United

Writing Note Book

CCE 313

Networking

Name : Reem

Subject:

Institute:

Class : Section :

Roll No : 1802621 Year :

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Reference Book

1. TCP/IP Protocol Suite

   by Forouzan

2. Computer Networking: A Top Down Approach Featuring the Internet

   by James F. Kurose,

   Keith W. Ross

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Sub.: Lecture - 1 (SM)

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Chapter 01 (Book 1)

Network - connection between devices

Internet - connection between networks

internet → ছোট network এর connection (200/300)

Internet → বড় network এর connection (millions)

ARPA - Advanced Research Projects Agency (1962)

ACM - Association of Computation of Machinaries.

1969 → Network established between ARPA

1973 → TCP concept

1977 → interc network between 3

1981 → Popularity of internet. (UNIX)

IP → Routing handle করে

TCP → segmentation

OSI model → ISO

1990 → www. Tim Berners Lee, commercial internet.

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Internet handle করে private agency.

4 service provider:

1) ~~Local~~ International ISP
2) ~~International~~ National ISP
3) Regional ISP
4) ~~Regional~~ Local ISP

Protocol → a set of rules

Standard → organized body

entity → communicating devices

3 key elements in protocol:

1. Syntax (structure)
2. Semantics (meaning define করে)
3. Timing

* Agency, Vendor, manufacturer etc, standards set করে

1. De Facto (কোনো new product launch করার সময় ঐ manufacturer standard set করে দেয়)

2. De Jury (নির্দিষ্ট organized body, standard set করে)

* Chapter এর পরের topic গুলো পড়তে হবে *

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Chapter 02 (Book 1)

(set of protocols) → Open System-২ টা different system কে সাথে communication buildup করবে regardless of different architecture.

Open Systems Interconnection

OSI Model has 7 layers.
not a protocol

কিভাবে connection/communication build up করবে তা জানা যায় OSI model কে সাথে

In a machine, একটা layer এর নিচের layer কে service কে call করে. কেউ উপরের layer কে service provide করে।

একটা machine কে একটা layer অন্য machine কে same layer কে সাথে communicate করে

7. Application layer
6. Presentation layer
5. Session layer

} Software related. (user support layer)

4. Transmission (port) layer → connection (Links two groups)

3. Network layer
2. Data Link layer
1. Physical layer

} Hardware related (network support layer)

= Basic and Application layer অ্যাডাম পড়াবেন =

1. Physical layer: physical কাজ করে, solely hardware related meaningless bit stream নিয়ে কাজ করে।

- Data rate/transmission rate ঠিক করে
- transmission mode ঠিক করে (simplex, half-duplex, full-duplex)
- নেটওয়ার্ক topology কি থাকবে তা ঠিক করে (mesh, bus, star, ring)
- line configuration handle করে (Point-to-point, multi-point)
- physical layer এর bit stream digital এ convert করে send করে।

(Computer motherboard - digital communication)

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2. Data Link layer: আলাদা আলাদা managable unit এ bit stream গুলোকে ভাগ করে। (frame/packet)

- MAC handle করে
- physical addressing handle করে (header add করে)
- flow control handle করে (Sender, receiver এর data rate same রাখবে)
- error control (trailer add করে)
- access control (Protocols ঠিক করতে কোন device link এ control করতে)

3. Network layer: data link বিভিন্ন network এর মধ্যে কাজ করে; শুধু বাইরের address দিয়ে এর বাইরের network এর ক্ষেত্রে

- sender-reciever আলাদা network এ থাকলে network layer কাজে লাগে।
- logical address কাজ করে। (header add করে)
- source-to-destination delivery
- Routing

4. Transport layer:

- process-to-process delivery (an application program running on the host)
- connection oriented or connectionless
- sequence number use করে; packet orderly পায় ~~ক্ষতি~~ even if packet order এ না পৌঁছায়।

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5. Session layer: (data ঐ point পর্যন্ত সব arrive হইছে কিনা)

- Synchronization point & check point add করে
- Dialog control: allows communication betn two process

6. Presentation layer:

- কিভাবে reciever এর কাছে present করবে
- translation (string, number
- encryption (privacy/security purpose)
- Compression

7. Application layer:

- interface এর সাথে related (software)
- FTP server is a part of this
- email " " " "

NVT – Network Virtual Terminal

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Sub.: Lecture-2 (SM)

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Chapter 02 (Book 2)

Application Layer

E-mail, Fb, Twitter → web application

Browser → application program

File transfer

1990 এর আগে → Text-based application

VOIP → Voice Over Internet Protocol

Network Application Architecture

Architectural Plan-

1) Client-Server:

- centralized system
- data center → অনেকগুলো server
- fixed address for server
- always on maintanance (always power on)
- হয়ত duplicate server থাকে
- নির্দিষ্ট bandwidth থাকবে

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2) Peer-to-peer:

- no centralized server; decentralized system
- Peer → client/server হিসেবে use করা যায়
- no fixed address (IP); পরিবর্তিত address
- reliability, security problem

Processes Communicating

communication → web based

1) Interprocess communication: OS interprocess communication set করে দেয়

Interface → Socket (API - Application Programming Interface)

- Transport layer কোন protocol use করবে তা application developer select করে দিতে পারে (program এর type wise)
- Buffer size select করে দিতে পারবে

* Addressing Concept

IP address → নির্দিষ্ট destination কে বুঝায় (IPv4 - 32 bits)

Port number (Process identifier) → by default প্রত্যেক application এর জন্য fixed.

HTTP - 80
SMTP - 25

www.iana.org

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Transport Services Available to Application

1) Reliable data transfere (no packet loss/ no bit corrupted)

loss-tolerant application → multimedia applications, conversational audio/video

2) Throughput (data transfere rate)

bandwidth-sensitive applications → which have throughput requirements.

elastic applications

3) Timing (realtime application)

realistic application

non-realistic application

4) Security (transport protocol এর provide করে)

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Transport Services Provided by the Internet

1) TCP services

- connection oriented
- full duplex communication; communication period → session
- data loss হলে inform করে
- reliable data transfer
- ~~had~~ handshaking phase

2) UDP Services

- connectionless
- no handshaking
- not reliable data transfer

* TCP/UDP, Throughput/timing handle করে না।

→ কাজ করবে: Developer দের extra algorithm use করতে হবে।

* Security-র জন্য TCP-র enhancement TLS.

TLS → Transport Layer Security.

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* Transport layer provide services to Application layer.

Web application - http

e-mail - ~~http~~ smtp

file transfer - ftp

multimedia streaming - http

Netflix - DASH

Remote access - TelNet

VOIP - SIP

Skype - SIP

* Internet Telephony বাদে সব TCP use করে।
↳ UDP use করে; যখন UDP fail করে তখন TCP.

* Network Application Components:

1. client (browser)
2. Server
3. Standard
4. Protocol → network application এর একটা component

Netflix - video store/transmit করে (different server)
- client info আলাদা server থাকে

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*** Web and HTTP (Mid)

www → 1990

*** radio/TV fixed time এ broadcast হয়; যখন তখন দেখা possible না। Web এ fixed time থাকে না, যেকোনো time (on demand) এ দেখা যায়। এজন্য web popular বেশি।

* Website:

webpage এ যা থাকে তা হল - object (a file that is addressable by a URL)

webpage basic document html file.

image, video, etc বাদে যা থাকে তা হল - base object; base html file

referenced object → image, video

- Object কে URL দিয়ে address বলা যায়

↳ 2 parts

www.pstu.ac.bd/CSE/CCE.pdf

1) hostname

11) path of object

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* http | 1.0 version → stateless protocol; client এর কোন state store করে না

- http | 1.1 → এখন use হয়.
- http | 2 → এখনও সব জায়গায় use হয় না

RFC → Request For Comment

* Protocol defines 4 things:

1. message কেমন তা define করে
   - Request message → client
   - Response message → server
2. Syntax → structure
3. semantics → actual meaning provide করে
4. (timing) When and how will be message sent; how will server recieve message.

** প্রত্যেকটার জন্য RFC থাকে।

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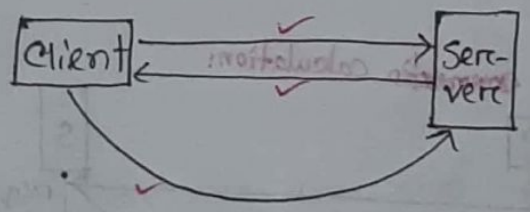
* Persistant & Non-persistant Connection

handshaking mechanism → message পাঠাবে কি না, কখন পাঠাবে এবং acknowledge করে; TCP connection এর জন্য।

client যে message পাঠায় → request message
server যে response পাঠায় → response message

→ 3 way handshaking



TCP connection সেটা provide করে।

Non-persistant connection:

- hyperlink এ click করলে server এর সাথে connection establish হবে।
- প্রত্যেক object এর জন্য আলাদা connection establish করতে হয়।
- এইজন্য delay অনেক হয় যা neglect করা যায় না।

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Persistant Connection

- by default persistant এ কাজ করে with pipelining

Timeout interval → fixed time এর পরে connection close হয়ে যাবে

Persistant → একটা TCP connection দিয়ে সব কাজ করা যায়

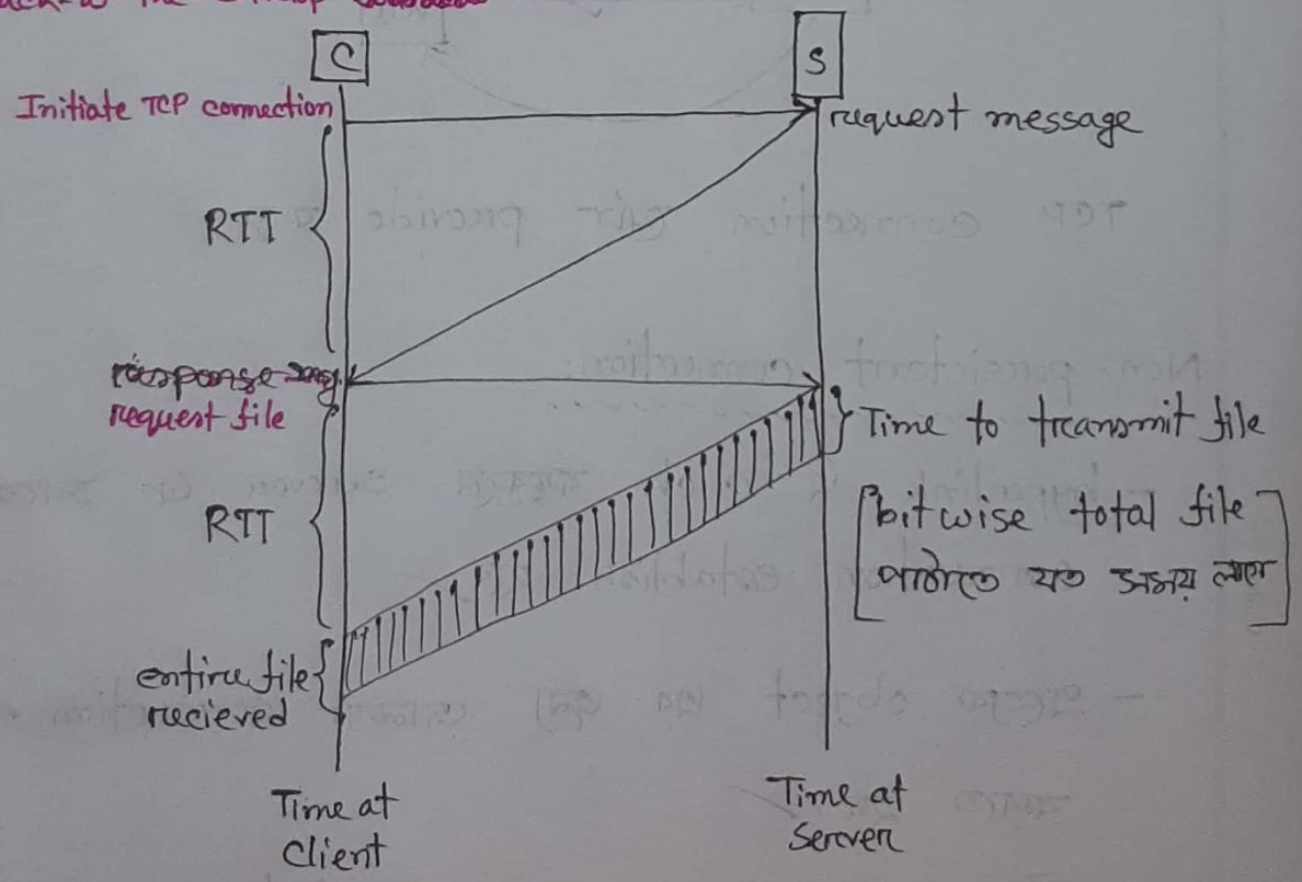
Non-persistant → অনেক গুলো TCP connection লাগে

→ শুধু একটা RTT

1 RTT → TCP connection

1 RTT → request-recieve Object

Back-of-the-envelop ~~connection~~ calculation:



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RTT → Round Trip Time

C → S → C পর্যন্ত যত সময় লাগে

Client sends 3 type of documents to server:

1. Active → Client side থেকে change হবে (Client site runs)

2. Dynamic → Per request এ change করা যাবে (server site runs)

3. static → Server provides; client can't change

Stateless:

Cookies → user, server এর মধ্যে interaction

↳ কোন website browse করলে - backend db তে unique id create করে data store করে রাখে।

Cookies allow sites to keep track of the users

Set cookie header

browser এর cookie file এ hostname + identification no. store করে।

বিভিন্ন shopping site যে info store করে রাখে

~~Statelessness~~ State oriented

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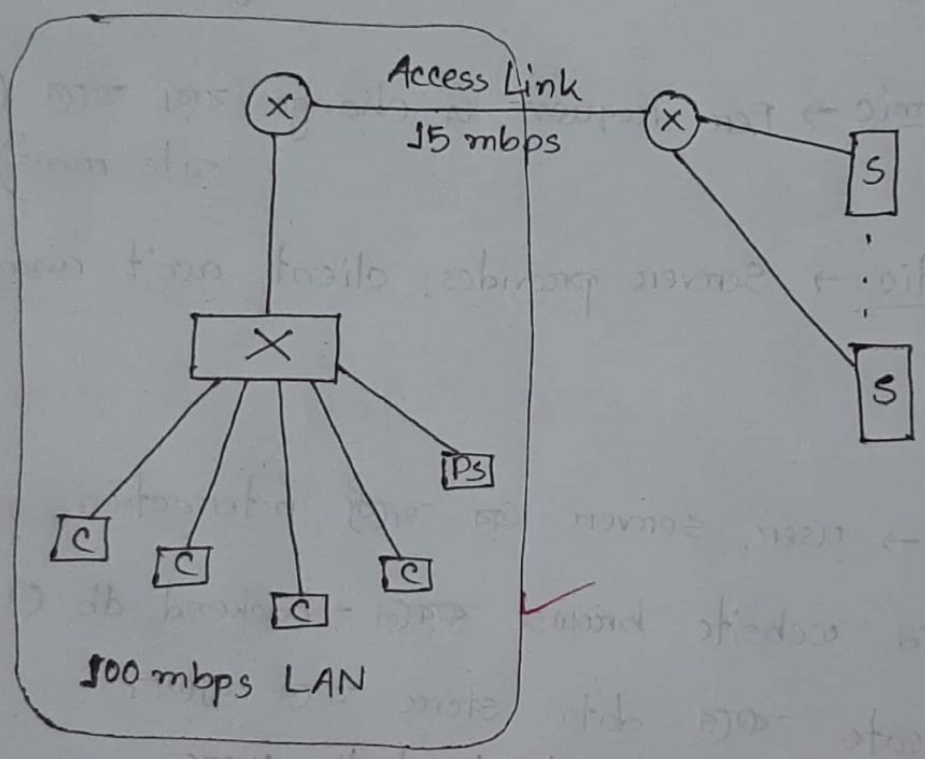
Proxy Server: web caching এর কাজ করে;

cache memory-র মত কাজ করে;

- ISP provide করে থাকে;
- institution কিনে use করতে পারে।
- both client and server



- web cache reduce the response time
- " redu traffic on an institution's access link

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Message Format

HTTP Request Message

Request Line ← [GET / Faculties/CSE/CCE/Teachers.pdf HTTP/1.1]

↳ space ↳ space

Header Lines ←

- Host : www.pstu.ac.bd
- Connection : Close → Non-persistant
- User-agent : Mozilla/5.0
- Accepted-Language : fr → french version of object
  - en → English
  - bn → Bangla

↳ fixed

Request line has 3 fields → Method file + URL file + HTTP version

5 Methods :

i) GET → যখন request message এর মাধ্যমে document চাওয়া হয়

ii) HEAD → Document সম্পর্কে কিছু information জানতে চাইলে

iii) POST → Form box এর কিছু save করতে চাইলে

iv) PUT → কোন document/file upload করতে চাইলে

v) DELETE → কোন object delete করতে চাইলে

Entity Body → GET এর ক্ষেত্রে empty [extra description যদি পাঠানোর প্রয়োজন হয় তাহলে]

POST এর ক্ষেত্রে used হয়

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** HTTP Response Message (3 sections → status line, header lines, entity body)

Status Line ← [HTTP/1.1 200 OK → status message

Status Code

Header lines ←
- Connection : Close
- Date :
- Last-Modified :
- Server :
- Content-length : (কত byte এ into পাঠাচ্ছে)
- Content-type : (image/ or anything - যা পাঠাচ্ছে)

Server http version support না করলে কাজ করবে না

* RTT Delay:

1. Processing delay : router এ packet আসার পর sender address destination address check করে; সেই route এ পাঠাতে যে time লাগে (negligible). Error bit check করে. থাকলে ফেলে পাঠাবে

2. Queuing delay : একটা packet পাঠানোর আগে কতক্ষণ wait করতে হয় সেই time (negligible).

3. Transmitting delay : per bit check করে then transmit করতে যতটুকু delay হয় → L/R

4. Propagation delay : এক router থেকে আরেক router এ পাঠাতে যে time লাগে → d/s (negligible)

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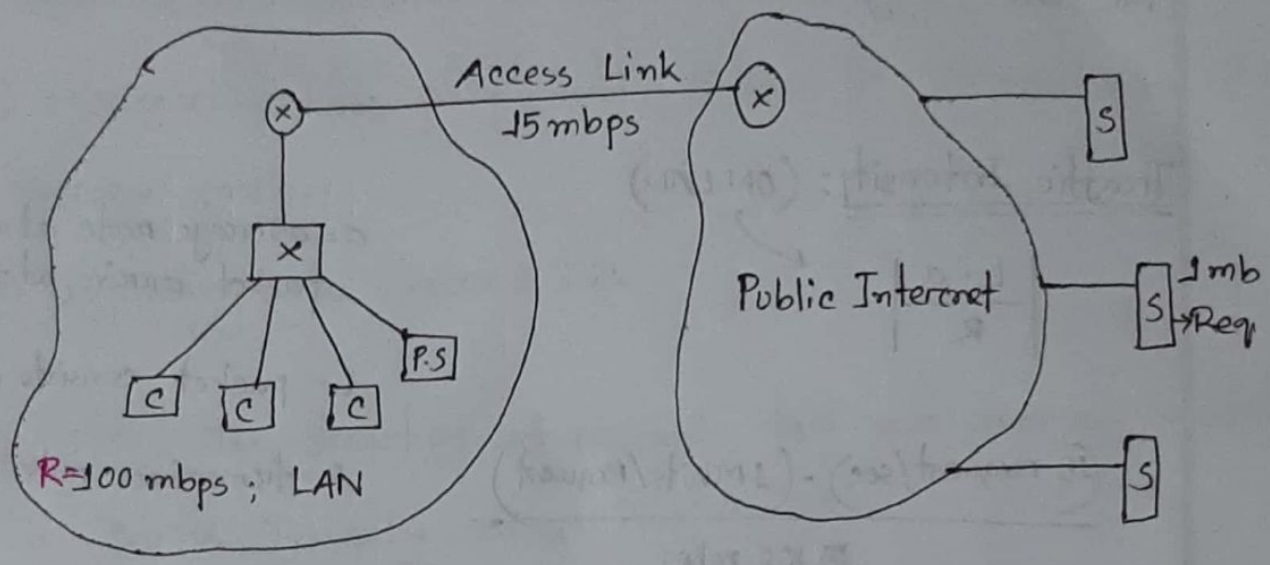
* Proxy Server



Let,

L = Req = 15/ sec Average request rate

Average Object size = 1 mbits = a

Delay হয় –

1. Internet delay: router থেকে server পর্যন্ত http request পাঠাতে যে time লাগে।

Let, internet delay = 2 sec.

2. Access delay: delay between two routers.

$$\left| \frac{(15 \text{ request/sec}) \cdot (1 \text{ Mbits/request})}{100 \text{ mbps}} \right|$$

$= 0.15$ sec

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3. LAN delay: Total response of time, is the sum of the LAN delay.

Traffic Intensity: (ON LAN)

$$\left|\frac{L \cdot a}{R}\right|$$

a = average rate at which packet arrive at the queue

L = packets consists of L bits

R = transmission rate

$$= \frac{(15 \text{ request/sec}) \cdot (1 \text{ Mbits/request})}{100 \text{ mbps}}$$

$= 0.15$

traffic intensity on the access link-

$$\frac{(15 \text{ request/sec}) \cdot (1 \text{ Mbits/request})}{15 \text{ mbps}}$$

$= 1$

* Traffic intensity < 0.8 → time কম লাগে
* Traffic intensity > 0.8 → time বেশি লাগে
* Proxy server হলে → delay বেশি
* Proxy server → client, server দুইটাই

hit rate: the fraction of requests that are satisfied by a cache; typically range from 0.2 to 0.7

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* Traffic Intensity 1 এর কাছাকাছি চলে আসলে delay অনেক বেশি হয়। এর জন্য ২ টি solution হতে পারে-

i) increase access rate from 15 mbps to 100 mbps ; but it'll become costly.

ii) upgrading the access link

Hit rates : The fraction of requests that are that are satisfied by a cache. Typically range in (0.2 - 0.7).

Let, hit rate = 0.4 (means 40% (0.4) satisfied ; 60% (0.6) unsatisfied)

$(0.4 \times 0.01 \text{ seconds}) + (0.6 \times 2.01 \text{ seconds})$

$= 1.2$ seconds

* Advantages of Proxy server

1. Lessens the response time
2. Cost is not increasing
3. Traffic decreases
4. Program performance are better

CDN → Content Distribution Network

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Chapter-23 (Fourozan)

Electronic Mail:

SMTP, POP, IMAP, and MIME

Architecture → 4 scenarios

Scenario 1:

When the sender and the receiver of an e-mail are on the same mail server, we need only two user agents.

