

Characteristics of Network

- Delivery - Must deliver correct data to correct destination.
- Accuracy - System must deliver data accurately.
- Timeliness - System must deliver data in a timely manner. Data delivered later is useless.
- Jitter - Variation in the packet arrival time. It is uneven delay in delivery or audio or video.
- Text is more error sensitive and less time sensitive.
- Audio or Video is more time sensitive and less error sensitive.

Latency ∵ = jitter or Delay

private network = LAN
public network = internet
private but widely used = extranet (Nadra)

Switch = intelligent hub = faster

Hub = 10mbps = slow

Broadcast = send message to all (1 to all)

WAN

Network of Networks

public network = no authorization

(Real-time protocol)

RTP ~~Reas~~ rearrange for UDP

Types of Wan

Point to Point WAN (Server)
Switched WAN (wired)

Broadband

VBR = Variable Bit Rate

CBR = Constant Bit Rate

CIR = Committed Information Rate

flow control make connectivity b/w slow & fast

Infrastructure Network: Physical to wireless
Backhaul Frontend

Overall performance of network is throughput
(source to destination)

Com

Layer 1 = Hub
Layer 2 = Switches & nodes
Layer 3 =

Mean Opinion Score (MOS)

NMS = Network management system

Assignment ①

PERNA architecture

Download

DPC latency

Routable IP address

On	192.168.0.1
In	192.168.1.0
NE	

Non Routable IP address

Off	128.0.0.1
Line	172.0.0.1
	1.0.0.1
	10.0.0.1

Core Switch \Rightarrow Distribution Switch.

UMT

SAN \Rightarrow Storage Area Network, Backbone of cloud.

Public IP \Rightarrow

Local IP \Rightarrow Non-Routable IP Address.

RADIUS

Standards

- ~~IEEE 802.11~~

Protocols

- language of networks

-

Jitter \Rightarrow time difference between communication.

Standards

① De-facto \Rightarrow Private / Illegal

② De-jure \Rightarrow Private

IEEE

\Rightarrow Institute of Electrical & Electronic Engineers. (IEEE 802 Standards)

Assignment ②

mesh network \Rightarrow Naq ka broadband.

RF C

Request for comments

802-RFC.

IETF \Rightarrow Internet Engineering Task Force.
(IANA) \Rightarrow Internet Address Number Assignments.

~~Internet Architecture~~

Internet Architecture is based on Layer 3 devices (Routers or ~~Routers~~ Routable switches)

Router is a device which connects same as well as different devices.

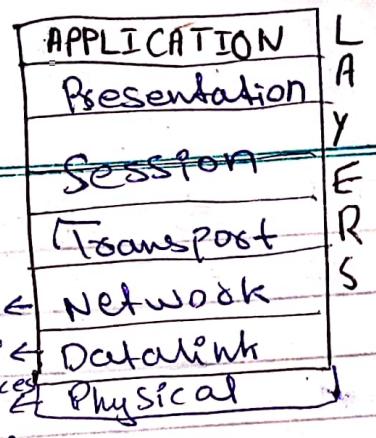
Udp \rightarrow cannot rearrange packets.

Network Protocol

Rules or Protocols for communication network.

Need for Protocol Architecture

- ① Source must activate path for communication or inform the destination.
- ② Source must see that destination is prepared to receive data.
- ③ file transfer Application on source must conform file management at destination to accept and store file
- ④ A format translation function may need to be performed if the format on system are different.



- Physical layer

~~Layer 1~~ / Router / IP
switch / is used / Address / Packet ←
MAC / Frame ←
Physical Devices ←
Physical

Gateway covers layer 4, 5, 6, 7

Gateway device wed only devices
are different

Simultaneously = multitasking

Network of network is called internet

Types of packet switching

- (1) Data gram
- (2) Virtual

- Data gram allows packets to travel
with different paths or routes.

→ TCP protocol

text - more error less time sensitive.

Voice / video - more time less error sensitive.

↓
UDP protocol.

Data Sequencing - to detect loss or duplicate packets.

Data Routing - to find most efficient path between source and destination.

Data formatting - defines group of bits within a packet which constitutes data, control addressing and other information.

Flow Control - ensures resource sharing and protection against traffic congestion by regulating the flow of data on communication lines.

Routers is a layer 3 device connect same as well as different network.

- Selects most efficient and shortest path.

RIP \Rightarrow Routing information protocol.

tells all the paths available.

OSPF \Rightarrow Open shortest path.

Selects the shortest path.

- Routers are the backbone of internet.

Frame \rightarrow has mac Address

Packet \rightarrow has IP Address.

Error control - detect errors in message.
Method for correcting errors is
to retransmit the ~~error~~ erroneous
message block.

Precedence and order of transmission -

- condition all nodes about when to transmit their data and when to receive data from other nodes. Gives equal chance for all the nodes to use communication channels.

Data-Security - Prevents access of data

key feature of Protocol

- Syntax - format of data blocks.
- Semantics - control information & error handling
- Timing - speed matching and sequencing.

Collect most common & widely used logical or Application port Numbers
List them.

Assignment. (3)

→ longer Distance communication.

