



- ✓ provides a way to have access to n/wed service
- ✓ authentication
  data compression
  end user services (file transfer, email, web browsing)

Protocols

FTP File Transfer Protocol
allows transfer of files between 2 ~~transport~~ computer systems with login req by the requester.

Telnet - to remotely open a session on another computer acting as a server. (relies on TCP for transport)

SMTP - to send e-mail

HTTP - to carry web browsing req to web server web pages from servers to browser

POP3 - Post Office Protocol (uses TCP)
to transfer email to a local program

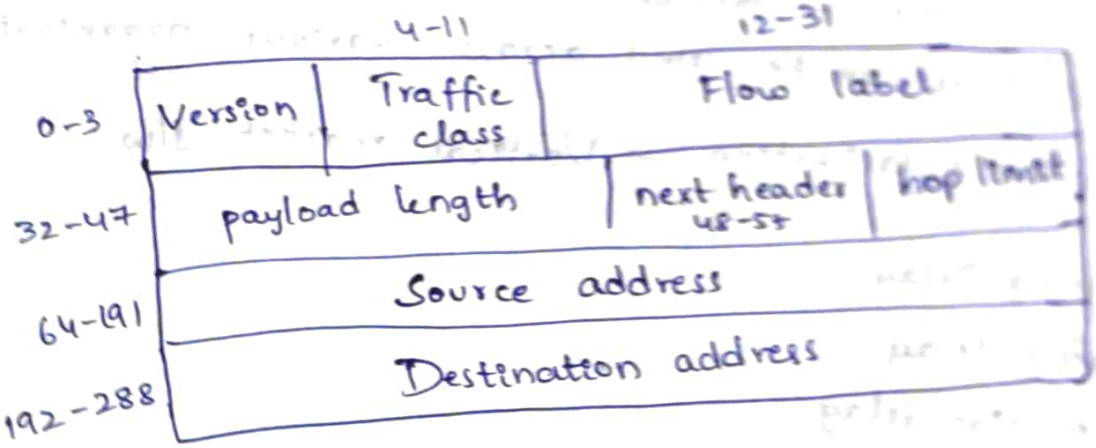
DNS - use names instead of IP addresses to refer IP devices

IMAP4 - Internet Mail Access Protocol
to download their e-mail to a local computer program.

MIME Multipurpose Internet Mail Extension
extends format of email msgs to support attachments of audio, video, images and application programs.

PGP - encrypting, decrypting and signing messages or files using a key pair.

IPv6



Benefits: Larger Address space
Improved security
Simplified header format

IPv4	IPv6
→ 32-bit address length	128-bit address length
→ supports manual and DHCP address configuration	
→ can generate 4.29×10^9 address space	3.4×10^{38}
→ sec protocol / feature is dependent on appli.	→ IPSec inbuilt feature
→ address rep: decimal	→ hexa decimal
→ checksum field available	not available
→ 5 classes	→ no classes
→ support VLSM	→ no
→ has broadcast msg transmission scheme	→ multicast and anycast msg transmission scheme is available