Scenario 2:

When the sender and the receiver of an e-mail are on different mail servers, we need two UAs and a pair of MTA's (client and server).

Scenario 3:

When the sender is connected to the mail server via a LAN or a WAN, we need two UAs and two pairs of MTAs (client and server).

Scenario 4:

When both sender and receiver are connected to the mail server via a LAN or a WAN, we need two UAs,

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two pairs of MTAs (client and server), and a pair of MAAs (client and server). This is the ~~polaroid~~ most common situation today.

* User Agent

- composes, reads, replies to, and forwards messages.
- Two types:
  - i) Command-driven → mail, pine, elm
  - ii) GUI based → Eudora, Outlook, Netscape

E-mal address → $\boxed{\text{local part}}$ @ $\boxed{\text{Domain name}}$

* Message Transfer Agent

- To send mail, client MTA
- To receive mail, server MTA

SMTP → Simple Mail Transfer Protocol

Commands → sent from client to server

Response → sent from server to client

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**Mail Transfer phases

Three phases

- Connection establishment : 3 steps
- Mail Transfer : 8 steps
- Connection termination: 2 steps

*** Example 23.1

* Message Access Agent

SMTP → Push protocol : pushes message from client to server

Pull protocol : the client pulls messages from the server.

Two Message Access protocols:

i) POP3 → Post Office Protocol, version 3

ii) IMAP4 → Internet Mail Access Protocol, version 4

MIME - Multipurpose Internet Mail Extensions

*MIME এর পর থেকে বাকিটা পড়ে নিতে হবে -

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POP3 (Port 110)

Two modes:

1) Delete mode → message read, write করার পর delete হয়

2) Keep mode → message read, write করার পর delete হয়ে যায় না

IMAP4

server এর under এ folder create করা যায় & folder manage করা যায়।

MIME

- Non-ASCII character কে ASCII character এ convert করে
- Five headers:

1) MIME-Version
2) Content-Type
3) Content-Transfer-Encoding (7 types)
4) Content-ID
5) Content-Description

Web-based Mail

web-based mail use করলে → HTTP

mail server to mail server → SMTP

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Chapter 19 (Fourouzan)

Domain Name System (DNS)

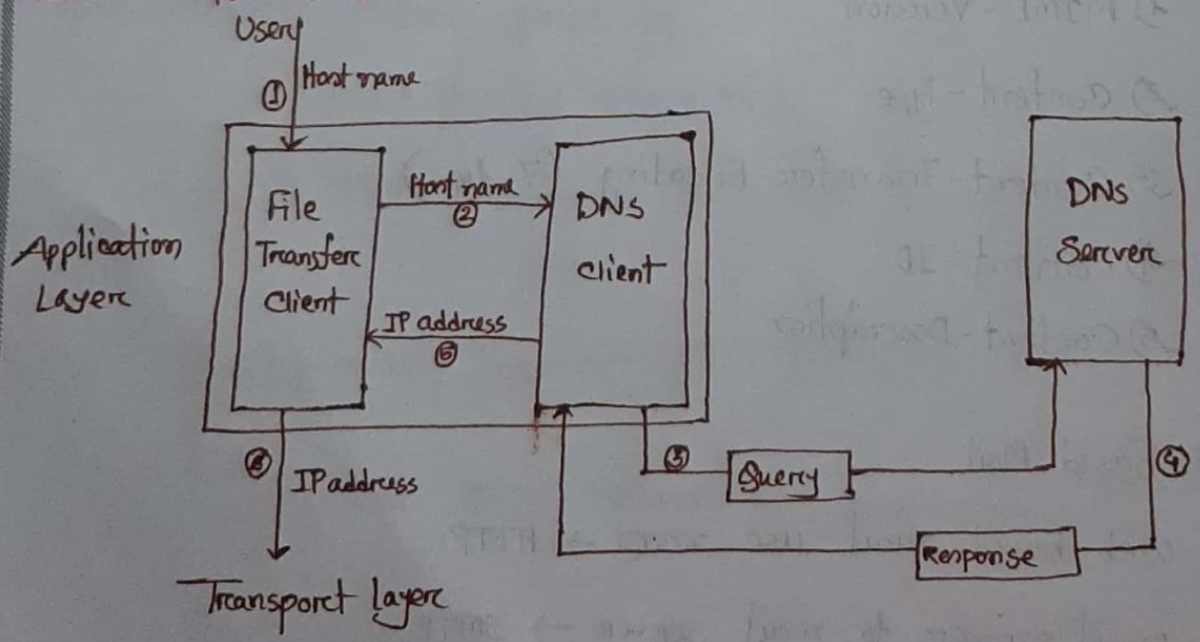
Two types program -

1) Client-Server based program

2) Supporting program (DNS)

*** Why DNS?**

To identify an entity, TCP/IP protocols use the IP address, which uniquely identifies the connection of a host to the Internet. However, people prefers to use names instead of numeric addresses. Therefore, we need a system that can map a name to an address or an address to a name.



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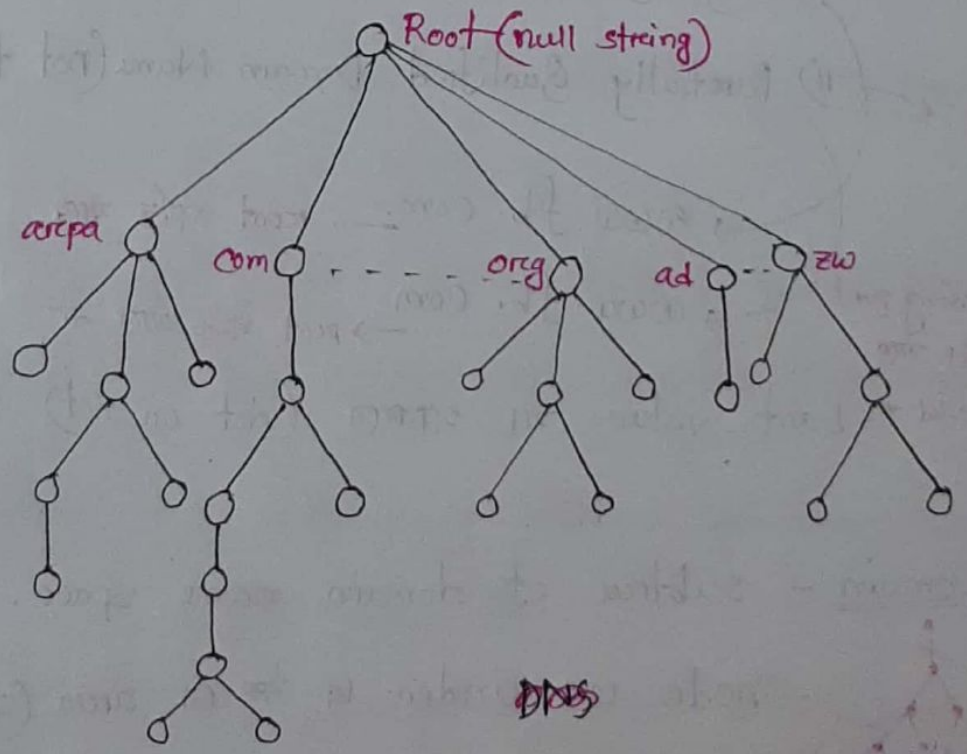
* **Namespace** : maps each address to a unique name; can be organized in two ways -

1) Flat namespace (sequence of character without structure) (Can't be used in a large system; may not be unique)
2) Hierarchical namespace (made of several parts; always unique)

Domain namespace (hierarchical way তে server গুলো আজানো থাকে)

- hierarchical namespace
- inverted-tree structure with root at the top
- tree with 128 levels : level 0 (root) to level 127.



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* Terminologies :

Label - each node in the tree has a label, which is a string with maximum 63 characters. Root label is null string (empty string).

- guarantees uniqueness (pstu , ac , bd — labels)

Domain ~~name or~~ name - sequence of labels separated by dots (.); always read from the node up to the root. full domain name always ends in null ~~ter~~ label (root).

(pstu.ac.bd)

Two types -

I) Fully Qualified Domain Name (terminated by null string)

II) Partially Qualified Domain Name (not terminated by null string)

pstu ; cccw :

resolver missing part গুলোকে supply করে:

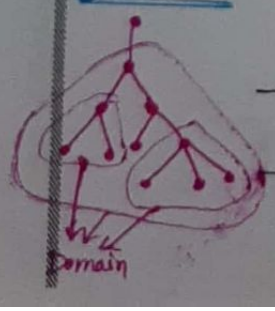
pstu → pstu.ac.bd

→ www.fb.com. → root পর্যন্ত যাবে

→ www.fb.com → root পর্যন্ত যাবে না

* Last value যা থাকবে (dot or not) তার উপর depend করছে

Domain - subtree of domain name space.



- node এর under এ যে area (যতগুলো children)
- can be divided into domains or sub-domains.

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* Distribution of DNS server:

1) Centralized - Common server; সবার address রাখবে

2) Decentralized - distributed system; root server এর under এ যেসব node থাকে তার detail info রাখে

* Problems with Centralized DNS server:

1. Consumes more time
2. Central server এ problem হলে সব server affected হয়
3. Complex, Lengthy process
4. একটা server এর উপর tracking load বেশি

Zone - What a server is responsible for or has authority over is called a zone.

- Creates a database named zone file and keeps all the information for every node under that domain.

Zone file transfer → secondary server primary server এর থেকে info নেয়।

(secondary server downloads information from primary server)

* Zone vs domain

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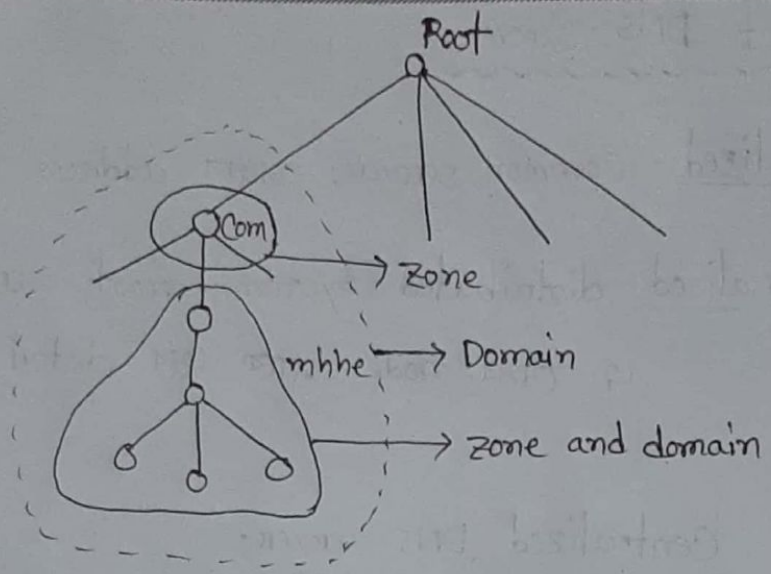

Zones and domains

Root server - its zone consists of the whole tree.

- doesn't store any info about domains

Node servers other than root server -

Two types:

1) Primary server: stores a file about the zone for which it is an authority; responsible for creating, maintaining and updating the zone file.

2) Secondary server: transfers the complete information about a zone from another (primary) server and stores in the local disk.

update লাগলে primary server update করে secondary server এ পাঠাবে।

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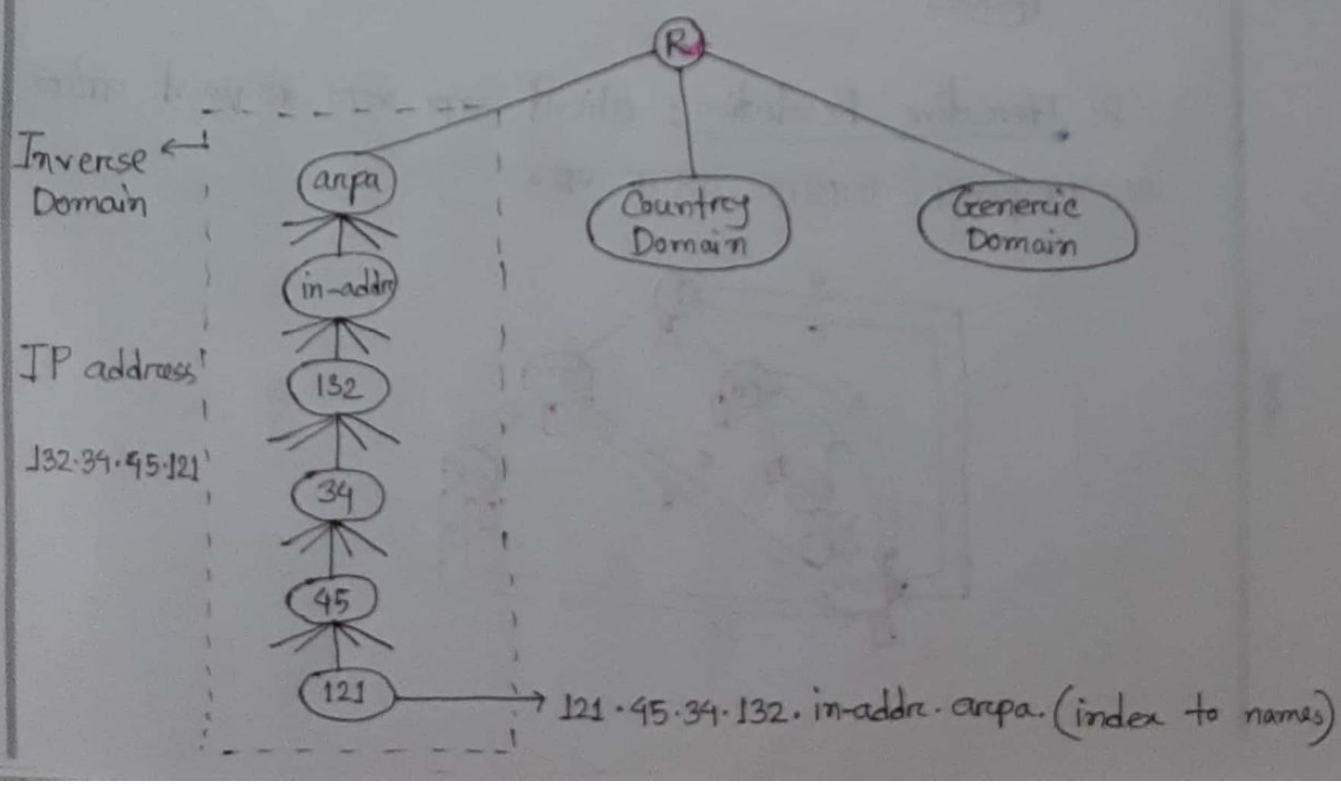
** Redundent information create করার জন্য ~~pre~~ both primary & secondary servers are important.

DNS → client part : host
server part

DNS Tree → 3 parts/sections:

name to address mapping
- 1) Generic domains : institution এর উপর dependent total 14; com, org, etc.
- 2) Country domains : country based; bd, pk, us, etc

address to name mapping
- 3) Inverse domains; map address to name; handles pointer query (query to map address to name)



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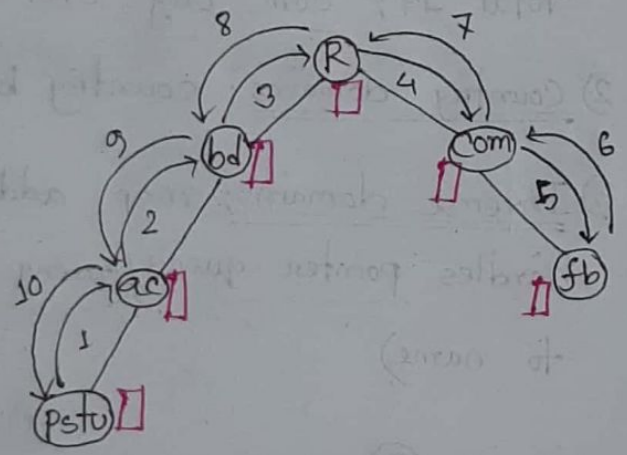
* **Resolution**: mapping a name to an address or an address to a name is called name-address resolution.
(resolver যা করে থাকে)

Resolver → DNS client

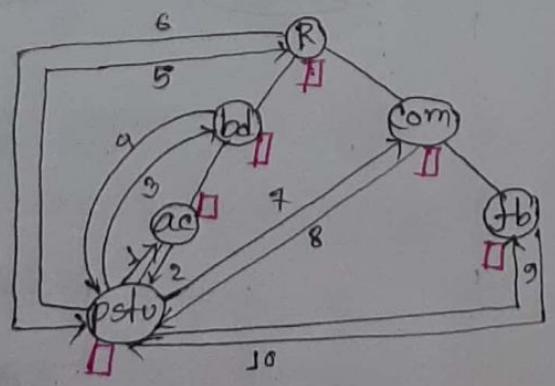
Resolution Two types-

1. **Recursive Resolution**: request পাঠানোর পর response আসার আগ পর্যন্ত আর কোন কাজ করে না



server গুলোতে cache এই into store করে রাখতে future use এর জন্য

2. **Iterative Resolution**: client বার বার request পাঠায় response আসার আগ পর্যন্ত.



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* Caching - বার বার info search না করে cache করে রাখে cha cache server.

** যখন response authorative source থেকে না নিয়ে cache memory থেকে নেয় তখন server response - কে unauthorative হিসেবে mark করে দেয়।

TTL (time-to-live) — defines time in seconds that the receiving server can cache the information. After that time, the mapping is invalid and any query must be sent again to the authorative server.

কতক্ষণ পর্যন্ত cache এ info stored থাকবে

Registrar : Authority ; ICANN registrars কে responsibility দেয়।
(See দিতে হবে)

next class → query message, response message

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Sub.: Lecture-8 (SM) Online

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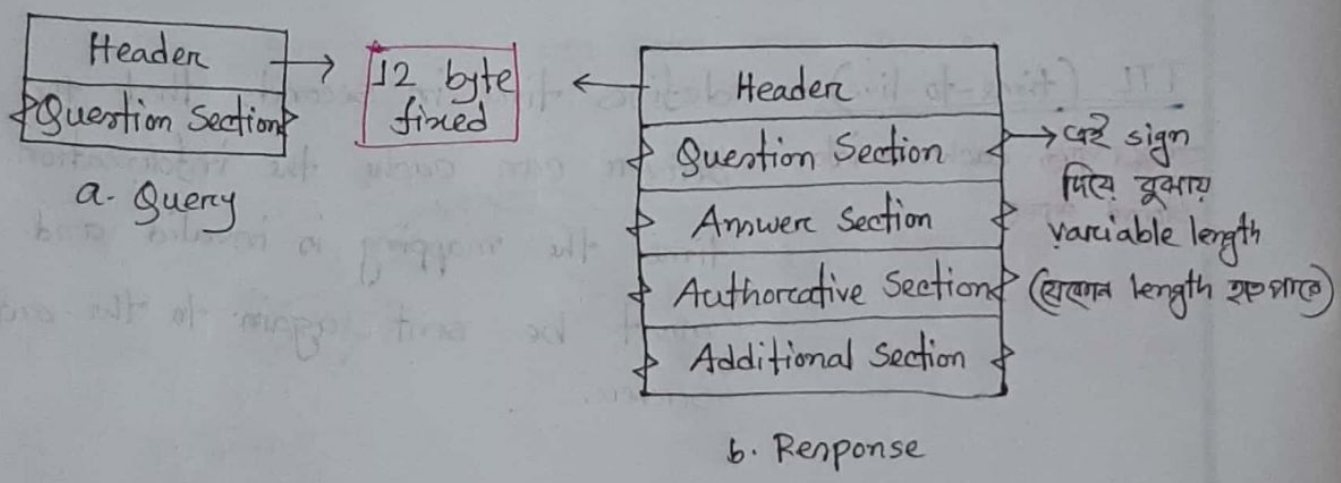
* DNS Messages : Two types –

1) Query message → client

2) Response message → server

Message format



** Query & Response same header format

Header

Identification – 16-bit ; প্রত্যেক Query-র জন্য আলাদা identification no. থাকে.

Flags – 16-bit; একেকটা bit দিয়ে fixed কিছু indicate করে

Identification	Flags
No. of Question records	No. of Answer records (0)
No. of Authoritative records (0)	No. of Additional records (0)

All 0 when query message

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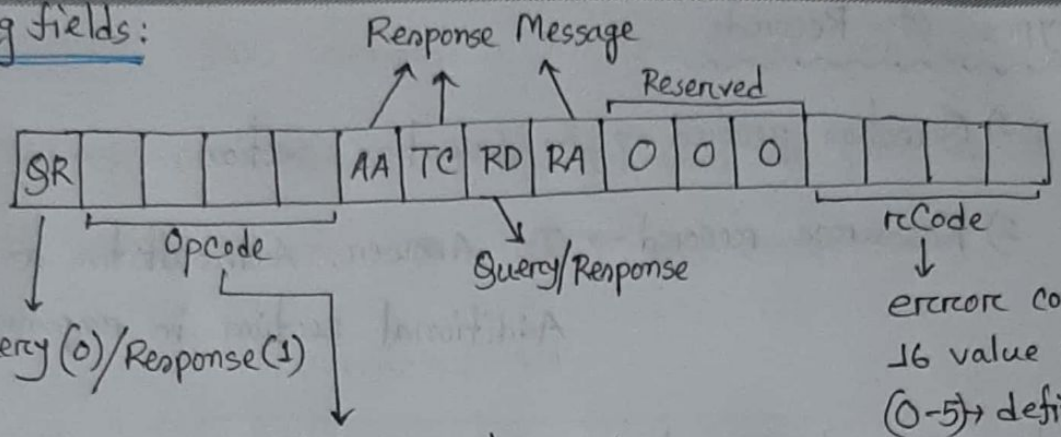
* Flag fields:



rcCode → error code; ~~16 bit possible~~ 16 value possible (0-15); (0-5) → defined; (6-15) → undefined

defines type of query/response

binary value:
- 0 = standard (0000)
- 1 = inverse (0001)
- 2 = server status request (0010)

0 = No error
1 = Format error
2 = Problem at name server
3 = Domain reference problem
4 = Query type not supported
5 = Administratively prohibited.

AA → Authorative Answer (1)

TC → Truncated (1 means over 512 bytes) → UDP use করলে

RD → Recursion Desired (1 = client requires ~~query~~ ~~message~~ recursive answer. set in query message and repeated in the response message

RA → Recursion Available (1 means recursive response available)

**

Question Section → consists of one or more question records. (QR)

Answer Section → consists of one or more resource records. (R)

Authoritative Section → gives information (domain name) about one or more authoritative servers for the query. (R)

Additional Information Section → provides additional information like IP address of the domain name to that may help the resolver.