Serial Communication: Bit by bit communication

- one wire One bit then other bit transfer

Parallel communication: Byte by byte communication

8-bits transfer parallelly in 8 different wires.

→ shorter distance communication.

Automatic Repeat Query (ARQ)

- Purpose: to ensure sequence of information packet is delivered in order and without errors or duplication despite transmission- errors & losses.
 - Stop and Wait ARQ
 - Go-Back N ARQ
 - Selective Repeat ~~ARQ~~ (cannot be considered as ARQ) due to retransmission.

Basic Elements of ARQ:

- Error code with high error coverage

Stop and Wait ARQ

- Send frame
- wait for Acknowledgement
- then receive Ack
- then send other frame.
- One frame at one time.

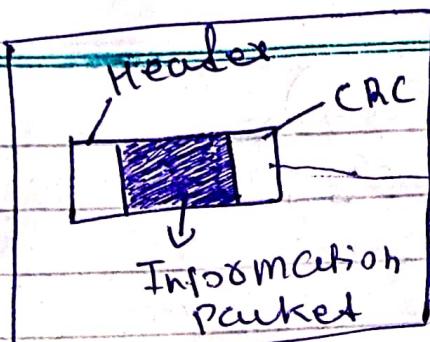
- Transmit



- Receive



TTL → Time to live



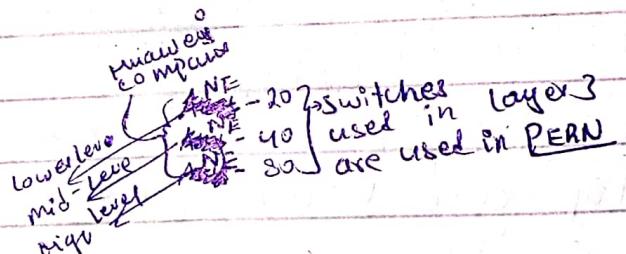
Frame of Information.

Go-Break + N

- one or more frames can be.
- Also called sliding window ARQ.

Dial UP → modem

Point to Point → Router



95-99 % Dominency ⇒ CISCO Routers

Submarine Cable

SMW ⇒ SEA ME WE

South East Asia Middle East Western Europe.

ARPA Net. American Research Project Agency Network.

- project in early 1970
- To connect some universities with paradigm.
- Project given by American defense and universities to experts.
- To transfer some files.

Sindh University \Rightarrow 156 mbps only.

TCP can Re-Arrange

UDP cannot Re-Arrange \rightarrow RTP Assist. UDP to
re-Arrange

Attributes of Internet

Internet was developed to support.

- Adaptive Routing (Dynamic Routing)

- means the traffic can take different routes through the internet depending on network condition
- Possible result is that destination may receive packets out of order.
- load is balanced.

- Connection less System

- means circuits are not set up between users
- As result, internet doesn't maintain ongoing knowledge of user traffic and does not build fixed path.
- packet switching. (chopping into smaller packets)

- "Best effort" delivery

- no disturbance should be there.
- (ya to correct karo ya to discard)
Information should be error less. (Best effort).

- Data Application:

This Aspect of internet describes that internet is not particularly for voice or video, because there is no time for voice or video.

NGN → Next Generation Network.

- Unicasting or Multicasting Operations:

- One to one → Unicasting
- One to many → Multicasting
- Any one can Access → Anycasting
- One to All → Broadcasting.

IP is Part of Network Layer.

POP →

SMTP →

Telnet, FTP, Email, web

Application

SUIT Protocols

Public Protocols

- TCP

- UDP

TCP \Rightarrow HTTP SMTP POP FTP }

UDP \Rightarrow RTP (Real Time Protocol)

} Application layer.

Host-to-Network layer in TCP/IP model is combination of two layers (Physical and Data-link layers).

Internet Model is also called DOD model.

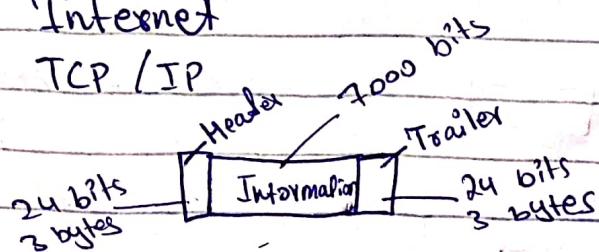
DOD \Rightarrow Department of Defense in America.

Reference Models

- OSI

- Internet

- TCP / IP



Packetization efficiency is 99.3%.

7000 / 7040 bits are efficient.

- Internet is Packetized form Network
- Internet is stored and for Network
- Internet is shared Network - as public Network
- Internet is Public Network

OSI

Internet model

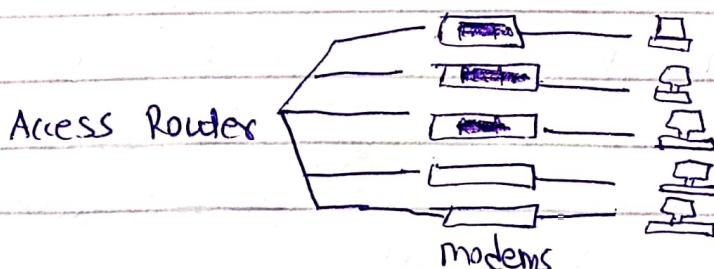
Layers.