For response message

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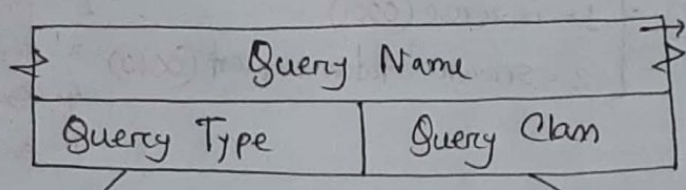
* Types of Records

1) Question record → In Question section

2) Resource record → In Answer, Authoritative and Additional section in response message.

Question Record Format

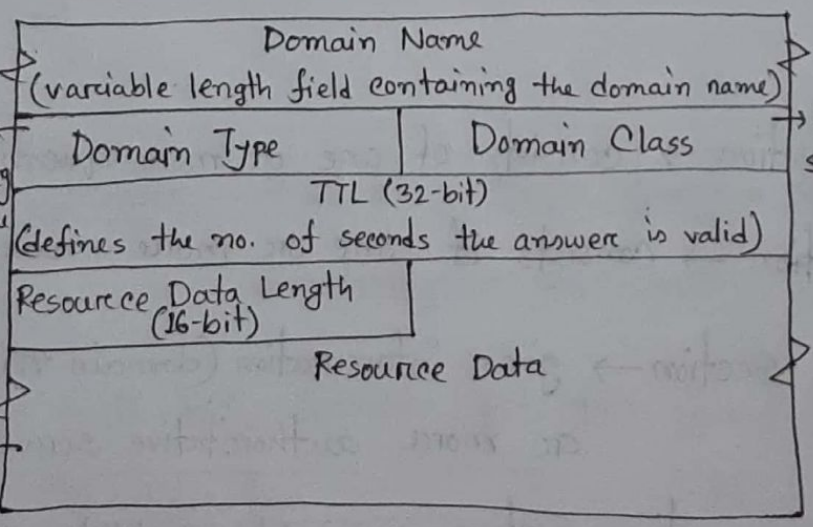


→ variable length field containing a domain name

16-bit field defining a type of query (Table 19.3)

16bit field defining the specific protocol using DNS (Table 19.4) (1; IN; Internet)

Resource Record Format



16-bit field defining a type of the domain

16-bit field defining the specific protocol using DNS

variable length field containing the answer to the query or the domain name of authoritative server or additional information.

can be – a number, a domain name, offset pointer, character string

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Compression: DNS defines a 2-byte offset pointer that points to a previous occurrence of the domain or part of it. (pointer দিয়ে point করলে memory কম লাগে, তাই compression).

2-byte ; 16-bit

1	1	Address of the beginning byte
2-bits		14-bits

offset pointer format

** Example 19.1, 19.2, 19.3 ***

*** Flag এর hexadecimal value দেয়া থাকলে সেটা কি mean করে?
(binary তে convert করে দেখাতে হবে)

Encapsulation:

- DNS can use either UDP or TCP; Port 53
  - UDP → r.message size < 512
  - size of response message > 512 : TCP connection is used

Registrar: IP address and name ~~very~~ verify করে যে এটা unique কিনা; সেই IP, name এ কোন host exist করছে কিনা - যদি থাকে তাহলে change করে দিতে বলবে otherwise DNS database এ add করে দিবে। A fee is charged.

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DDNS → Dynamic DNS :

যখন DNS এ কোন change হয় তখন DNS master file এ change করতে হবে। Domain name change হয়ে যায়। তখন ২ ভাবে কাজ করা যায় –

1) নিজে আশেপাশের সব secondary server কে notification পাঠায় যে কিছু update হয়েছে তখন secondary server zone transfer করে নিয়ে নেতে পারে।

2) Secondary server গুলো periodically change করতে পারে যে কোন update আছে কি নেই; update হলে primary server থেকে zone transfer করে secondary server এ নিয়ে আসে।

* Security of DNS

- IETF has devised a technology named DNS security (DNSSEC) that provides message origin authentication and message integrity using a security service called digital signature.

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Sub.: Lecture-9 (SM)

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* DDNS

- ২ ভাবে কাজ হয়
  - i) Actively
  - ii) Passively
- এই কাজগুলো হয় DHCP এর আন্ডারে

Chapter-18

Host Configuration : DHCP

DHCP → Dynamic Host Configuration Protocol

- IP address যে change হয়ে যাচ্ছে সেটা handle করা হয় DHCP-র আন্ডারে

** যখন computer on করি, network এর সাথে connected হই তখন চার ধরনের information থাকা দরকার -

1. নিজের একটা IP address থাকবে
2. Subnet Mask
3. যেই router এর সাথে via হয়ে network এর সাথে connected থাকবে তার IP address.
4. DNS server এর IP address

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* Previous Protocols

RARP → Reverse Address Resolution Protocol
- datalink layer এর broadcast service use করে.
- এটা শুধু নিজের computer নিয়ে কাজ করে।
- সব network এ RARP না থাকলে কাজ করবে না
- এটা information আমাদেরকে দিতে পারে না; Only IP

ARP → maps an IP address to a physical address
RARP → maps a physical address to an IP address

BOOTP → Bootstrap Protocol
- client/server protocol, designed to overcome RARP issues
- DHCP-র কাছাকাছি; এটা information show করতে
- as its client/server protocol, can be anywhere in the Internet
- ~~প্রত্যেক~~ not static configuration protocol (যখন dynamic configuration এর প্রয়োজন হয় তখন use করা যায় না)

এই জন্য এই ২টা protocol এখন আর use হয় না।

* DHCP - client-server application protocol
- ঠিকঠাক Info. ই দিবে
- ২ ধরনের কাজ করতে পারে

  i) static configuration show করবে (BOOTP-র মত কাজ করতে)

  ii) Dynamic configuration show করবে

- client and server ~~সব~~ same or different network এ থাকতে পারে।

  Same network is not common

  * fig: Client-Server on same network

Passive Open → client কিছু পাঠানোর আগে server এর port open করতে হয়; Port 67 (DHCP server)

Active Open → client port 68

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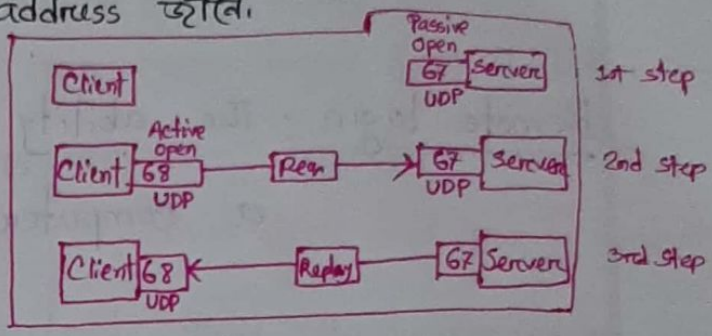
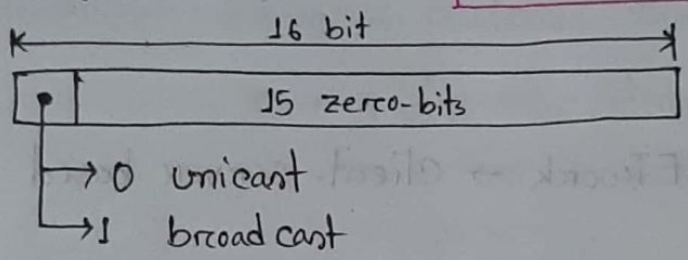
* Client- Server on two different networks (figure)

Relay agent → client site এর যেকোনো host/router হতে পারে;
Server এর address জানে।

* Use of UDP ports



Flag format:



** request message পাঠানোর জন্য server এ যে চারটা IP address এর কথা বলা হয়েছে তা একটা configuration file এর মধ্যে থাকে।

- TFTP ~~ms~~ message এর মাধ্যমে
  ↳ encapsulated in UDP datagram

* Configuration

- Static Address Allocation
- Dynamic Address Allocation

Lease → temporary address গুলো use করার time period.

** DHCP → Dynamically address allocate করার জন্য use করা হয়।

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Chapter 20

Remote Login : TELNET and SSH

Remote login : The ability to access the data stored on a computer from a remote location.

* TELNET

TErminaL NETwork → client-server based application protocol

Login → i) Local login : Central PC-র মাধ্যমে আমাদের show করবে

ii) Remote login (যখন কোন remote machine এ login করতে চাই)

Time-Sharing Environment → একেকজনকে নির্দিষ্ট time allocate করে দেয়া হয়; parallally কাজ করে

** Central PC-র সাথে যখন 5/6 টা PC - terminal হিসেবে connected থাকে এবং সেটা থেকে as a user connected হয় বা login করে সেটা Local login.

যেখানে user সরাসরি connected থাকে তাই কেকে local login বলা হয়।

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** Remote Login:

Terminal driver → keyboard, monitor, mouse, etc.

আমাদের কাছ থেকে input নিয়ে TELNET client এর কাছে পাঠায়।

Password হিসেবে keyboard থেকে যে keystrokes client input করছে তা interpret করে

Pseudoterminal driver → pretends that the characters are coming from a terminal as remote operating system is not designed to receive characters from TELNET server.

* NVT → Network Virtual Terminal

Local computer & remote computer এর মাঝে common character set use করা হয় যেন পরস্পরকে বুঝতে পারে - সেটাই NVT. client থেকে keystrokes নিয়ে TELNET client NVT form এ characters গুলো Internet এ through TELNET server এ যায়

** TELNET এর ক্ষেত্রে ২ টা জিনিস transfer হয়

i) Data character transfer → | 0 | | | | | | | | (ASCII)

ii) Control character transfer → | 1 | | | | | | | | (ASCII)

* Options

- Client & Server এর মধ্যে negotiation এর জন্য use হয়।

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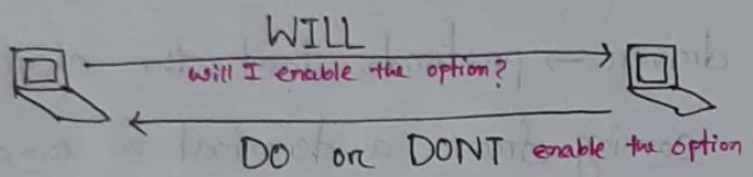
** NVT Character set for Option negotiation

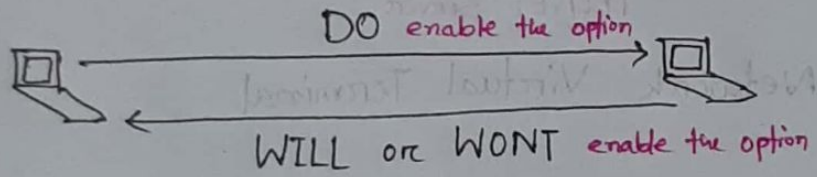
I) WILL → যখন permission নিবে কোন option enable করার জন্য

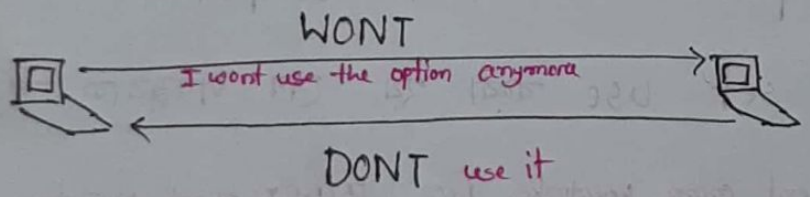
II) ~~WONT~~ WONT → যখন server এর option enable করতে বলা হয়

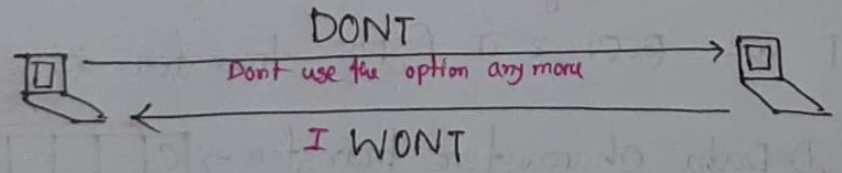
III) DO

IV) DONT









এই চারটা option এর কাজকে বলা হয় option negotiation

** Example 20.1

IAC → Interpret as Command (characters are interpreted as commands)

If two IAC received, first one is discarded and the second is interpreted as data.

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* Suboption Negotiation

একটা option এর মধ্যে sub option থাকতে পারে।

NVT character set –

I) SE → Suboption End

II) SB → Suboption Begin

* Modes of Operation

I) Default mode (Half-duplex)

Client server কে একটা line লিখে পাঠাতে পারে কিন্তু যদি কোন ভুল হয় তাহলে সেটা edit করা যায় না। server এর কাছে যাওয়ার পরে আবার request পাঠাতে হয় (edited line)

II) Character mode

Total একটা line না পাঠিয়ে character by character পাঠাবে। একটা character পাঠানোর পর server যখন সে receive করেছে তখন next character পাঠাবে।

III) Line mode (Full-duplex)

একটা line লিখে পাঠাতে পারবে & typo হলে সেটা edit করা possible.

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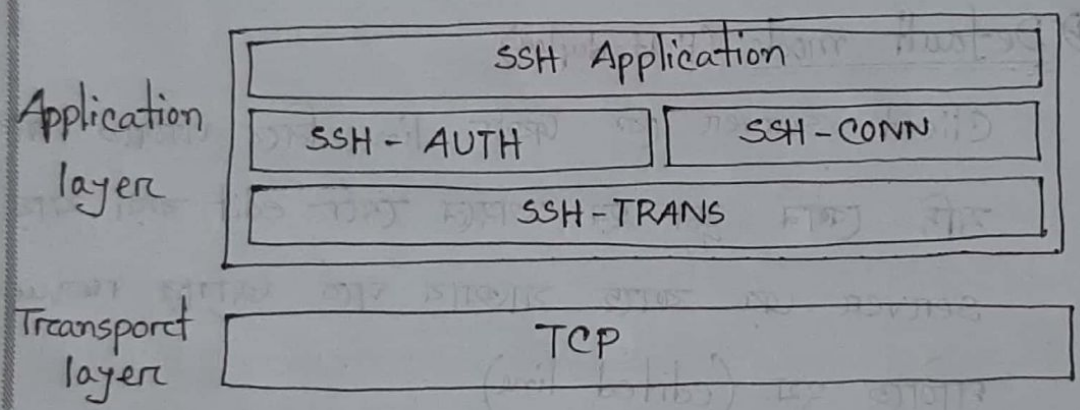
* Secure Shell (SSH)

TELNET is not much secured.

SSH 1
SSH 2 } 2 versions

বর্তমানে SSH 2 use করা হয়

Components of SSH



SSH Application

SSH Authentication Protocol; SSH Connection Protocol

- multiplexing করে অনেক channel এ ভাগ করে, data transmission handle করে

SSH ~~Transmission~~ Transport layer protocol

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→ server authentic কিনা তা verify করবে

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* Port Forwarding

SSH remote login করা অসম্ভব, আগে অন্যান্য protocol গুলোকে securely transmit করার জন্য Tunnel create করে দেয়া হয়।

SSH Tunneling / Port forwarding

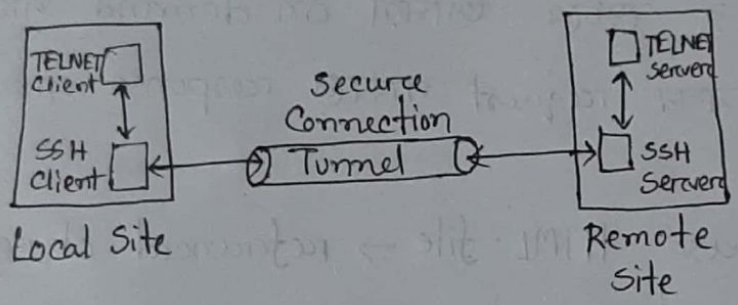

fig: Port forwarding

- TELNET, SMTP can use services of SSH using port forwarding mechanism.

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chapter: HTTP

Review for Mid

***Web and HTTP কেন popularity পায়?**

radio, TV broadcast এর ক্ষেত্রে যখন service provider যা provide করবে তখন দেখতে পাবো।

www, http-র ক্ষেত্রে আমরা on demand পাবো; নির্দিষ্ট কোন সময় নেই যখন request পাঠালে response পাওয়া যাবে এমন।

* Object, base HTML-file → referenced object, URL
↳ search করার পর প্রথমে আসে

HTML-file, image, Java applet, audo file

***HTTP**

- HTTP → Client-server based application protocol
  - Client → browser
  - server → যেখানে সবকিছু store করে রাখে

- TCP-র মাধ্যমে connection establish করতে হয়

  port / socket no → 80

- stateless but বর্তমানে http-কে state-oriented করা হয়েছে বিভিন্ন মাধ্যমে।

  transaction এর ক্ষেত্রে; cookies

2 types → 1) persistent http – আগের connection established থাকে
2) nonpersistent http – বার বার TCP connection creation

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By default → Persistent

If non-persistent → parallally not serially.

RTT → time for a small packet to travel from client to server and back.

* Two types http message

1) request message : client → server (ASCII - human readable)

↳ request line

[header lines

Carriage return → \r\n

entity body → যদি request এর আগে extra description পাঠাতে চায় তখন এটা কাজে লাগে;

- সব method এ use হয় না

- response message এ আমরা যে object চাচ্ছি তা entity body-র মাধ্যমে পাঠানো হয়।

2) response message : server → client

↳ status line

[header lines

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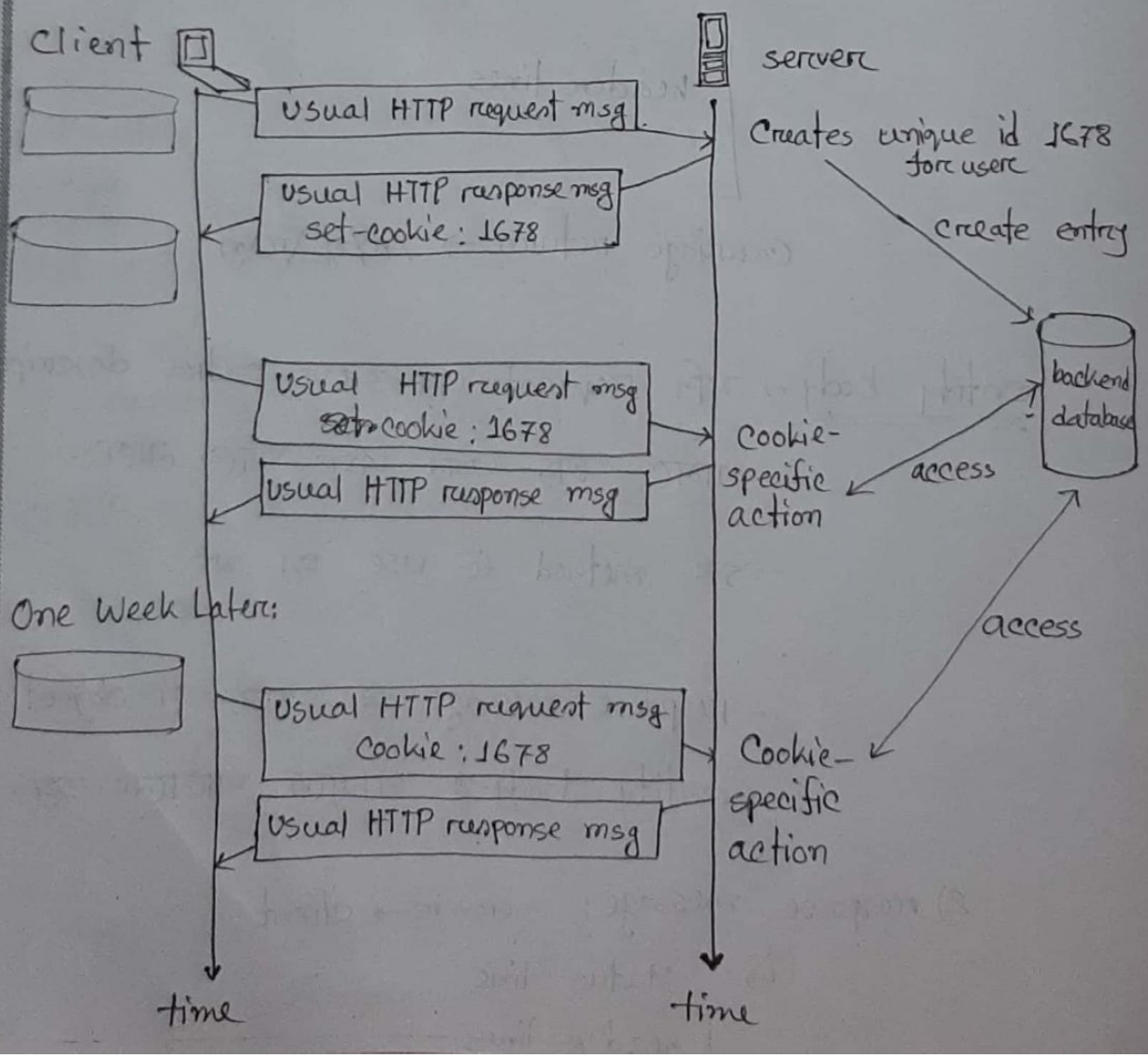
* Cookies → state oriented

4 components:

1) Cookie header line of HTTP response message
2) Cookie header line in next HTTP request message
3) Cookie file kept on user's host, managed by user's browser
4) backend database at website



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* Cookies: Comments

Cookies can be used for -

- authorization
- shopping carts
- recommendations
- User session state (Web email)

Disadvantage -

- personal info কে server sell করে দিতে পারে
- privacy maintain করা server এর উপর depended

* Web caches

- delay কমানোর জন্য use করা হয় (rom থেকে info আনার থেকে cache থেকে info আনলে response time কম হয়)
- reduce traffice on an intitution's access link

* Proxy Servers

- client, server দুইটা হিসেবেই কাজ করবে
  - server for original requesting client
  - Client to origin server

* Advantages

** Conditional GET

7 - marks
2 - questions → Mid

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Chapter 21

File Transfer: FTP and TFTP

FTP → File Transfer Protocol [in a standard mechanism provided by TCP/IP for copying a file from one host to another

TFTP → Trivial File Transfer Protocol

FTP → যেকোন file transfer এর ক্ষেত্রে যে protocol use করা হয়.

*** Some problems ~~may~~ must be dealt with first

different directory structures
different ways to represent text and data
different filename convention

Client/sender এবং server/receiver এই 2টি system এর মধ্যে বিভিন্ন ধরনে difference থাকতে পারে; file execution command এ difference থাকতে পারে, file এর name গুলো যেভাবে লিখে সেটার difference থাকতে পারে, OS আলাদা থাকতে পারে

FTP-তে শুধু file টাই transfer করে না, 2টি system যেন communication করতে পারে সেই বিষয়ে খেয়াল রাখা হয়।

** অন্যান্য client-server system এর সাথে FTP-র পার্থক্য-

→ অন্যান্য client-server system এ sender & receiver একটি connection use করে, একটি port no. এর মাধ্যমেই data send, control connection send করে।

FTP uses 2 TCP connections. The well-known port 21 is used for control connection and the well-known port 20 for data connection.

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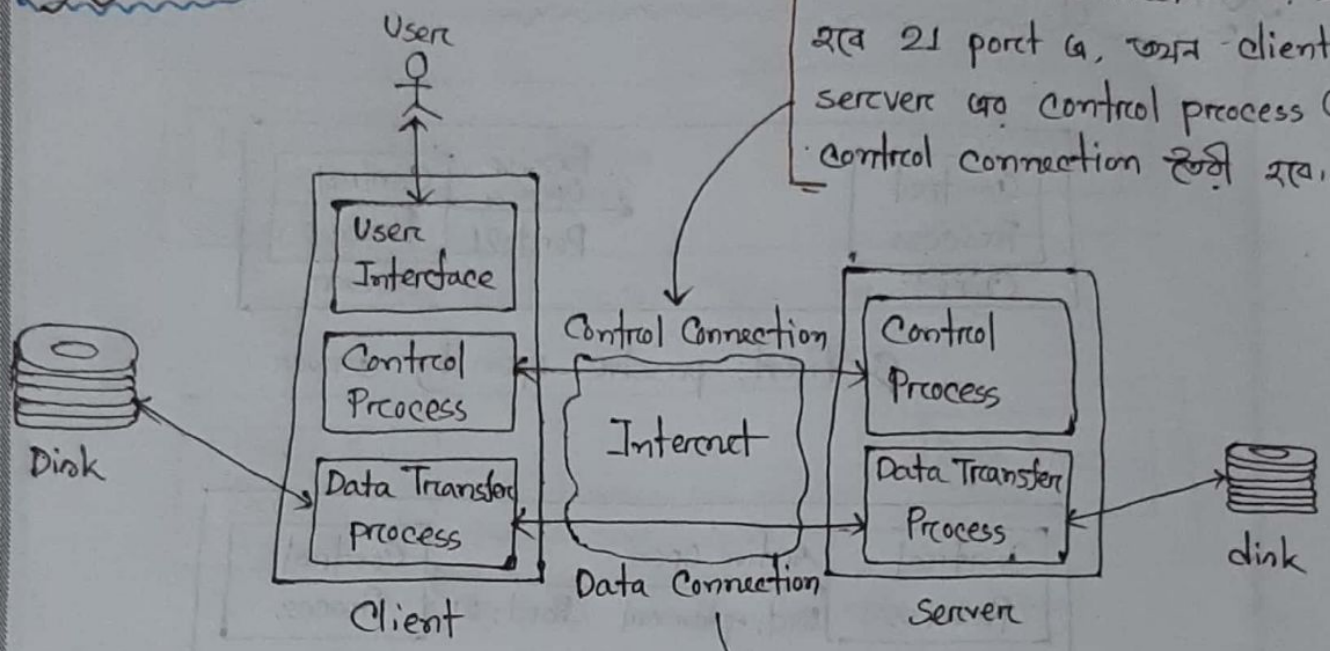
** FTP

যখন control connection এর প্রয়োজন হবে 21 port এ, তখন client & server এর control process এর মধ্যে control connection তৈরী হবে।



যখন data connection এর দরকার হবে তখন client & server এর data transfer process এর মধ্যে 20 port এ data connection তৈরী হবে।

Client এর 3 components -

1. User interface
2. Control process
3. Data transfer process

Server এর 2 components -

1. Control process
2. Data transfer process

** যতক্ষন পর্যন্ত file transfer হবে ততক্ষন পর্যন্ত control connection open থাকবে। অর্থাৎ command এর মাধ্যমে একটা control connection establish করার পর ঐ port টা active থাকবে

* Total data transfer এর আগে আগে data connection & control connection বন্ধ হয়ে যাবে

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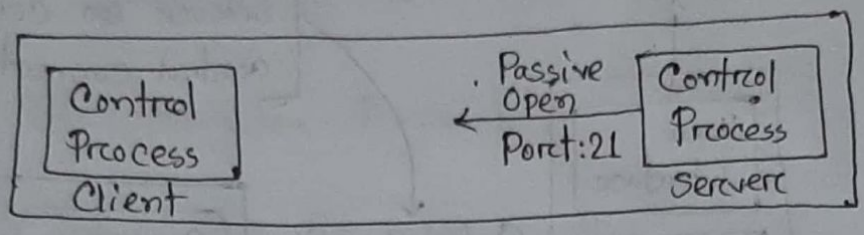
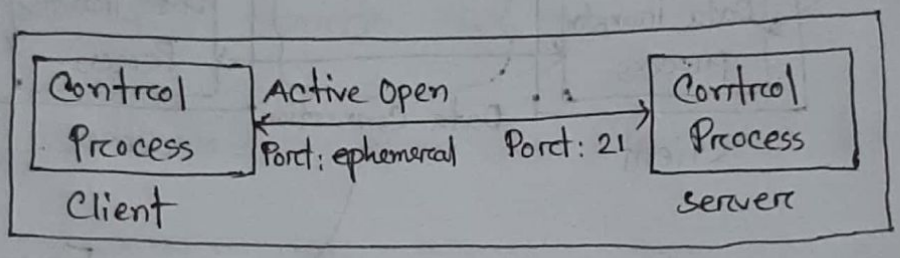
*Opening the control connection



a. First, passive open by server



b. Later, active open by client

কিছু কিছু port number বিভিন্ন application এর জন্য নির্দিষ্ট, এগুলো অন্য কেউ use করতে পারবে না (124 পর্যন্ত may be). Well-known ports কিন্তু এর বাইরে কিছু port আছে ($2^{32}/2^{64}$ range এর) যা নির্দিষ্ট না তাদেরকে বলা হয় ephemeral port. Client যেকোন একটা port use করে communication শুরু করতে পারবে।

Passive open – connection establish করার জন্য যখন port open করে

Active open – port open হয়ে যখন connection establish হয়

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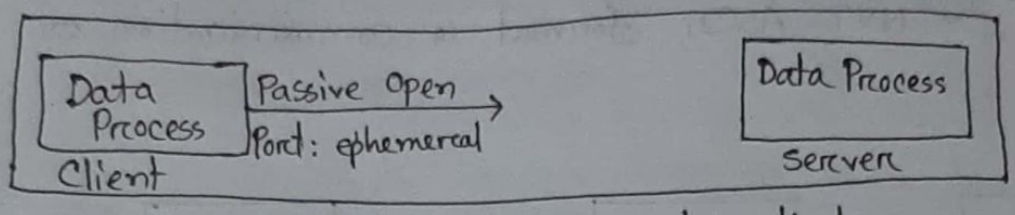
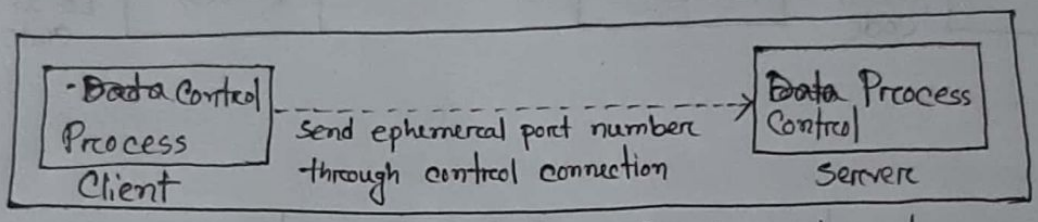
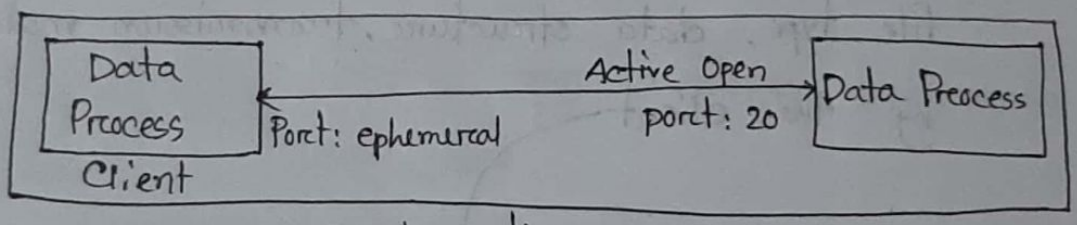
* Creating the Data Connection



a. First, passive open by client



b. Second, sending of ephemeral port



c. Third, active open by server

** Control connection এ server passive open হয়, Data connection এ client passive open হয়।

** Port 20, 21 server এর জন্য fixed, but client always এর ephemeral port use করে।

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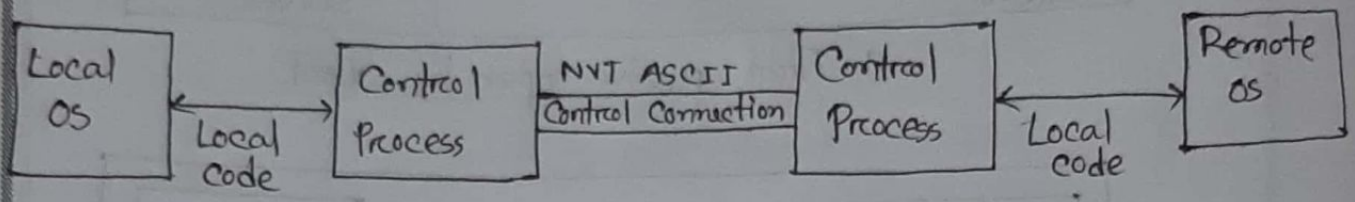
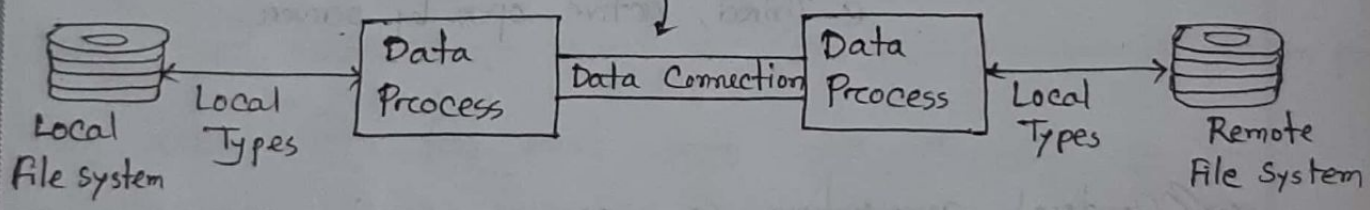
* Communication over Control Connection

- NVT ASCII format এ communication হয়



* Communication over Data Connection

- file type, data structure, transmission mode are defined by the client



File types - 3 ধরনের হতে পারে।

1) By default ASCII (যদি define করা না থাকে) [Text file]

2) EBCDIC (যখন server-client both EBCDIC support করে)

3) image file (যখন কোন binary ~~format~~ এ file - continuous stream of bits) [compiled file]

এছাড়া আরো 2টি attribute থাকে

1) print version 2) Non print version

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Data Structure – 3 ধরনের structure

1) File structure (default) – শুধুমাত্র কতগুলো byte যাবে, কোন structure follow করবে না।

2) Record structure – যেখানে কতগুলো block block আকারে যাবে অর্থাৎ total byte-stream কে কতগুলো block/record এ ভাগ করবে

3) Page structure – equal sized কতগুলো page এ ভাগ করা থাকে – page এ header, page no. থাকতে পারে।

Transmission Mode – FTP-র জন্য 3 ধরনের transmission mode কাজ করে

1) Stream mode (default) – byte stream transfer এর ক্ষেত্রে

2) Block mode – block-block করে transfer এর ক্ষেত্রে

3) Compressed mode – using run-length encoding, compressed file transfer.

* Command Processing

- During communication, commands are sent from the client to the server and responses are sent from server to the client.

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Commands → Six Groups:

1) Access commands (Lets the user access the remote system)
2) File management commands [Lets the user access the file on the remote computer and manage them]
3) Data formating commands [Let the user define data structure, file type and transmission mode]
4) Port defining commands [define the port no. for the data connection on the client site.]
5) File transfer commands (Lets the user transfer files)
6) Miscalleneous commands [deliver information to the FTP user at the client site.]

Responses → Five groups (Two parts: 3 digit no., followed by text)

First digit (defines status of the command):

1) Positive preliminary reply (1 - First Digit)
2) Positive completion reply (2 - " ")
3) Positive Immediate reply (3 - " ")
4) Transient negative completion reply (4 - " ")
5) Permanent negative completion reply (5 - " ")

* Second Digit (defines status of the command):

0 → syntax
1 → information
2 → connections
3 → authentication and accounting
4 → unspecified
5 → file system

* Third digit provides additional information

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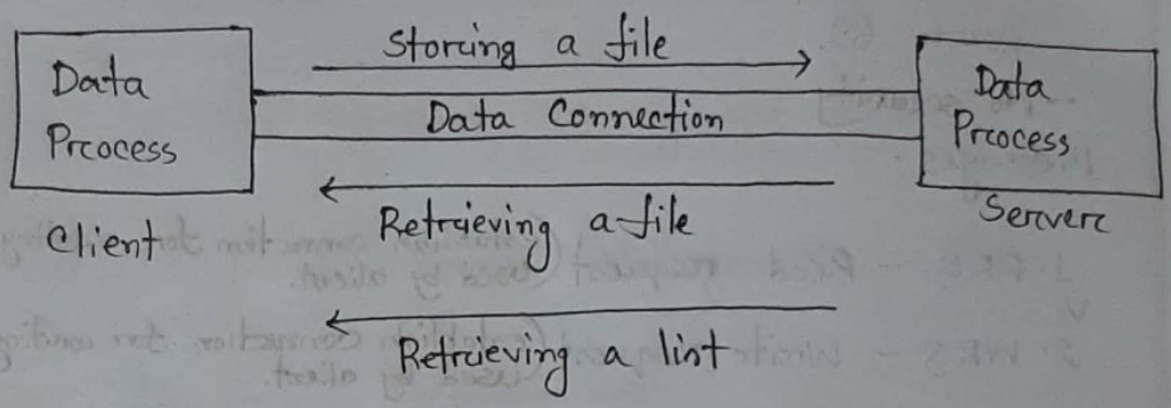
* File Transfer



File retrieving – যখন কোন কিছু server থেকে copy করে client এ নিয়ে আসা হবে। (downloading a file)

File storing – যখন client থেকে কোন কিছু copy হয়ে server এ যায় (uploading a file)

Retrieving List – directory তে পাওয়া

* Anonymous FTP (Some sites have a set of files available for public access)

publicly as accessible documents এর জন্য –

id – anonymous

password – guest

* Security for FTP (যদি secured shell use করে, তখন এটা SFTP)

- unencrypted password ; in plaintext
- use/apply Secured Socket Layer; then it is called SSL-FTP

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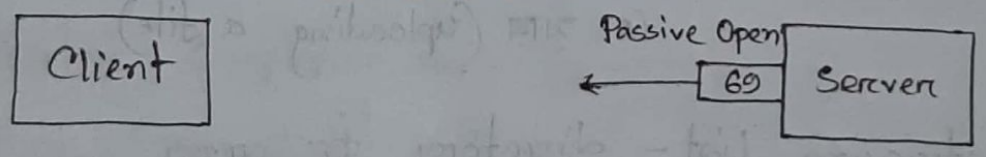
* TFTP

- TFTP uses the services of UDP on the well-known port 69.
- No security

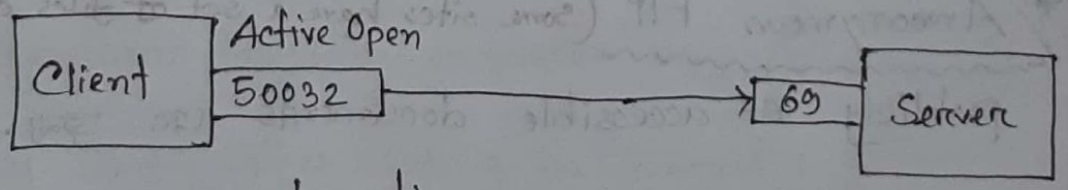
Messages:

1. RRQ – Read request (establish connection for reading data from server used by client.
2. WRQ – Write request (establish connection for writing data to server used by client.
3. DATA (used by client or server to send blocks of data)
4. ACK – acknowledge (used by client or server to acknowledge the receipt of data.
5. ERROR (used by client/server when a connection cannot be established or when there is a problem in data transmission.

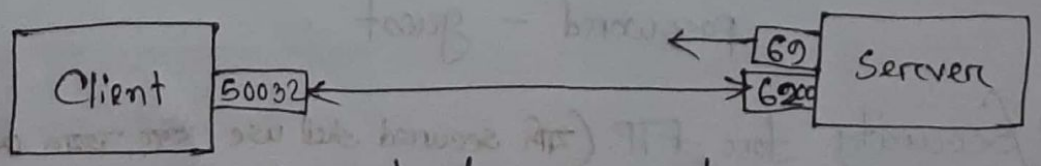
* UDP Port numbers used by TFTP



a. passive open by server



b. active open by ~~serv~~ client



c. rest of communication

* security
* Applications

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Chapter 24

Network Management: SNMP

SNMP → Simple Network Management Protocol

* Functions of a Network Management System

i) Configuration management

- Reconfiguration (hardware, software, user-account)
- Documentation (hardware, software, user-account)

ii) Fault management

- Reactive (Detecting, Isolating, Correcting, Recording faults)
- Proactive (Prevention)

iii) Performance management

- Capacity (Every network has a limited capacity)
- Traffic (blocking may occur if there's excessive traffic)
- Throughput (monitors throughput so it isn't reduced)
- Response time (checks response time)

iv) Security management

v) Accounting management

*** Data Communication and Network – Fourozan

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* Network Management System এর function গুলো কেবলমাত্র service. এই service গুলো দেয়া/ নেয়ার জন্য SNMP use করা হয়

SNMP → Application level protocol

* SNMP uses manager and agent concept.

Manager - host computers (runs client program)

Agent - routers, servers (runs server program)

→ Managerial কাজ গুলো manager করে agent control করে

SNMP → client-server paradigm এ কাজ করে

* Managerial কাজ initiate করে manager

* Trap message - warning (agent initiate করে)

* SNMP uses two other protocols as assistant protocols.

SMI - Structure of Management Information

MIB - Management Information Base

* Management Task এর জন্য 3 tr protocol প্রয়োজন হয় (SNMP, SMI, MIB)

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* SNMP (Simple Network Management Protocol)

- defines the format of packets exchanged between a manager and an agent.
- it reads and changes the status of objects (values of variables) in SNMP packets

* SMI (Structure of Management Information)

- defines the general rules for naming objects, defining object types (including range and length), and showing how to encode objects and values.

* MIB (Management Information Base)

- creates a collection of named objects, their types, and their relationships to each other in an entity to be managed.

** SMI কতগুলো rule set করবে এবং সেই rule অনুযায়ী MIB object create করবে এই এই object গুলোকে SNMP encapsulate করে নতুন packet তৈরী করে সেই অনুযায়ী receiver কে পাঠাবে।

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* All objects managed by SNMP are given an object identifier (always starts with 1.3.6.1.2.1)

* SMI

- Name (Hierarchical structure
- Type
  1. Simple
  2. Structured
     - sequence
     - sequence of
- Encoding Method
  - Tag
  - Length
  - Value

* MIB

- 10 different object groups

* system
* interface
* address translation
* ip
* icmp
* tcp
* udp
* egp
* transmission
* snmp

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* SNMP

PDU – protocol data units

** UDP Ports

161 → server (agent)

162 → client (manager)

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Chapter 25
Multimedia

Audio-Video services - 3 categories:

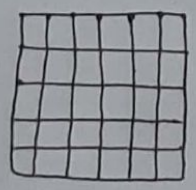
i) Streaming stored audio/video (on-demand)

ii) Streaming live audio/video (broadcasting)

iii) Interactive audio/video (internet telephony)

** Video - collection of static pictures

* resolution - no. of pixels contained in each frame.



row wise কতগুলো pixel

column wise " "

* frame rate - how many images shown per second.

* refresh rate - how many ~~types~~ times a pictures can be refreshed per second.

* codec - one type of conversion technique.

A software that compresses a video and convert the signal for reception

* container - is like a box that contains video, audio and metadata.

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* Compression – the process of reducing the total no. of bits needed to represent a given image or video sequence.

* Streaming stored audio/video

4 approaches –

1. 1st approach : using a web server
   [file 1st এ download করে then mediaplayer এ পাঠিয়ে play করতে হয়। mediaplayer browser এর সাথে connected থাকে]
2. 2nd approach : using a web server with Metafile
   [mediaplayer directly connected to web server. Web server stores two files - actual audio/video and a metafile - stores info about aud/vid]
3. 3rd approach : using a media server [controls the playing of audio/video file]
4. 4th approach : using a media server and RTSP
   → 1st http, then RTSP RTSP – Real Time Streaming Protocol

http-র উপর কাজ করে

* Streaming live audio/video

Ondemand Stored audio/video – unicast
Live audio/video – multicast
} both are sensitive to delay, can not retransmit

* Real-time Interactive audio/video

Characteristics :

Jitter – introduced in real time data by the delay between packets

- ✓ Time relationship
- ✓ Time stamp
- ✓ Playback buffer
- ✓ Ordering
- ✓ Multicasting
- ✓ Translation
- ✓ Mixing
- ✓ Support from transport layer protocol

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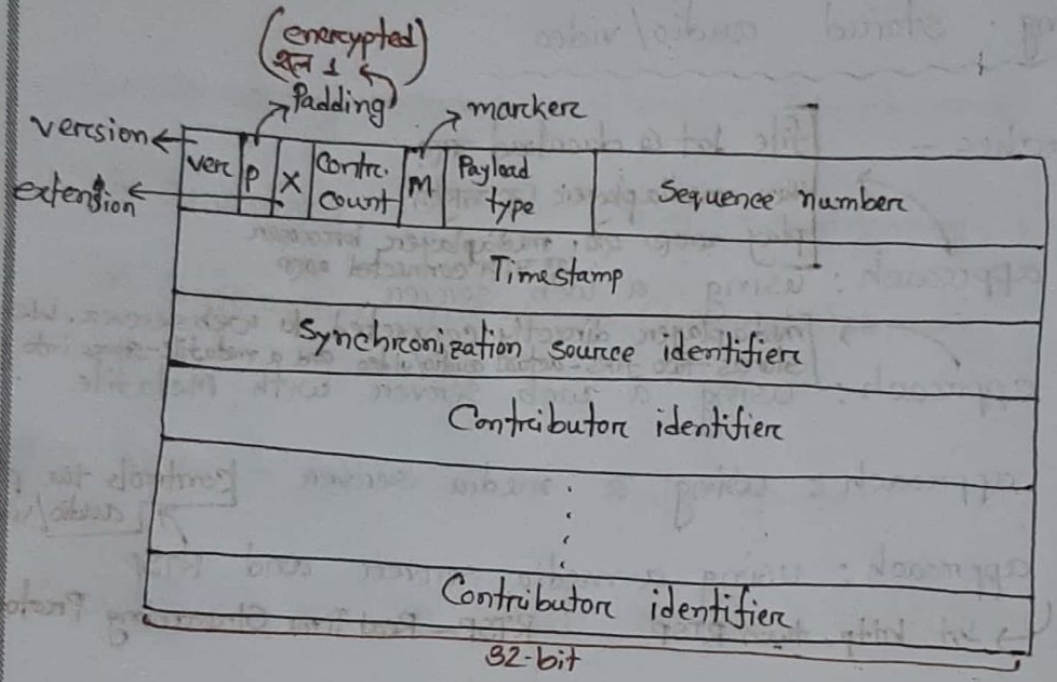
* RTP - Realtime Transport Protocol

RTP Packet Format



* RTP uses temporary even-number UDP port

* RTCP - Real-time Transport Control Protocol

5 types messages:

1. Sender report
2. Reciever report
3. Source description message
4. Bye message
5. Application-specific message

* RTCP uses odd-number UDP port.