Application	Application	Application layer
Presentation		
Session		
Transport	Transport	Internet layer
Network	Network	
Data-link	Data-link	
Physical	Physical	Hardware layer

DLC \Rightarrow Data link control protocols.

① - Dial-up Access

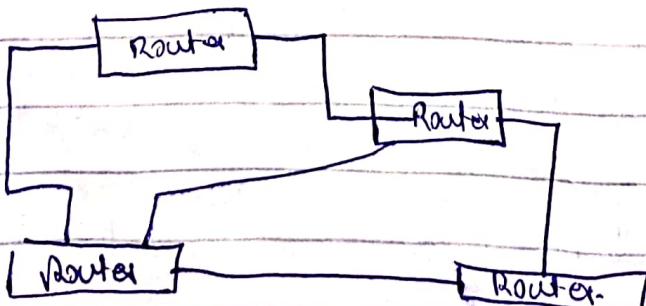
Point to point \leftarrow PPP - Point to point protocol is used.
Protocol.



Dial-in or DSL connects hosts to Router.

Routers are connected with high speed Point to point links.

② Point to Point Links



PTP \Rightarrow for variable routers

HDL \Rightarrow for Cisco routers

RADIUS \Rightarrow Remote Access Dialup User Service.

Serial communication \Rightarrow bit by bit

Parallel communication \Rightarrow byte by byte.

To make serial communication we will use
Packetization. (Packet by Packet). thousands of
bits in one packet.

NE \Rightarrow 20

NE \Rightarrow 40

NE \Rightarrow 80

Login

- ① - Manual login
- ② - PAP Password Authentication Protocol
- ③ - CHAP Challenge Handshake Authentication Protocol.

RFC \Rightarrow Reference for
Comments

Datalink Protocols for Point to Point.

- SLIP (Serial Line IP) (RFC 1055)

- Protocol for sending IP datagrams.

- PPP (Point to Point Protocol.) (RFC 1661)

- Protocol for dial-in and high speed Routers

-

- HDLC (High-level Data Link) (ISO)

widely used

Default protocols for serial links on Cisco Routers

PPP is based on variant of HDLC
Default.

Copper

E1 → 2mbps minimum.

T1 → 1.54 mbps minimum

Optical fibre

Ethernet

- 10 base T

100 base T

1000 base T

10 Gbps.

Bus Topology → 10 mbps

Ring Topology → 16 mbps

- Now we use ethernet for WAN.

- For long distance we use media converter or connectors. (bit converters) in fibres.

-

WAN Protocols

- HDLC

+ PPP

- Frame - Relay

In WAN, For dialup we will use PPP.

PPP

- PPP is variant and all rounded. (HDLC is only used in CISCO).

- PPP and HDLC are very similar.

- PPP have several sub-protocols which make it functionable.

MPLS \Rightarrow Multiprotocol level switching

Open System

- Multiple devices connected from multiple platforms eg: Huawei with CISCO.

CPE \Rightarrow Customer Premises Equipment (Modem)

CHAP \Rightarrow Pin code and Hash code is used for Authentication.

- for Password change.

~~for~~

PAP \Rightarrow

login name / Password with Telephone number or Device number.

Manual login

only login name / Password.

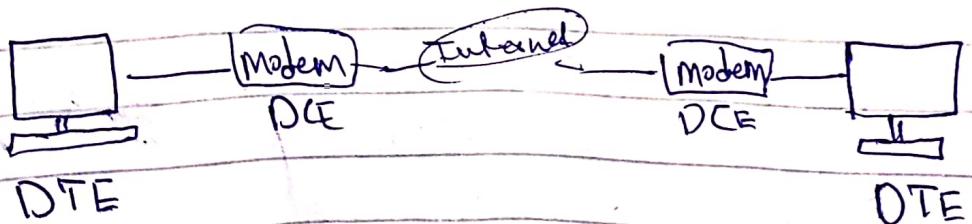
PPP
 HDLC
 mpls
 Frame - Relay
 exam
 X25
 ATM
 MPLS

Ethernet and wifi
 networks are layer-2
 networks.

X25 → layer 3 Protocol (complex)
 Frame Relay → layer 2 Protocol (simple)

DTE ⇒ Data Terminal Equipment
 - Sender and Receiver Computer
 - DTE can't be Network Node.

DCE ⇒ Data Circuit ~~Terminating~~ Terminating Equipment
 - modems
 - WAN cards
 - Provides interface to Packet switching through WAN card



Jitter → Buffering delay
or discontinuity in
voice or video.

Frame Relay

- Simplified version of X-25
- No flow control path and error control path
- Virtual paths are created. Pre defined.
- Two layers.
- Protocol multiplexing (voice / video / Text at ^{same} time)
- Congestion control added. (only allows ~~more~~ packets with tags / labels). \boxed{VC} virtual circuit.

WRED → Weightage Random Early Detection

- High speed (due to simplicity). RED