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* VOIP - Voice Over IP

- SIP - Session Initiation Protocol
  - messages (INVITE, ACK, BYE, OPTIONS, CANCEL, REGISTER)
  - addresses (IPv4, Email, Phone no.)
  - simple session (establishing a session, communicating, terminating)
  - tracking the callee (uses register server & proxy server when the callee isn't at here terminal)

- H.323
  - Protocols
  - Operation

* G.71 or G.723.1 for compression
* H.245 to negotiate the compression method
* Q.931 for establishing or terminating connections
* H.225 used for registration with gatekeeper to negotiate bandwidth.

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* Peer-to-Peer [no single server concept; server এর উপর total dependency থাকে না; user controlled any device connected in pair.

Stream video traffic - major consumer of internet bandwidth
YouTube, Netflix

- bitTorrent protocol

** Multimedia - video

Audio/Video compression - একটা video-র অনেকগুলো version থাকতে পারে
MP4, MPEG, HD

* DASH Protocol (YouTube, Netflix)

Dynamic Adaptive Streaming over HTTP

** সব version media server এ stored থাকে। প্রত্যেক video-র version গুলোর url meta file থেকে client এর browser এ পাঠায়।

* YouTube video version গুলো YouTube server এ stored থাকে।

10 seconds chunks এ ভাগ করা থাকে

* DASH protocol - common protocol set করার জন্য

a device or computer program that encodes or decodes a data stream or signal

- codec important না
- Container - MP4
- apple বাদে বাকি device

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HLS - apple devices / iOS

- codec important
- container - MPEG-2

HTTP Live Streaming Protocol

HTTP based adaptive bitrate streaming communications protocol developed by Apple Inc. and released in 2009.

RTMP format - 2010 পর্যন্ত

* CDN (Content Distribution / Delivery Network) - group of geographically distributed & interconnected servers

- 80% user কে provide করতে হয় তখন server এর উপর চাপ পড়ে। এজন্য CDN use করা হয়
- proxy server এর মত কাজ করে
- যখন main server এ কোনো কিছু upload হয় তখন সব server এর CDN এ সেই file চলে যায়।
- CDN public / private হতে পারে

** Google CDN infrastructure 3 টি

- 19 mega data centers (around lakhs servers)
- Big cluster (with few hundred servers) - কিছু static document থাকে
- Small cluster (with tens of servers)

Netflix, YouTube - case study

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** There can be three types of problems at a Data Center:

1. speed, edge-to-edge throughput কমে যায়; consumes more time

2. same file or document needs to be brought everytime from distance; proxy server can help

3. if any problem arises, everything gets affected.

Throughput - the amount of data passing through a system or a process.

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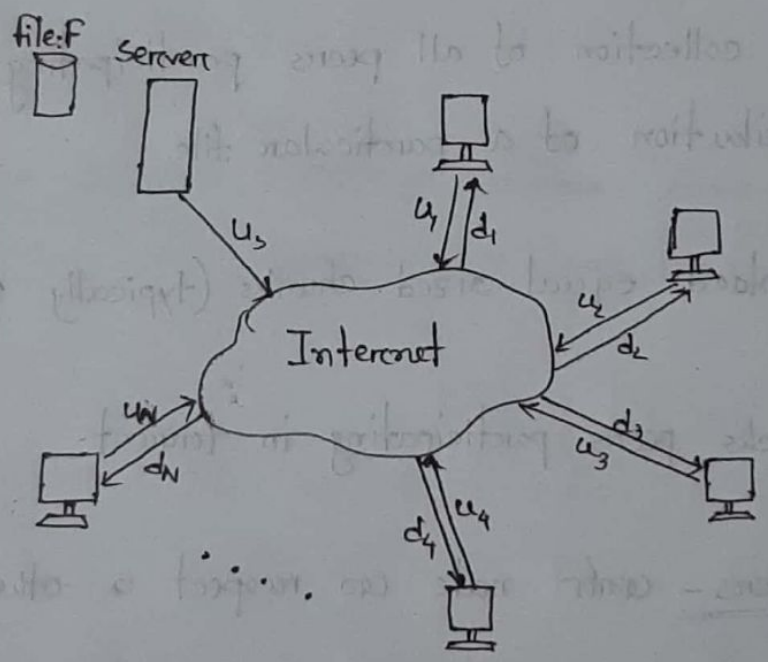
Chapter 2 (Ross)

* Peer-to-Peer Applications

- no total dependency on server
- no single server concept
- user controlled ~~dev~~ any device connected in pair

* P2P File Distribution



d = download rate

u = upload rate

Distribution time = time to distribute file (size F) from one server to N peers

for client-server; $D_{cs} = \max\left\{\frac{NF}{u_s}, \frac{F}{d_{min}}\right\}$

N এর value বাড়লে D_{cs} এর value বাড়তে থাকবে

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for P2P ;

$$D_{P2P} = \max\left\{\frac{F}{u_s}, \frac{F}{d_{min}}, \frac{NF}{u_s + \sum_{i=1}^{N} u_i}\right\}$$

** upload capacity অনুযায়ী distribution time কমে যাবে - N এর মান বেশি হলে।

*** Difference between Client-server and Peer-to-Peer architecture

* BitTorrent (Byte size) - Tit-for-Tat mechanism

Torrent - the collection of all peers participating in the distribution of a particular file.

- peers download equal-sized chunks (typically 256 KBytes)

Tracker - tracks peers participating in torrent

Neighboring peers - একটা node এর respect এ other nodes

** Peer has to take two types of decision :

1) কার কাছ থেকে download করবে → rarest first - যেই chunk rare তাকে আগে download করবে যেন rare chunk এর সংখ্যা বেড়ে যায়।

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2) কাকে upload করবে → trading algorithm use করে যার download rate / upload rate বেশি এমন 4 tr node কে select করবে যে; chunk provide করবে - এই 4 tr peer কে বলা হয় unchocked. এবং একটি ~~random~~ peer কে randomly choose করবে যাকে বলা হয় optimistically unchocked.

*** P2P

- total architecture setup করা easy
- less expensive
- less secured: যেকোনো hacker, device কে access করতে পারে, এজন্য vast level এ use করা হয় না।

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Chapter 14

User Datagram Program

* Transport Layer Protocols

UDP

- Connectionless protocol, ~~message~~
- not reliable protocol
- short data/msg transfer এর জন্য used
- no error control, flow control, congestion control
- between Application Layer and Network Layer
- message oriented protocol - full byte কে smaller divided না করে একটা message হিসেবে দেয়া হয় এবং সেই অনুযায়ী সেটা transmit করা হয়

TCP

- connection-oriented protocol
- reliable protocol, retransmission capability
- byte-oriented protocol
- has flow control, error control & congestion control

SCTP

- has both UDP & TCP's best features.
- Stream Control Transmission Protocol
- message-oriented
- reliability, retransmission capability
- flow control, error control, congestion control

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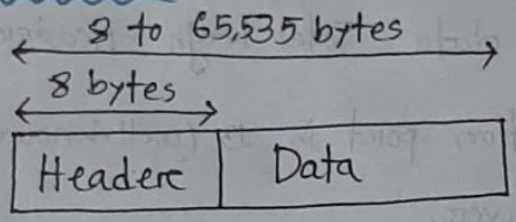
* Application layer এ যে message গুলো তৈরী হয় তা Transport layer এ এসে encapsulate হয়ে এবং new header add হয়। Then এটা Network layer এ গিয়ে আরেকটা header add হয়ে IP datagram এ পরিণত হয়।

* Datagram Format



a. UDP user Datagram

* **UDP Datagram**: UDP-র যে packet টা তৈরী হয়; application process এর পথে যে message গুলো পাঠানো হয়, total সেই bit এর combination & header নিয়ে যা তৈরী হয় সেটাকে বলা হয় user datagram.

- UDP-র ক্ষেত্রে যে packet তৈরী হয় তার একটা packet কে বলা হয় একটা user datagram.
- TCP-র ক্ষেত্রে যে packet তৈরী হয় সেটাকে বলা হয় segment.

* UDP Header format

application process এর 16-bit port no.

0	16	31
2byte Source Port No.	2byte Destination Port No.	
2byte Total length	2byte Checksum	

Total datagram এর byte এর সংখ্যা

কিছু কিছু UDP-র ক্ষেত্রে error control করা হয় checksum এর মাধ্যমে। (not mandetory)

b. Header format

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* Example: UDP header in hexadecimal format

CB84000D001C001C

a) Source port no: CB84 or 52100

b) Destination port no: 000D or 13

c) Total length of the user Datagram: 001C or 28 bytes

d) The length of the data = Total length − Header = 28 − 8 = 20 bytes

e) Since the destination port is 13 (well-known port), the packet is from client to server.

* Server এর ক্ষেত্রে port no. well known (0 − 1023). যেহেতু source port 52100 (not well known) and destination port is 13; so this is a client-to-server.

f) Daytime process is for 13 port. (এগুলো মনে রাখতে হবে)

* Services Provided by UDP

- Transport layer protocol; process-to-process communication
- Connection less service
- Never provides flow control, congestion control
- Provides error control only when checksum is used which is not mandatory.
- Encapsulation for sender & Decapsulation for receiver
- Multiplexing (একবারে যদি একটা client একাধিক process এর information server কে send করতে চায় তাহলে আবার info কে একত্রিত করে একটা signal হিসেবে পাঠাবে)

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- Demultiplexing (receiver এটা signal কে differentiate করে কয়গুলো process এর কাছে আলাদা আলাদা করে পাঠাবে)
- Queuing (Buffering technology) - যখন কোন port no create হবে তখন memory তে সেটা store করার জন্য location তৈরী হবে সেটা queue format এ buffer তৈরী হবে both sender & receiver side.
- UDP uses a simple protocol

* Well-known Ports used with UDP

Port	Protocol	Description
13	Daytime	returns date & time
53	Domain	DNS
69	TFTP	Trivial File Transfer Protocol
111	RPC	Remote Procedure Call
161	SNMP	Simple Network Management Protocol
162	SNMP	SNMP (trap)

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* UDP header এর আগে একটা Pseudoheader - ও যায়

Pseudoheader	32-bit source IP address		
	32-bit destination IP address		
	All 0s	8-bit protocol	16-bit UDP total length
Header	Source Port Address	Destination Port Address	
	UDP Total Length	Checksum	
	Data		

TCP-র জন্য protocol no. → 6

UDP-র " " " → 17

* Checksum calculation

153.18.8.105		
171.2.14.10		
All 0s	17	15

1087	13
15	All 0s

T	E	S	T
I	N	G	Pad

→ 16 bit এর multiple করার জন্য

এখানের সবগুলোকে 16-bit করে নিয়ে then যোগ করতে হবে

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10011001 00010010 → 153.18

00001000 01101001 → 8.105

10101011 00000010 → 171.2

00001110 00001010 → 14.10

00000000 00010001 → 0 and 17

00000000 00001111 → 15

00000100 00111111 → 1087

00000000 00001101 → 13

00000000 00001111 → 15

00000000 00000000 → 0 (Checksum)

01010100 01000101 → T and E

01010011 01010100 → S and T

01001001 01001110 → I and N

01000111 00000000 → G and 0 (Padding)

10010110 11101011 → Sum

Complement → 01101001 00010100 → Checksum

* Value of checksum for some hypothetical situations:

- যদি checksum sender add করতে না চায় তখন All 0s.
- যদি sum All 1's হয়, তাহলে একবার complement করলে all 0s আসবে। তাই আবার complement করতে হবে।
- যদি sum All 0s আসে। But এটা কখনো possible না।

* Encapsulation - sender process এ প্রত্যেক layer এ একটা করে header add হয়।

* Decapsulation - receiver process এ header গুলো discard হয়ে যাবে।

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* Queuing in UDP

· Outgoing queue - client যেই byte গুলোকে পাঠাতে চাচ্ছে তা outgoing queue তে পাঠাবে এবং UDP সেটা server এ পাঠানোর ব্যবস্থা করবে।

· Incoming queue - অপর পক্ষ থেকে যেই value গুলো আসবে তা থাকবে

- Both client & server এ incoming & outgoing queue থাকে

* Applications of UDP

- IP address to name or name to IP address convert request for DNS is done using UDP.

- Realtime stream, stored audio-video stream এসব ক্ষেত্রে UDP use করা হয়, retransmission problem create হয় না। (UDP + RHTP)

* SNMP-র ক্ষেত্রে segment wise পাঠানো হয় তাই এক্ষেত্রে UDP reliable না; TCP

* বড় কোন file download এর ক্ষেত্রেও TCP needed.

*** UDP used in

- simple request-response communication
- process with flow-error control mechanism (TFTP)
- suitable for multicasting
- SNMP
- RIP
- Real Time applications

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Chapter 15

Transmission Control Protocol

TCP

- Connection oriented service
- process-to-process communication
- stream delivery service (এতে বলা হয় sender-receiver এর মধ্যে একটা logical tube/line create করা হয়েছে যার মধ্যে দিয়ে stream of bits আদান-প্রদান হয়)
- Full-Duplex communication (Both party can communicate at a time)
- Reliable service
- ~~Comme~~ Multiplexing & Demultiplexing

* Well-known Ports used by TCP

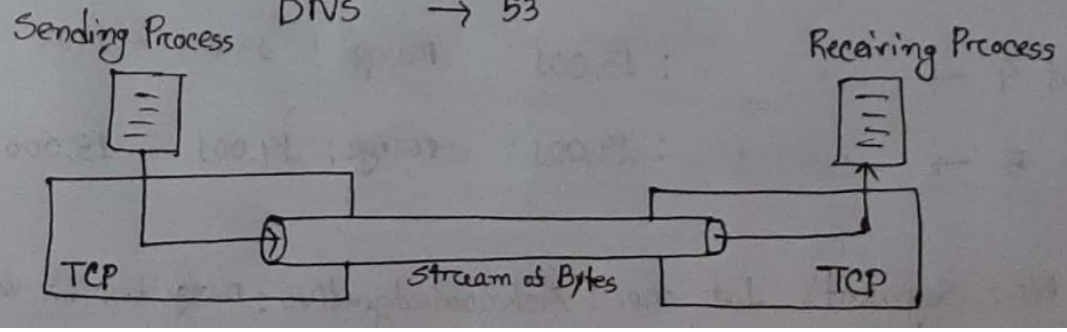
FTP → 20, 21

TELNET → 23

SMTP → 25

HTTP → 80

DNS → 53



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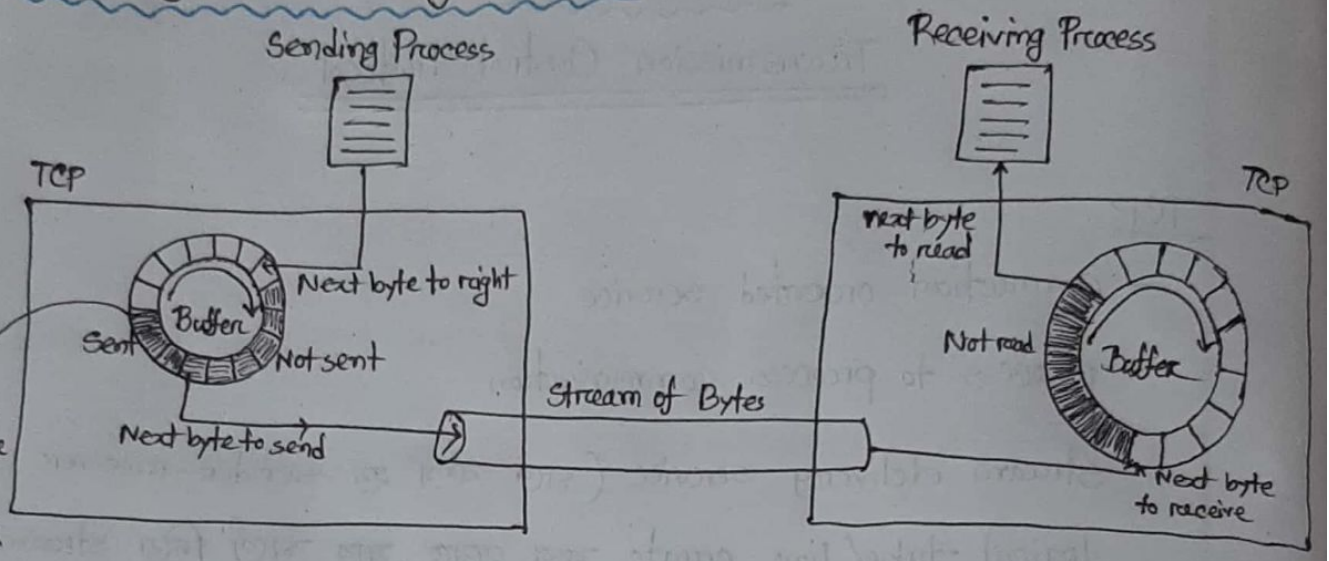
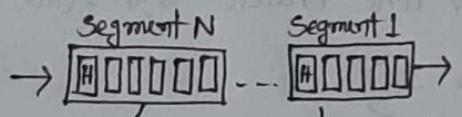
* Sending and Receiving Buffer



পাঠানো হয়েছে but acknowledge পায় নাই, তাই সাথে সাথে মুছে ফেলে না। acknowledge পাওয়ার পর মুছে ফেলবে।



5টা byte নিয়ে একটা segment

4টা byte নিয়ে একটা segment

- একটা packet এর মধ্যে একাধিক segment থাকতে পারে

*** Example 15.1 :** TCP connection transferring a file of 5000 bytes. The first byte is numbered 10,001. Five segments, each 1000 bytes

Sol^n: Following shows ~~each no. of~~ segment no. of each segment :

Segment 1 → Sequence no : 10,001 range : 10,001 – 11,000

Segment 2 → " " : 11,001 range : 11,001 – 12,000

Segment 3 → " " : 12,001 range : 12,001 – 13,000

Segment 4 → " " : 13,001 range : 13,001 – 14,000

Segment 5 → " " : 14,001 range : 14,001 – 15,000

Sequence No : Segment's 1st no. ; Acknowledgment No : range last bit এর পরের bit

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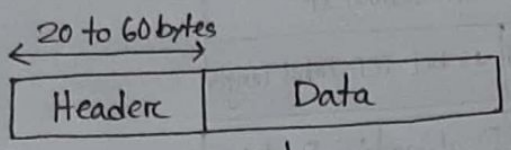
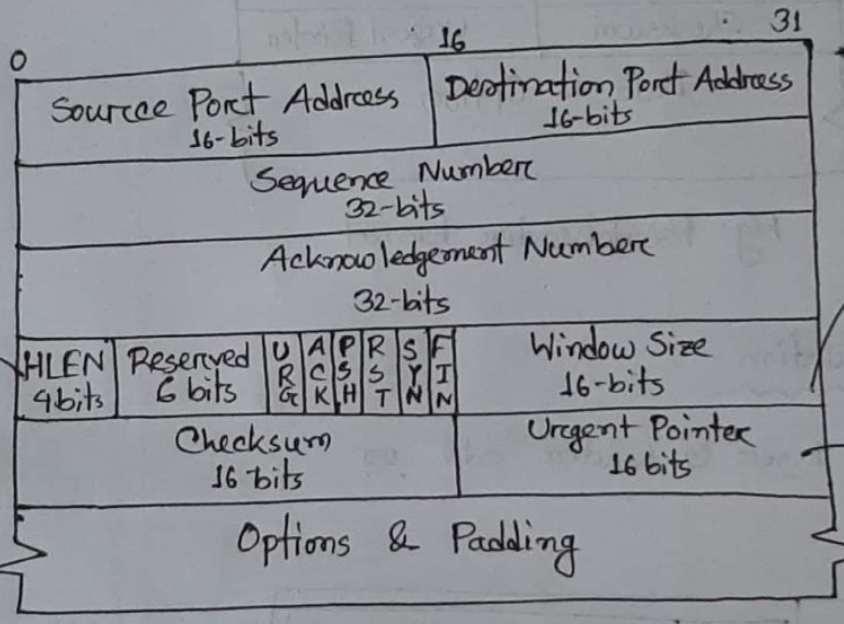
* TCP segment format



a. segment

options add হতে পারে তাই upto 60 bytes



b. Header

Header Length:
Decimal Value
1 = 4 bytes
2 = 8 bytes
3 = 12 bytes
Lowest হবে 5 কারণ lowest size 20 & highest হবে 15 কারণ highest size = 60

Buffer/Queue size; যেই size পর্যন্ত receive করার ক্ষমতা থাকে

Urgent flag bit set করা থাকলে এখানে 16-bit এর urgent pointer value দেয়া হয়

Urgent Pointer:
অনেকগুলো byte পাঠানো হলে যদি এমন কোন byte থাকে যেটা প্রসেস এর কাছে আগে পাঠাতে হবে.

Flags: Control field

URG = Urgent Pointer bit
ACK = Acknowledgement bit
PSH = Request for Push
RST = Reset the connection
SYN = Synchronize sequence no.
FIN = (Final) Terminate connection

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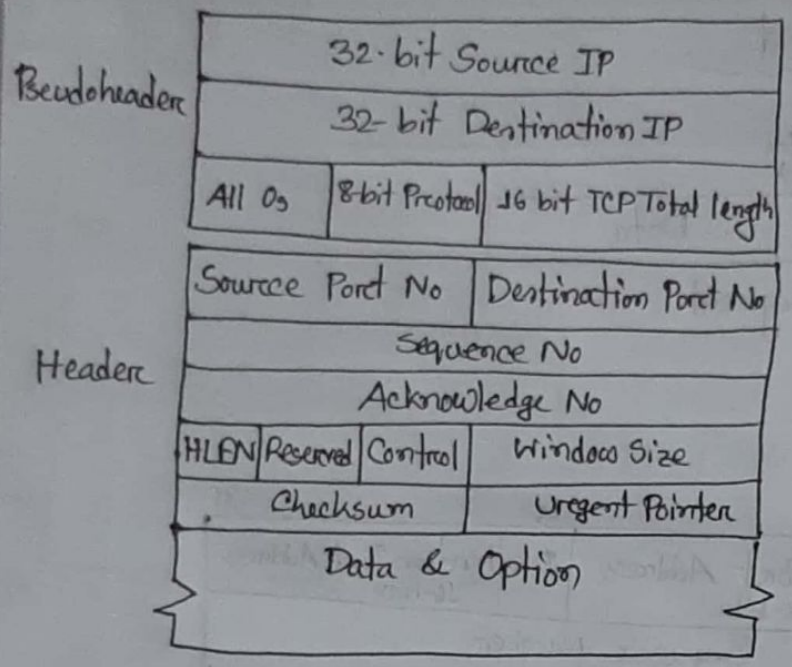
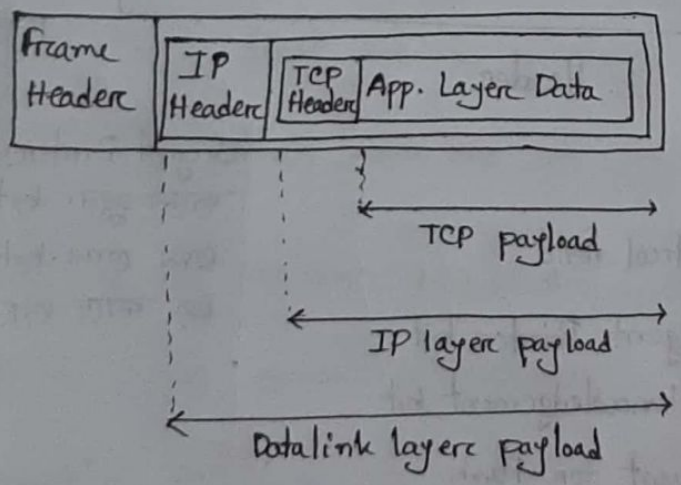


Fig: Pseudoheader format

* Encapsulation

- ~~Data~~ layer ও header add হয়



* TCP Connection

- Connection establish → Three way handshaking
- Data Transfer
- Connection Terminate
- Connection Reset

} Mandatory

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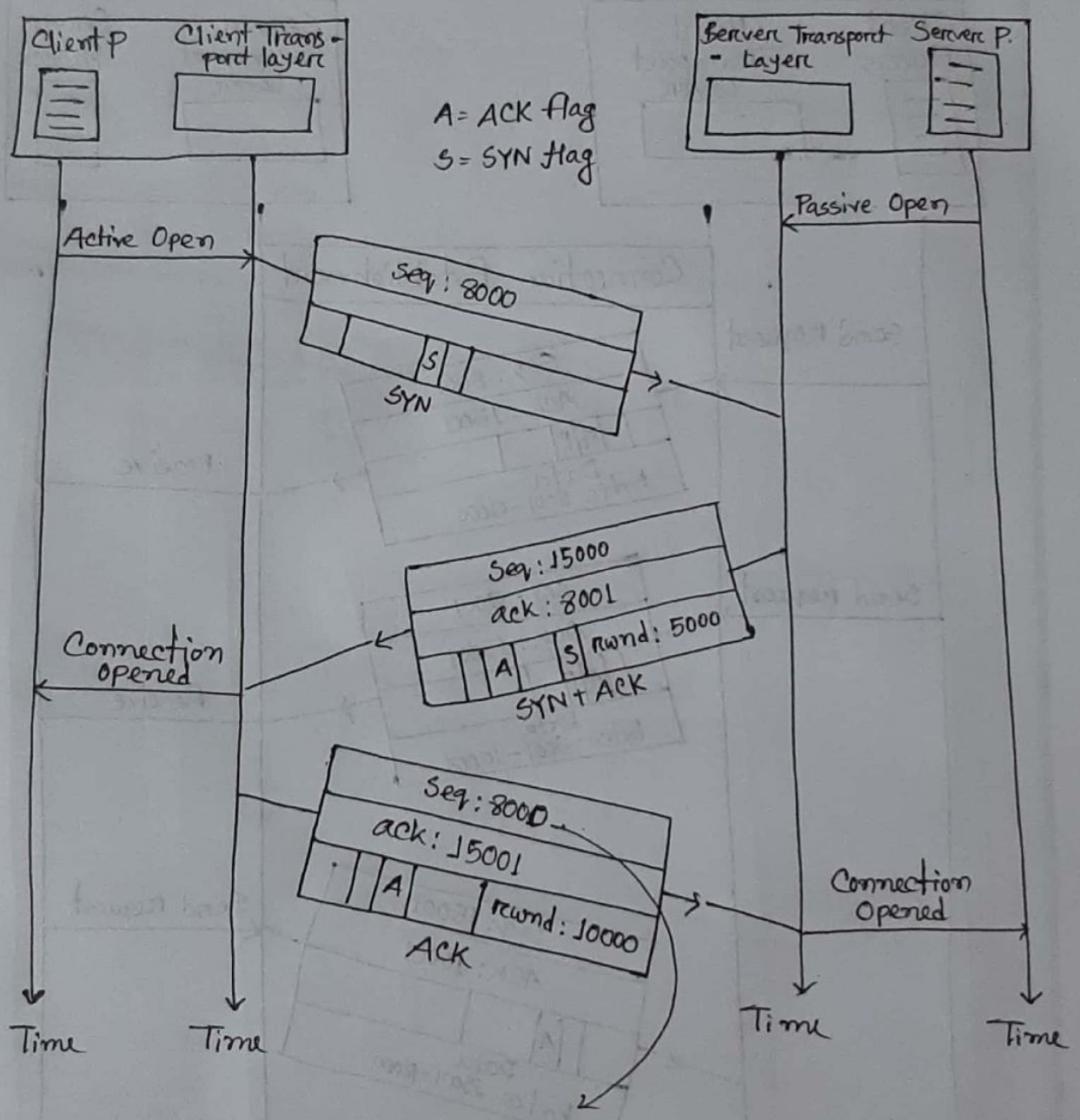
* Connection establishment (Using 3-way Handshaking)



here 8000 means no data, just acknowledgement cause 1st seq. no was 8000 which sent no data.

If piggybacking then seq. no would be 8001.

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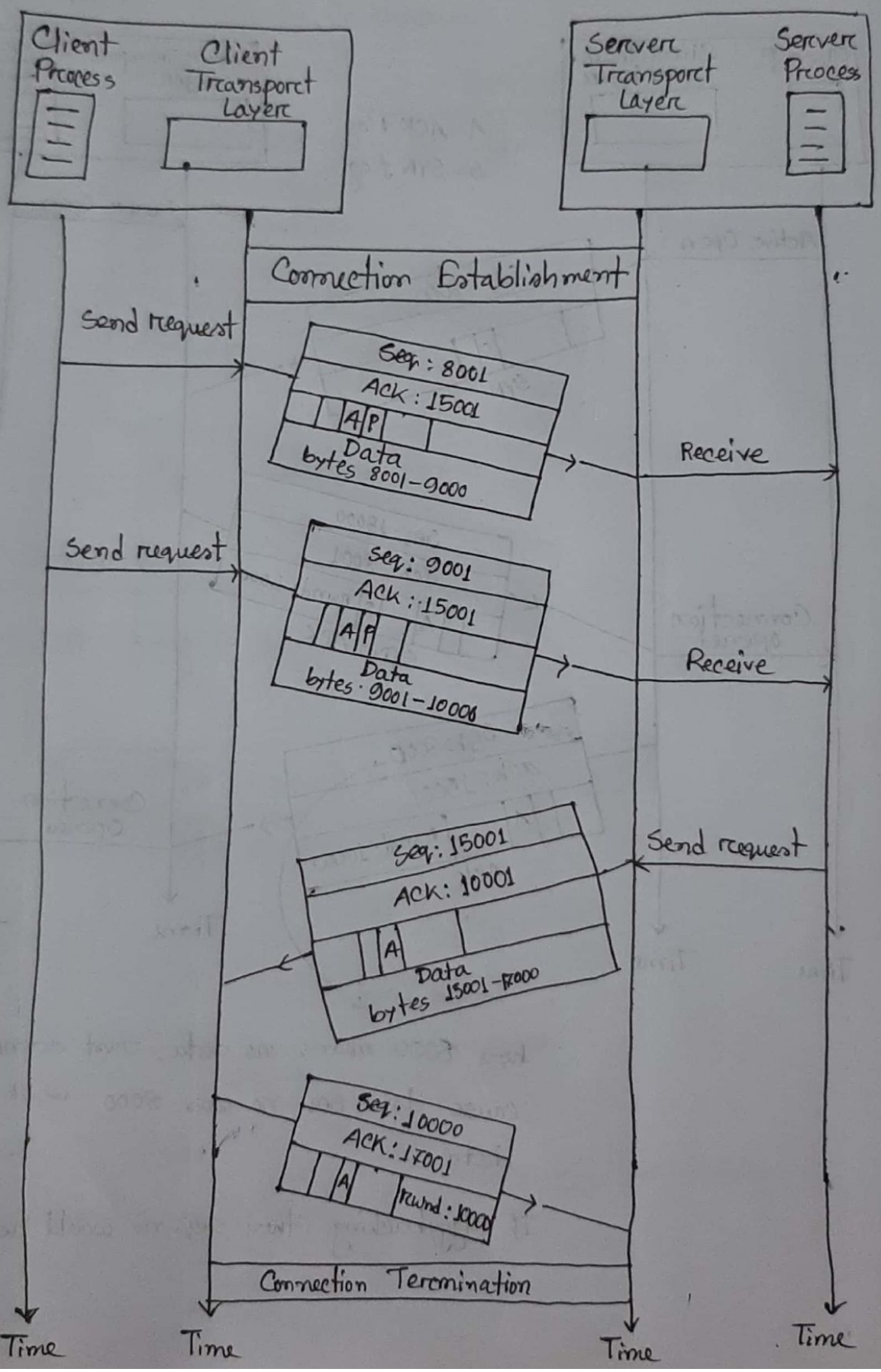
* Data Transfer



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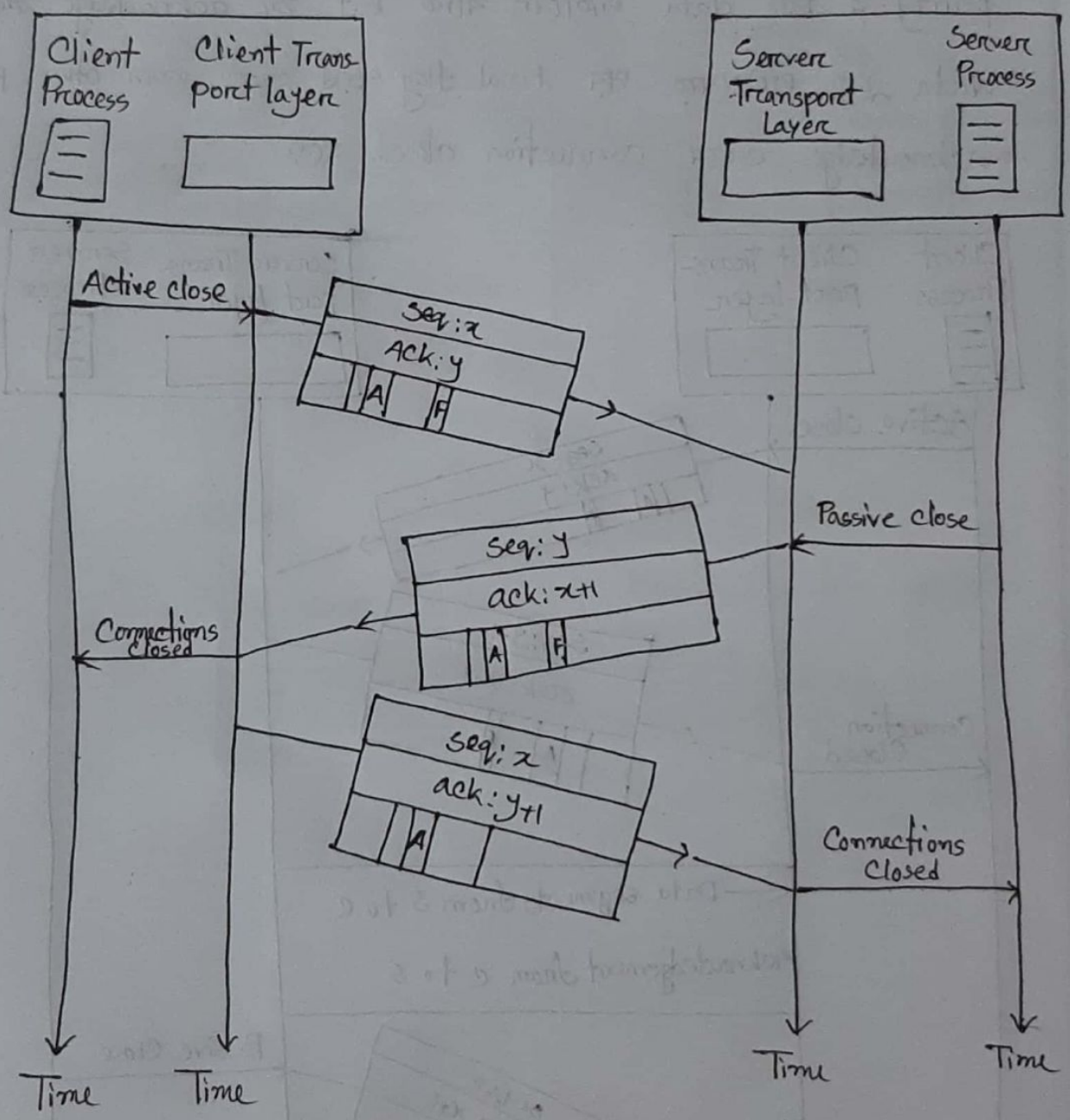
* Connection Termination with three-way handshaking



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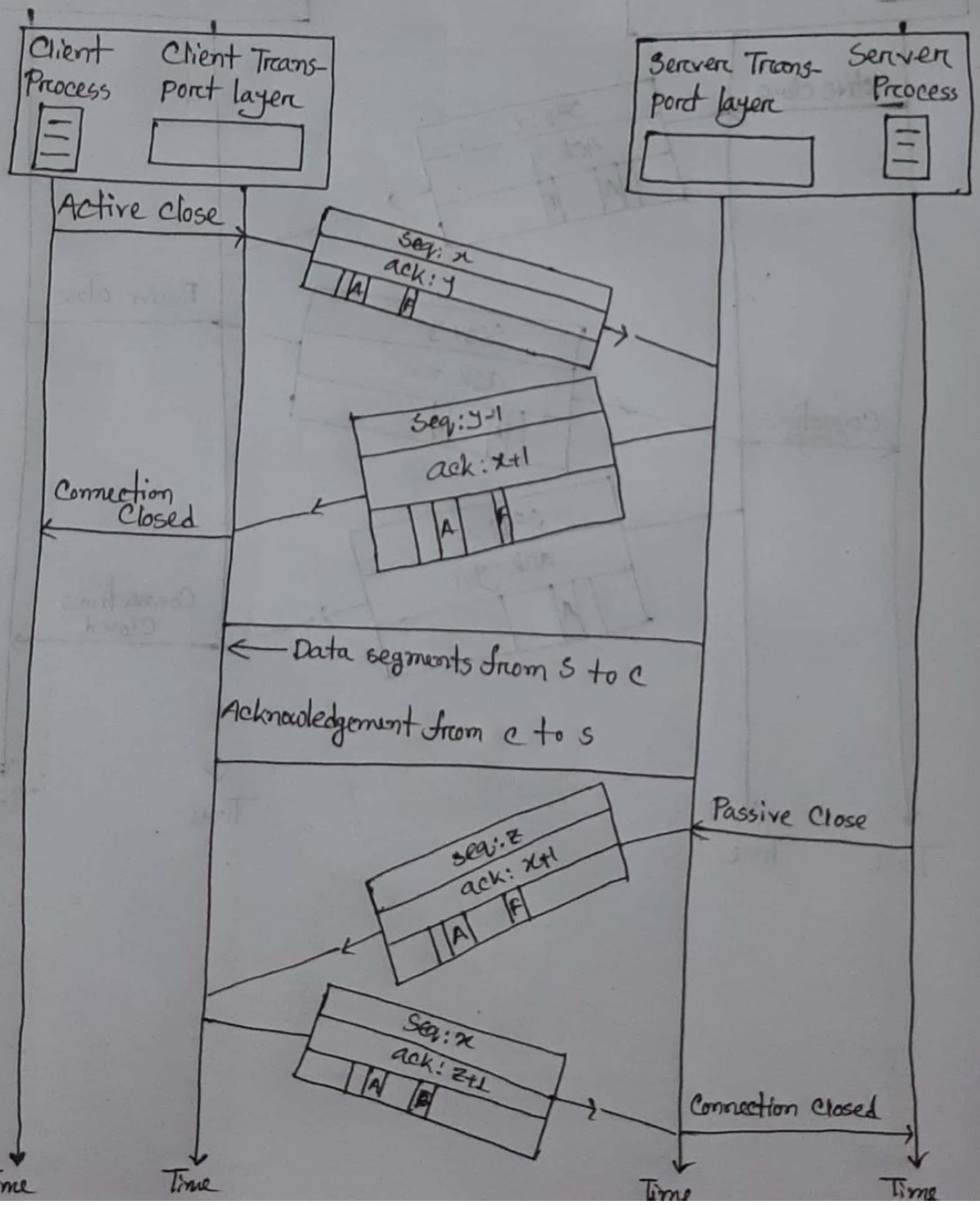
* Half - Close

- এক party final flag পাঠায় connection close করার জন্য কিন্তু অন্য party-র কিছু data পাঠানো বাকি but সে acknowledge করবে। then data টুকু পাঠানোর পর final flag send করবে, তখন other party acknowledge করলে connection closed হবে।



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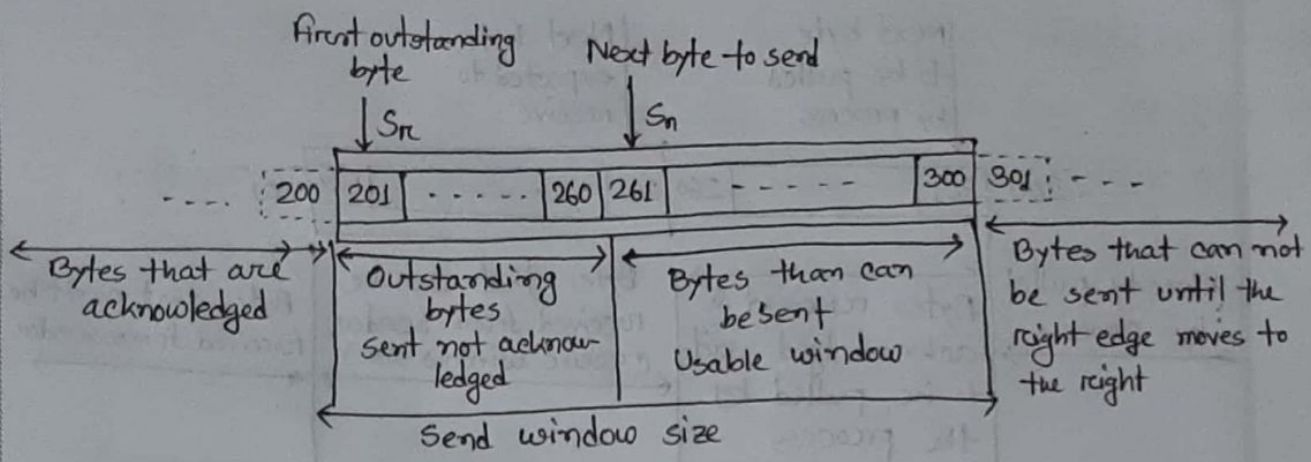
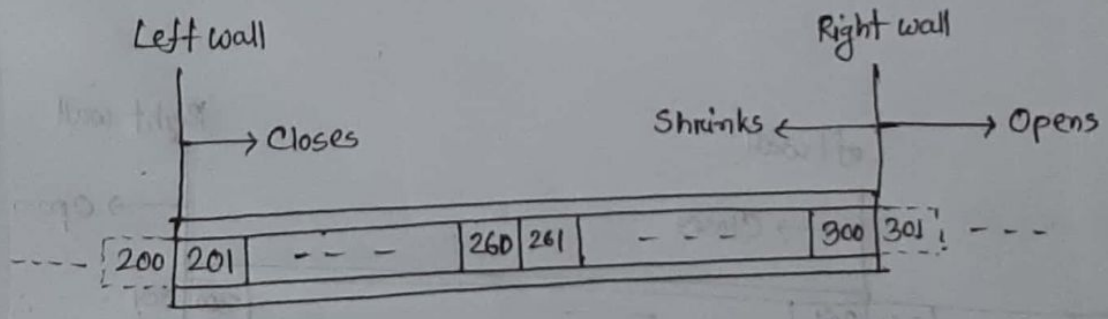
* Windows in TCP



a. send window



b. Opening, closing, shinking send window

Sub.: _____ SAT SUN MON TUE WED THU FRI

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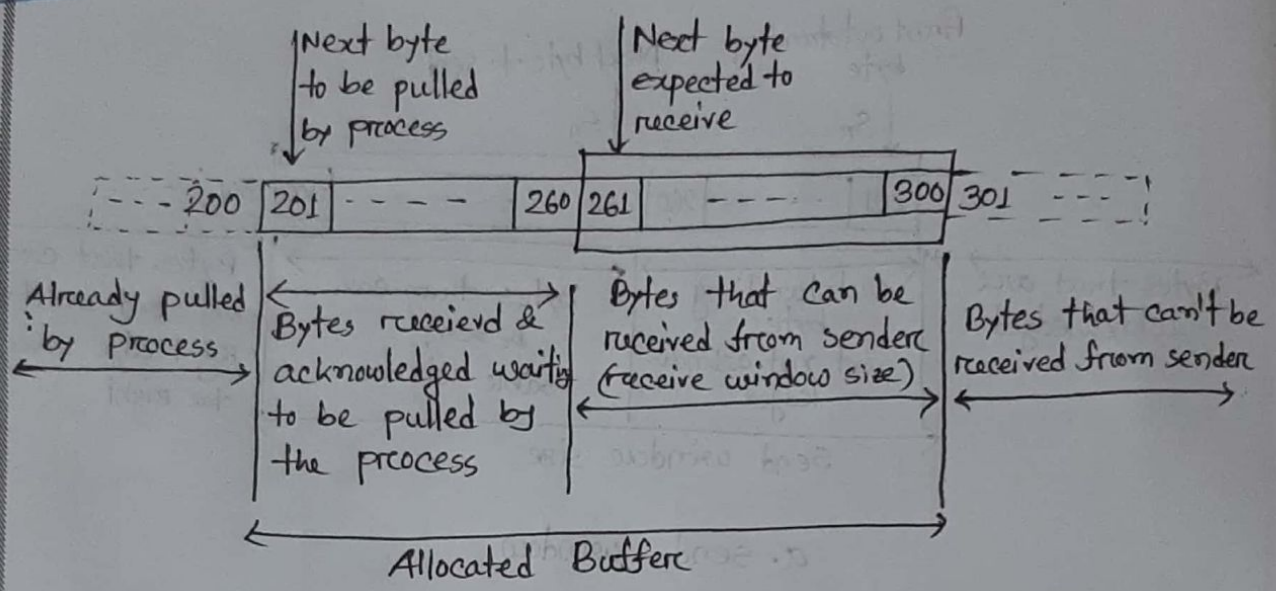
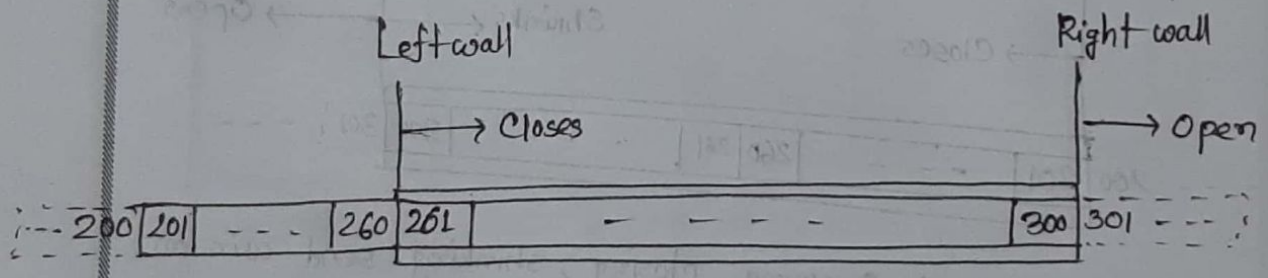
* Receive window



a. Receive window and Allocated Buffer



b. Opening & closing of ~~ee~~ receive window

* Shrink possible ~~ar~~

Sub.: SAT SUN MON TUE WED THU FRI

DATE: / /

* Flow control

- যদি receiver এর 4 tr byte receive করার ability থাকে কিন্তু sender 5 tr byte পাঠায় তাহলে 1 tr byte loss হয়ে যেতে পারে। এজন্য flow control mechanism থাকে যা দিয়ে window size আদান-প্রদান হয়

* Error Control

- Checksum
- Acknowledgement
- Timer

* Congestion Control

- Open-loop mechanism: congestion হবার আগে সেটাকে prevent করা।
- Closed-loop mechanism: congestion হবার পরে prevent করা

* Options

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Sub.: Lecture-1 (SMZ)

SAT SUN MON TUE WED THU FRI

DATE: 25 / 07 / 2022

Computer Networking

Cisco - free log in করতে হবে

"Introduction to Packet Tracer 0920

Cisco Virtual Academy"

- এই course টি complete করতে হবে।

Chapter 01 (2nd Book)

The Internet: network of networks

interconnected ISPs LAN + WAN = ethernet

Internet: Computer network connecting billions of computi devices.

Host = end ~~users~~ system; network এর আগে connected

Packet switches = routers, switches

Communication links = fiber, copper, radio, satellite

Networks: Connection of devices, routers, links..

Sub.: SAT SUN MON TUE WED THU FRI

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Protocols - HTTP (web), Skype, TCP, IP, WiFi, 4G, Ethernet, streaming video. [set of rules]

* All communication activity in Internet governed by protocols

Standards - RFC : Request for comments

IETF : Internet Engineering Task Force

Infrastructure - provides services to applications.

Network edge - hosts, access ~~media~~ network, physical media.

- hosts : clients and servers
- servers often in data center

Access network, Physical media:

- wired, wireless communication links.

Network core - interconnected routers
- network of networks

Hop : router থেকে router এর distance (device to device)

Sub.: SAT SUN MON TUE WED THU FRI

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* How to connect end systems to edge router?

- residential access nets
- institutional access networks (school, company)
- mobile access networks (WiFi, 4G/5G)

* Difference between Edge router and Core router:

Access Networks: Cable-based access

FDM: different channels transmitted in different frequency basis.

HFC - Hybrid fiber Coax

DSL - Digital Subscriber Line

Wireless access networks (via access point)

Wide Area Cellular Access Networks

Wireless Local Area Networks

Enterprise Networks: companies, universities

Home Networks

Data Center Networks

Slide - 20

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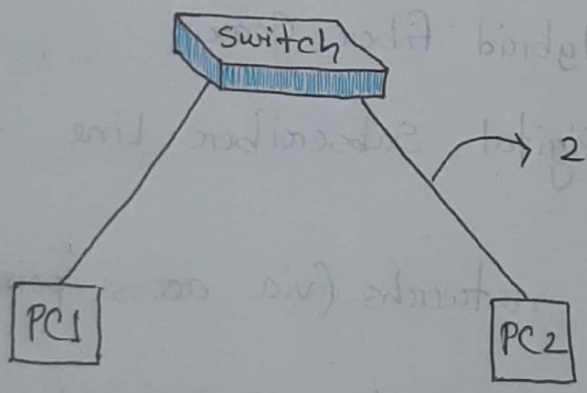
For Lab experiments :

1. Account login করতে হবে
2. Simulator install করতে হবে

Lab example - 6 :

→ 2 টি same device এর জন্য cross cable use করতে হবে



→ 2 টি different device এর জন্য straight line cable use করতে হবে

Sub.: Lecture 2 (SMZ)

SAT SUN MON TUE WED THU FRI

DATE: 31 / 07 / 2022

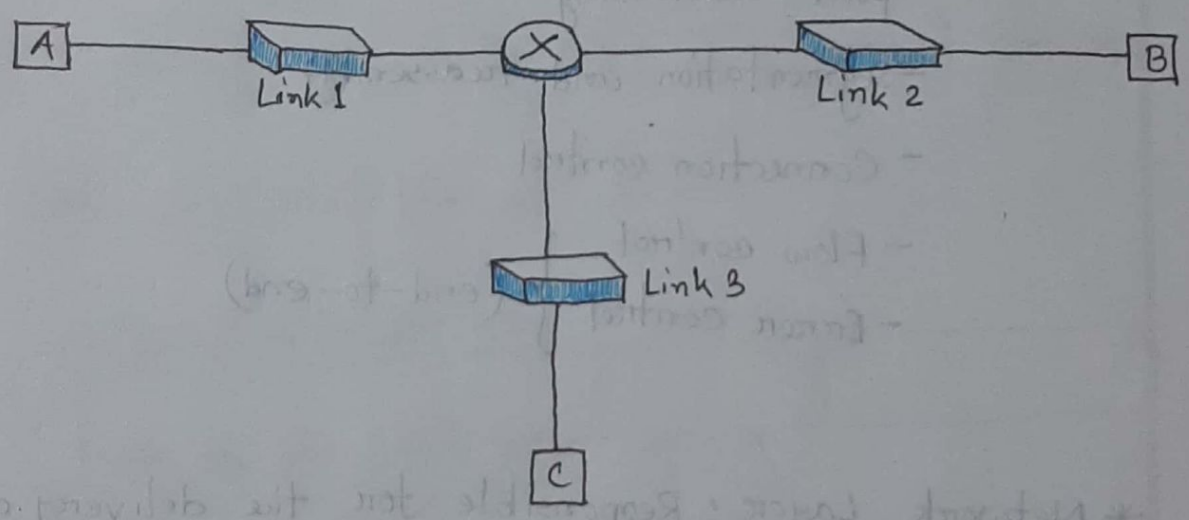
TCP/IP Layer

Internet - Network of networks

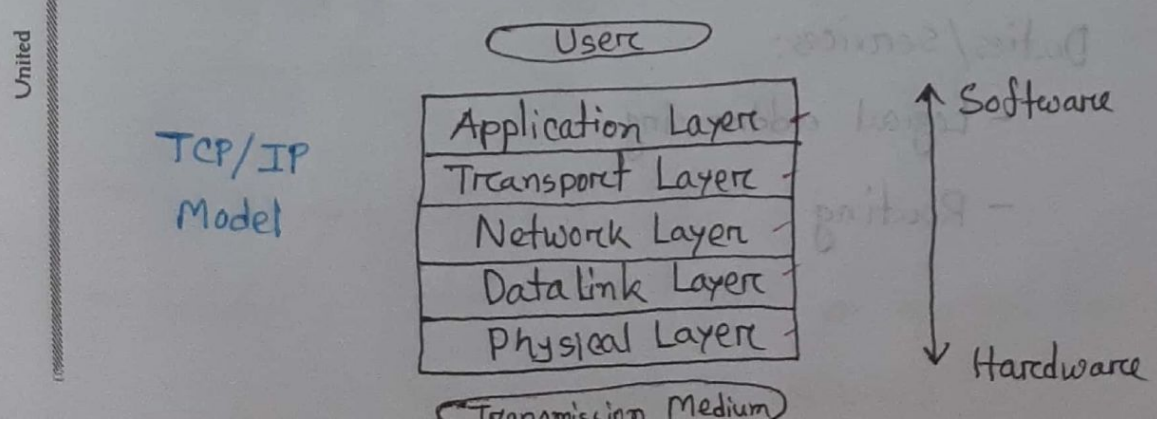
The Internet - Large no. of interconnected networks

* Communication through an internet

Communication from A to B



* Internet Layer Model



Sub.: SAT SUN MON TUE WED THU FRI

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* **Application Layer**: Responsible for providing services to the user.

- Only layer to interact with user

* **Transport Layer**: Responsible for delivery of a message from one process to another.

Duties/ Services:

- port addressing
- segmentation and reassembly
- Connection control
- Flow control
- Error control

} (end-to-end)

* **Network Layer** (Internet layer): Responsible for the delivery of packets from the original source to destination

Duties/Services:

- Logical addressing
- Routing

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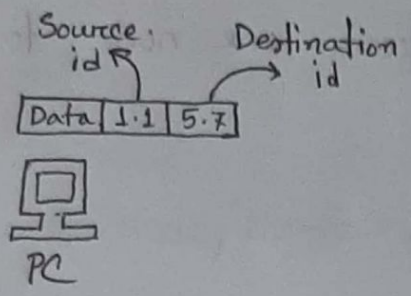
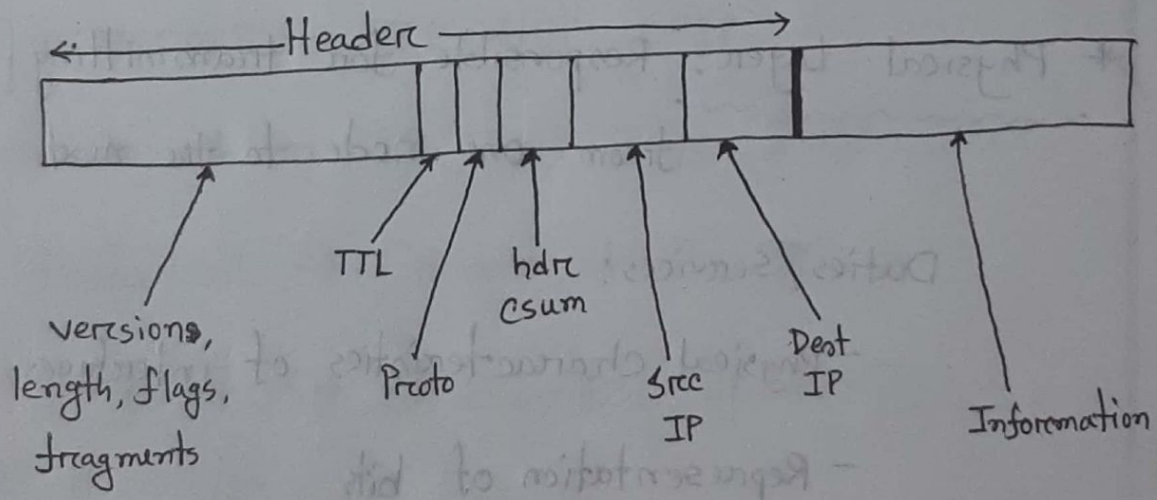
প্রত্যেক PC-র একটা unique id থাকে 32 bit এর (IP address)



1.1, 5.7, .. are logical address or IP address

- Routing algorithm use করা হয়
- Routing → cost, traffic দেখে পথ ঠিক করবে।
- Hop-to-Hop গেলে mac address যাবে
- subnet use করলে বেশি user connect করা যায়

* Layer 3: IPv4 Diagram



** Autonomous System – ASN

** Subnet এ 254 টা IP client এর জন্য use করা হয়।

00 & last IP special

Sub.: DATE: / /

SAT SUN MON TUE WED THU FRI

* **Data Link Layer:** Responsible for transmitting frames from one node to the next

Duties / Services:

- Framing
- Physical addressing
- Flow control (hop-to-hop)
- Error control (hop-to-hop)
- Access control

* mac address / physical address → hexadecimal numbers
* mac address change হবে hop-to-hop

* **Physical Layer:** Responsible for transmitting individual bits from one node to the next

Duties / Services:

- Physical characteristics of interfaces & media
- Representation of bits
- Data rate (transmission rate)
- Synchronization of bits

* wireless হবে digital

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** The Big Picture

* Internet Model

Node-to-node / Hop-to-hop : Data link layer

Host-to-host : Network layer

Process-to-process : Transport layer

* Protocol : A set of rules

Internet Protocol Suite (কোন layer এ কোন protocol)

- Application → HTTP, FTP, Telnet, SMTP
- Transport → TCP, UDP, SCTP
- Network → IP (IPv4), IPv6, ICMP, IGMP
- Data Link → Ethernet, Wi-Fi, PPP
- Physical → RS-232, DSL, 10Base-T

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* OSI Model

Open Systems Interconnection

Developed by - International Standards Organization

Two additional layers:

- Presentation layer
- Session layer

* **Session Layer:** Responsible for establishing, managing and terminating connections between applications.

Duties/Services:

- Interaction management
  - Simplex, Half-duplex, ~~duplex~~ Full-duplex
- Session Recovery

* **Presentation Layer:** Responsible for handling differences in data representation to applications.

Duties/Services:

- Data translation
- Encryption
- Decryption
- Compression

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** IP address 2 types

- Public IP / Real IP
- Private IP (10.32.0.0) - Local এর জন্য

IPv4 32 bit এর; 2^{32} devices connect করা যায়।

192.168

172.16.0

IPv6 128 bit এর; 2^{128} devices connect করা যায়;
এর IP শেষ হবে না

103.133.254.1 → Real IP

103.133.254.23 → PSTU - এর IP

Sub.: Lecture 3 (SMZ)

SAT SUN MON TUE WED THU FRI

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TCP/IP Protocol Suite

Chapter 05

IP address – identifier, uniquely identifies devices connected to the Internet. (the Internet address)

Computer – 4 addresses

1. Port address
2. Logical / IP address
3. Physical / mac address
4.

[NIC – Network Interface Card
নেটওয়ার্ক interface

IP layer = Network layer

* IPv4

- 32 bits long ; 4 byte → 4 octet বলে
- unique and universal
- address space 2^{32} or 4,294,967,296.
- numbers in base 2, 16, 256

permutation করে total কতগুলো combination এর IP address পাওয়া যায়।

Sub.: _____ SAT SUN MON TUE WED THU FRI

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Address space → total no. of addresses used by the protocol

* Dotted-decimal notation

128	64	32	16	8	4	2	1
7	6	5	4	3	2	1	0

* positional value যোগ করে IP address বের করা
* মূলত decimal এর ক্ষেত্রে (.) dot use করা হয়
* IP address এর range 0-255-র বেশি হওয়া যাবে না

0.0.0.0
255.255.255.255 } reserved IP/ special

1st IP → Gateway হিসেবে

Last IP → Special

Zero ← 0b → binary
0d → decimal
0x → hexadecimal
0c → octal } এটা আমরা করবে orc base subscript হিসেবে।

* IP address base - 256

Sub.: DATE: / /

** Example 5.1 → 5.4 =

Example 5.5:

1st address → 146.102.29.0

Last address → 146.102.32.255

bit by bit subtract (base 256)

$$\begin{array}{r} 146.102.32.255 \\ 146.102.29.0 \\ \hline 0.\ 0.\ 3.255 \end{array}$$

$0 \times 256^3 + 0 \times 256^2 + 3 \times 256^1 + 255 \times 256^0 = 1023 + 1 = 1024$

** Example 5.6 → ~~5.8~~ 5.10 = 5.11

* Bitwise AND operation

- 1, 2, 4 position এ যেটা সংখ্যা pick করবে
- 14 & 140 এর common positional value যোগ করে যেই value আসবে সেটা result.

** কেন AND operation করতে হবে?

→

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* Bitwise OR operation

- 1, 2, 4 position এ বড় সংখ্যা pick করতে হবে other than 0, 255
- ~~১, ২~~ এর ক্ষেত্রে সবগুলো positional value যোগ করে result বের করতে হবে।

** Two types addresses

- Classful addressing
- Classless addressing

* Classful Addressing: used the concept of classes

- Address space occupation –

Class A = 0 1st address; 2^{31} (50%)

Class B = 10; 2^{30} (25%) [Future]

Class C = 110; 2^{29} (12.5%) [Multicast]

Class D = 1110; 2^{28} (6.25%)

Class E = 1111; 2^{28} (6.25%)

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Dotted-decimal notation

Finding class of address –

Class A = 0 – 127

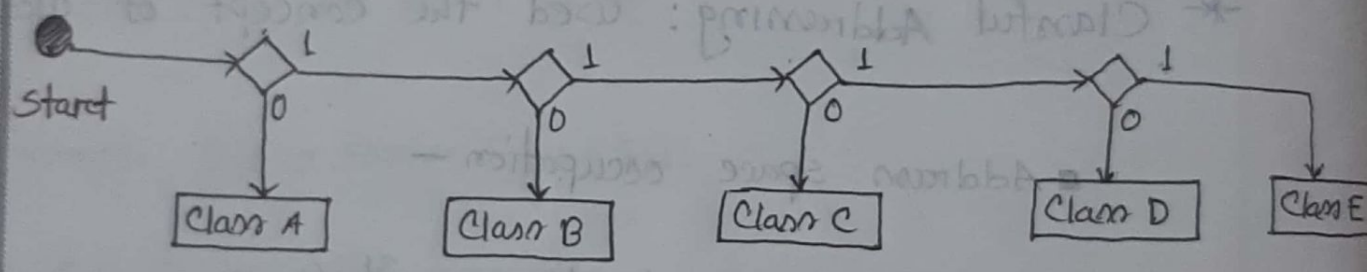
Class B = 128 – 191

Class C = 192 – 223

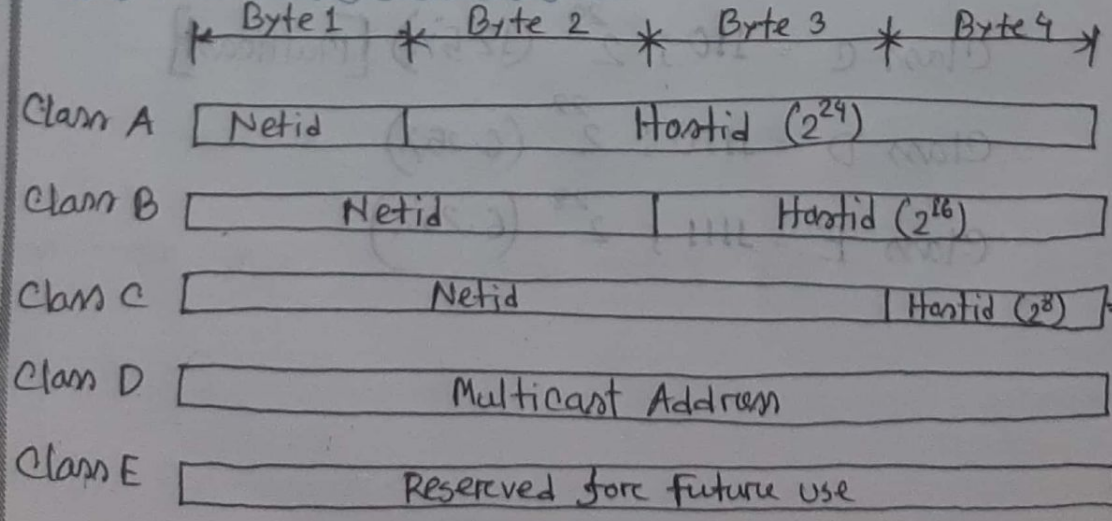
Class D = 224 – 239

Class E = 240 – 255

Finding the class of an address using continuous checking



* Netid and Hostid



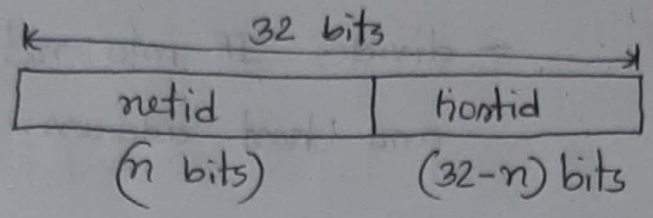
⇒ কম use হয়

Sub.: Lecture 04 (SM2)

SAT SUN MON TUE WED THU FRI

DATE: 07/08/2022

* Two level of addressing



Class A → $n = 8$

Class B → $n = 16$

Class C → $n = 32$

Extracting information in a block

1st address → netid-র পরে host portion zero করে দি

Last address → netid-র পরে host portion one করে দি

Total address space, $N = 2^{32-n}$

* Exam ও figure draw করতে হবে

network address → netid/first address (Exp - 73.0.0.0)

Broadcast address/special → (Exp - 73.255.255.255)

Network address → identifier of network.

Sub.: SAT SUN MON TUE WED THU FRI

DATE: / /

* Subnet Mask → identify network address

— divides IP into network address and host address.

**Mid → Chapter 05

**Chapter 05 এর exercise solve করতে হবে

Slide-54

Sub.: Lecture 05 (SMZ)

SAT SUN MON TUE WED THU FRI

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IP address wastage কমানোর জন্য → subnetwork করা হয়

* Three-Level addressing

Subnetting – a network is divided into several smaller subnetworks (subnets) with each subnetwork having its own subnetwork address

– network must be power of 2.

$$n_{sub} = n + \log_2 s \quad ; \quad s = \text{no. of networks.}$$

Network mask → default mask

Subnetwork address → ANDing operation

$$n_{super} = n - \log_2 s$$

* Classless addressing → short term solution

/n notation – prefix length

– classless addessing এ use হয়

Sub.: SAT SUN MON TUE WED THU FRI

DATE: / /

* Variable Length blocks in Classless addressing:

prefix → network address (n bits)

suffix → host address (32-n bits)

Prefix length can be 1 to 32.

Exp: 130.11.232.156/16

$n = 16$; prefix = 16

suffix = 16

CIDR → Classless Inter-Domain Routing

* Extracting Block Information:

(I) No. of addresses → $N = 2^{32-n}$

(II) First address → (any address) AND (Network Mask)

(III) Last address → (any address) OR [NOT (network mask)]

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Example - 5.29: 110.23.120.14/20

① Total no. of addresses, $N = 2^{32-20} = 2^{12}$

② First address = 110 . 23 . 120 . 14

255 . 255 . 240 . 0

110 . 23 . 112 . 0

240 → 128 + 64 + 32 + 16

120 → 64 + 32 + 16 + 8

Result = 64 + 32 + 16 = 112

③ Last address =

110 . 23 . 120 . 14

255 . 255 . 240 . 0

0 . 0 . 15 . 255 ← Complement / NOT

110 . 23 . 120 . 14

0 . 0 . 15 . 255

110 . 23 . 127 . 255

120 → 64 + 32 + 16 + 8

15 → 8 + 4 + 2 + 1 result = 64 + 32 + 16 + 8 + 4 + 2 + 1 = 127

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Sub: Lecture-6 (SMZ)

DATE: 15 / 08 / 2022

* Block Allocation

Block allocation responsibility → ICANN

Internet Corporation for Assigned Names and Address

IANA → Internet Assigned Numbers Authority

LIS → Location Information Server

APNIC (Asia Pacific Network Information Centre) → distribute and manage Internet number resources (IP addresses and AS numbers) in the Asia Pacific region's 56 economies

BTCL → Bangladesh Telecommunications Company Limited
- most accessible Internet Service Provider in BD.

* For the operation of CIDR, 3 restrictions applied to the allocated block:

1. The no. of restricted address ~~mer~~ needs to be power of 2. ($N = 2, 4, 8, 16, 32, \ldots$)

2. The prefix length for the block, $n = 32 - \log_2 N$.

3. Begginning address is $X \times N$; x = decimal value of the prefix

Sub.: _____ SAT SUN MON TUE WED THU FRI

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* Example 5.30, 5.31

* Subnetting

1. The no. of addresses in each subnetwork should be power of 2.

2. The prefix length:

$$n_{sub} = n + \log_2(N/N_{sub})$$

3. The starting address in each subnetwork should be divisible by the no. of address in that subnetwork.

* Example 5.32, 5.33, 5.34, 5.35.

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Sub: Lecture 7 (SMZ) Online

SAT SUN MON TUE WED THU FRI

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** Example 5.35 Review

* Special Addresses

Addresses reserved for special purposes.

Special blocks → some blocks of addresses are reserved for special purposes.

All-Zeros Address

0.0.0.0/32

reserved for communication

All-Ones Address

255.255.255.255/32

reserved for limited broadcast address in network.

Loopback Address

block 127.0.0.0/8 is used for loopback address

- can ping itself.

Private Address

for private use

10.0.0.0/8
172.16.0.0/12
192.168.0.0/16
169.254.0.0/16

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Multicast addresses

224.0.0.0/4 is reserved for multicast communication

* Special Addresses in Each block

Network Address

- The first address in a block

Direct Broadcast Address

- The last address in a block

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Sub.: Lecture 8 (SMZ)

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*** Lab Problem - 7 discussion

o——— x ———o

Class - 09 Date: 28/08/2022

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Sub.: Lecture - 10 (SMZ)

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DATE: 30 / 08 / 2022

IPv6 Addressing

Successor of IPv4 → IPv6

- hexadecimal notation
- 128 bit address
- 2^{128} = 340 undicillion addresses
- first 64 bit → network address
  last 64 bit → host address

Why not IPv5 – it was never called IPv5, but it used a value of 5 in the version field of the IP header

- Internet Stream Protocol
- so IPv4 direct successor IPv6.

** Why not IPv5? → IPv5 uses 32-bit also, companies thought that it would again limit again the abitity to generate IPv5 addresses.

** Why IPv6? → To allow for more unique TCP/IP address identifiers to be created, now that we've run out of 4.3 billion created with IPv4.

* IP Shortening

- Leading zero '0' omit করে

  $\boxed{04B3 \rightarrow 4B3}$

- Consecutive quarters of all zeros replaced with double colon (::) [শুধু একবার করা যায়]

  0000 · 0000 · 0000 · 0000 · 1334 → :: 1334

- 0000 কে 0 লিখা যায়

Sub.: _____ SAT SUN MON TUE WED THU FRI

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* IP Expanding

- put leading zeros
- replace double colon with zeros

2001 : 0DB8 : 8B00 : 0001 : 0000 : 0000 : 0000 : 0001 /64

- 2001 : 0DB8 : 8B00 → global routing prefix
- 0001 → subnet identifier
- 0000 : 0000 : 0000 : 0001 → interface identifier; host portion

** Compressed/Shortened IPv6 to Un-compressed/Expanded

1050 : : 5 : 600 : 300c : 326b

1050 : 0 : 0 : 0 : 0005 : 0600 : 300c : 326b (shortend expansion)

1050 : 0000 : 0000 : 0000 : 0005 : 0600 : 300c : 326b (expanded)

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Sub.: Lecture-11 (SMZ)

SAT SUN MON TUE WED THU FRI

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Mid Syllabus → Classfull address পর্যন্ত (8 marks)

* IPv6 Address Types

- Unicast: uniquely identifies an interface on an IPv6 enabled device

- Multicast: one host transmits to one block
  prefix → FF00::/8

- Anycast: DHCP করা থাকে, IP auto assign হয়ে যায়.
  group of computers that share a single address

** IPv6 doesn't have broadcast addresses.

Unicast address- এক pc access করবে অন্য pc তে.

Logical address fixed থাকে,

mac address change হয়

* 6 Types blocks

1. Global Unicast

2. Link local

3. Loopback Address → নিজের PC নিজেই ping করা যায়;
   127 series; 127.0.0.1 (Xampp এর IP); ::1/128 (IPv6)

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4. Unspecified Address

5. Unique Local → FC01

6. Embedded IPv4 → used to help transition from IPv4 to IPv6.

Local / Private IP → 4 or series

Global IP → Others

SUST → IPv6 use করে

** Static configuration

NAT → Private IP/Local IP → cmd → config IP

Command → show ip interface

EUI/64 → Extended User Interface / 64 bit

→ mac address 48 bit এর আগে আরো 16 bit add করে 64 bit new address তৈরী করে randomly generate করে।

FFFF - add করা হয়

PPPOE → Point-to-Point Protocol over Ethernet

PPP → Point-to-Point Protocol

PPPoE connection

Sub.: Lecture - 12 (SMB) On

SAT SUN MON TUE WED THU FRI

DATE: 12 / 09 / 2022

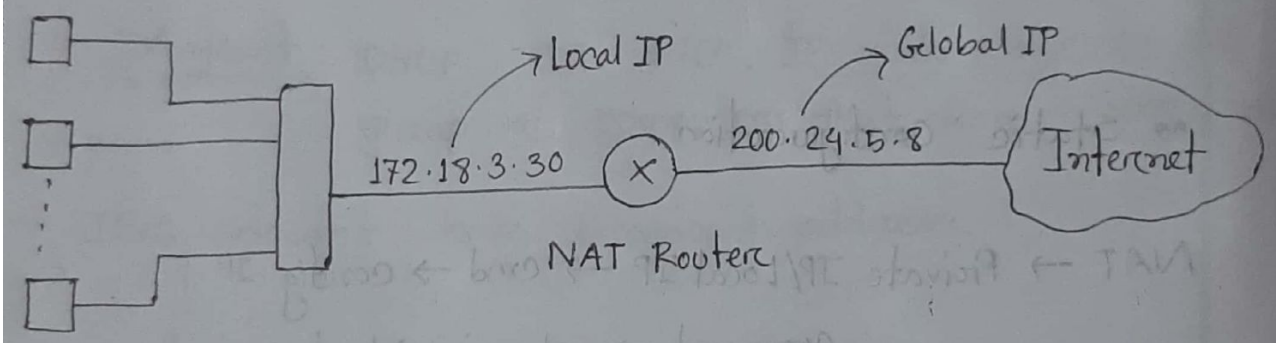
* NAT

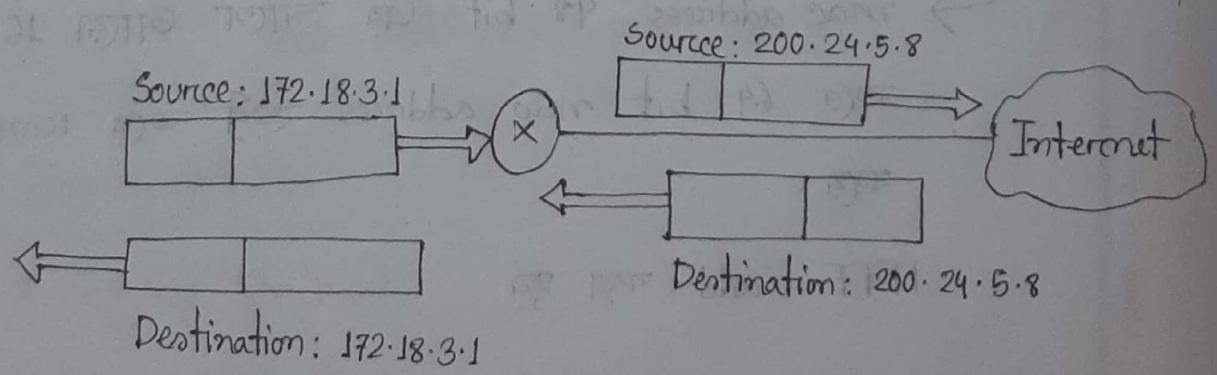
Network Address Translation

* IP waste reduce করার জন্য → subnetting করা হয়

NAT router → Local IP কে Global IP তে translate করে

* firewall এর ভিতর NATing করা হয়





PC - কে বাইরের world চিনবে NAT router এর IP দিয়ে.

Figure 5.41

Translation table → NAT router এর table

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Chapter 01 (Book 2)

Access Networks: data center networks

google, facebook → data service provider; need high bandwidth.

- high bandwidth links (10s to 100s Gbps)

Host: sends packet of data

- takes application message
- breaks into smaller packets of length L bits.
- transmission rate R; Link capacity, link bandwidth

Packet transmission delay = Time needed to transmit L bit packet into link $= \frac{L \text{ (bits)}}{R \text{ (bits/s)}}$

Links: physical media

- bit
- physical link
- guided media
- unguided media

coirceless → air media

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* Twisted Pair Cable
* Coaxial Cable
* Fibre Optic Cable → electromagnetic noise; আলোর গতিতে data transmit হয়

- Wireless radio

band → 2.4 GHz, 3.5 GHz, 5.5 GHz, 5.8 GHz

wireless connection এর collision remove করার way নেই

Line offsite কাজ করে

* Radio Link Types

- Wireless LAN
- Wide area
- Bluetooth
- Terrestrial microwave
- Satellite

Slide-24

Sub.: Lecture - 13 (SMZ)

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* The Network Core

national/global ISP

local/regional ISP

Edge router → Core router

- mesh of interconnected router
- router এর উপর depend করে packet কোথায় যাবে

Unmanagable switch → layer 2 এ কাজ করে

Packet Switching

* message performs a control function

Two types device কাজ করে

I) router

II) link layer switch (data link layer)

routing algorithm এর উপর base করে কাজ করে

Two key network core function

I) Forwarding (switching) - local action

II) Routing - global action

finding best path → routing algorithm এর কাজ

Sub.: DATE: / /

* Store and forward

packet transmission delay → $\frac{L}{R}$ seconds

L bit, R bps

source to destination → hop

Example: L = 10 Kbits

R = 100 mbps

hop transmission delay = 0.01 s

* Queueing

- queue of packets waiting for transmission over output link

packet queue loss → packets can be lost if memory (buffer) fills up.

* Alternative Packet Switching → Circuit Switching

dedicated resources : no sharing

- FDM , TDM follow করে

optical, electro-magnetical frequency divited into slots

↳ Time divided into slots

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* Packet Switching vs. Circuit Switching

Example solve করতে হবে

* Internet Structure

- hosts connects via ISP
- Interconnected ISPs
- $O(N^2)$ connections

IEP → Interpret Exchange Point

Content Provider Network → Google, FB, Amazon

tier-1 ISP;
Commercial ISPs.

* Network Performance Measuring Criteria:

1. Loss
2. Delay → Processing delay, Transmission delay, Queueing delay, Propagation delay
3. Throughput

** Caravan Analogy

Slide-54

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Sub.: Lecture-19 (SMZ)

SAT SUN MON TUE WED THU FRI

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* Throughput

- rate (bits / timeout) at which bits are being sent from sender to reciever.

Instantaneous : rate at which given point in time

Average : rate over longer period of time

$R_s < R_c$

$R_s > R_c$

Bottleneck link : link on end-end path that constraints end-end throughput

* Network Security

- Internet not originally designed with (much) security in mind.

** transactions এর ক্ষেত্রে http use করা হয়

* Packet Interception

Packet sniffing

- broadcast media (shared Ethernet, wireless)
- promiscuous network interface read/records packets (including password) passing by

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Sub.: SAT SUN MON TUE WED THU FRI

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* Fake Identity

Packet spoofing

- injection of packets with false source address

Denial of Service (DoS)

- attackers make resources (servers, bandwidth) unavailable to legitimate traffic by overwhelming resource with bogus traffic.

* Lines of Defense

- Authentication
- Confidentiality
- Integrity Checks
- Access Restrictions
- Firewalls

* Protocol 'layers' and reference models
* Layered network protocol stack
* Services, Layering and Encapsulation
* Internet History

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CamScanner

Sub.: Lecture - J5 (SMZ) Online

SAT SUN MON TUE WED THU FRI

DATE: 25 / 09 / 2022

* Lab work - 06 Discussion

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Sub: Lecture-16 (SMR)

SAT SUN MON TUE WED THU FRI

DATE: 16 / 10 / 2022

Chapter 6

Delivery and Forwarding of IP Packets

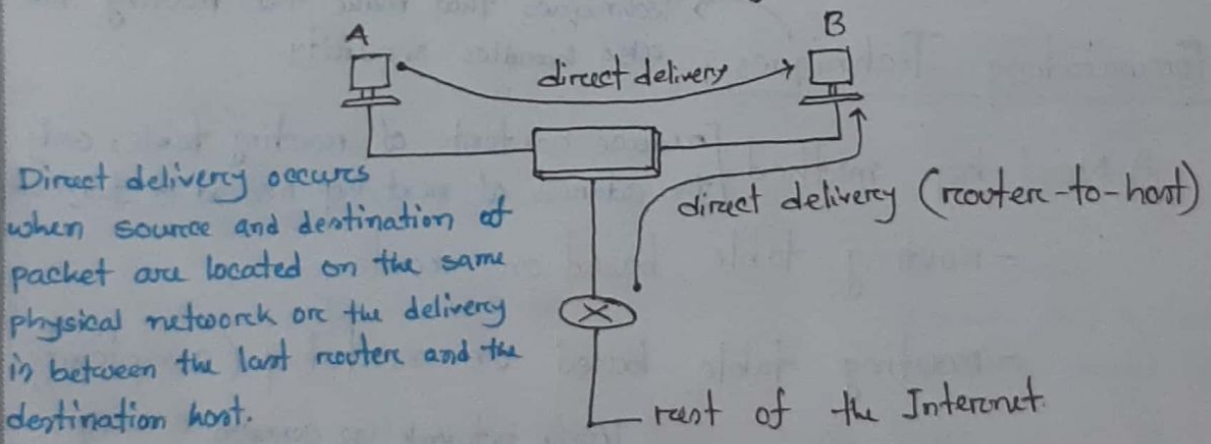
* Delivery of a Packet

- Network layer is responsible for this mechanism

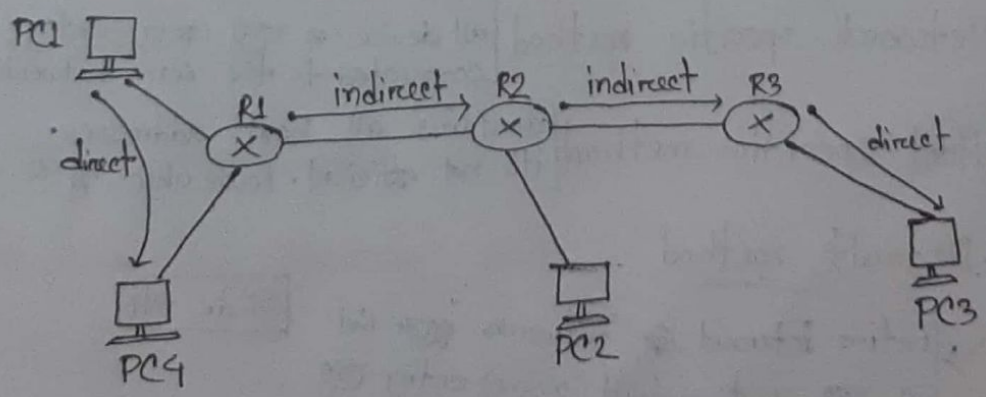
Two methods:

1) Direct delivery - একটা switch এর under এ থাকে
2) Indirect delivery - router-to-router, অনেকগুলো forwarding এর পরে

** switch কে vlan দিয়ে configure করা যায়.



Direct delivery occurs when source and destination of packet are located on the same physical network or the delivery is between the last router and the destination host.



Packet goes from router to router until it reaches its destination

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* Forwarding of a packet

- placing the packet in its route to its destination

- connectionless protocol → forwarding based on the destination address of IP datagram.

- connection-oriented protocol → forwarding based on the label attached to IP datagram

Two types of forwarding:

1) Based on Destination address (connectionless)

2) Based on Label (connection oriented)

Forwarding Techniques: → Techniques that make the routing table manageable also handles security.

1) Next-hop method [reduce contents of routing table; only contains the address of next hop instead of full/complete route]
   - routing table based on route
   - routing table based on next hop (complexity কম;

2) Network-specific method [একটা network এর connected all device এর জন্য একটা entry হবে; treat all hosts connected to the same network as single entity] ram, cpu কম লাগে

3) Host-specific method [contains all hosts addresses; it's not efficient. Route checking & security purpose এর]

4) Default method

[Entire Internet এর networks গুলো list না করে just default (0.0.0.0) entry দেয়া]

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Sub.: Lecture - 17 (SMZ) Online

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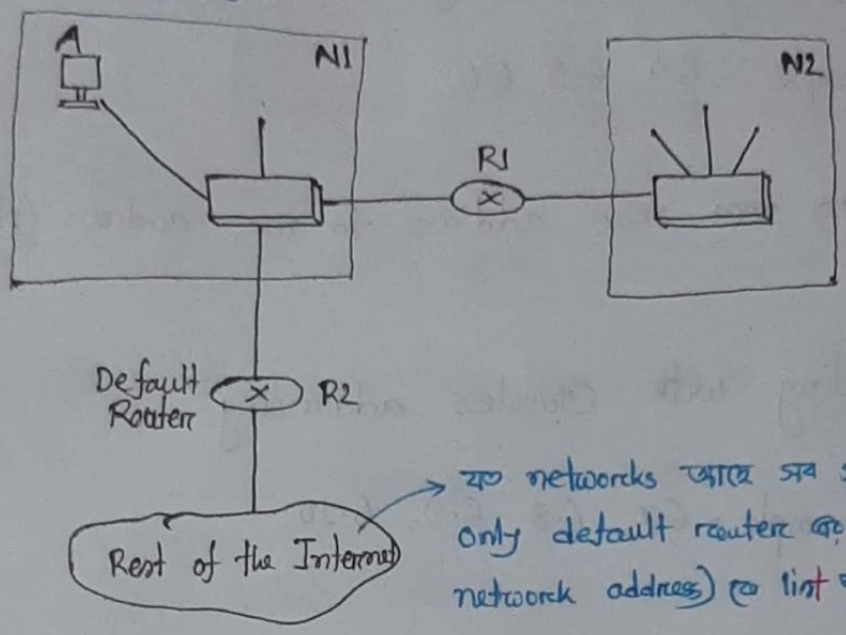
DATE: 18 / 10 / 2022

* Default Routing



যত networks আছে সব গুলোকে list না করে only default router এর address (0.0.0.0 network address) কে list করবে।

- Packet N2 network এ না গিয়ে default router R2 দিয়ে forward করে দিবে

Default IP - 0.0.0.0 (Network address)

* Forwarding with Classful Addressing

- forwarding without subnetting → Three columns: 1) Network address 2) Next-hop address 3) Interface no.
- forwarding with~~out~~ subnetting → Four columns: 1) Masks (/n); 2) Network Address, 3) Next-hop address, 4) Interface No.

* Destination address এর উপর basis করে A, B, C class এ ভাগ করা হয়।

* 28 bits right এ shift করে, left এ 0 বসিয়ে

* Masking off (ANDing) করে

Example - 6.1, 6.2, 6.3

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Forwarding with Subnetting

Example - 6.4, 6.5, 6.6

*ARP কাজ করে mac address to mac address (physical address)

* Forwarding with Classless addressing

Example - 6.7, 6.8, 6.9, 6.10

** Exercises related to three methods **

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Sub.: Lecture-19 (SMZ) Online

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Chapter 05 (Kurose)

Network Layer : Control Plane

Datagram – Network layer and transport layer এর মাঝে যা আদান-প্রদান হয় (Network layer যা নিয়ে কাজ করে)

Network layer এর control plane এর কাজ:

1. Network layer এর মাঝে যে router থাকে তাকে কিভাবে configure করা হবে
2. সেই router কে কিভাবে manage করা হবে
3. Datagram কিভাবে source-to-destination এ routed হবে

Routing Protocol : ২ টি algorithm এর basis এ কাজ করে

1. Link state algorithm
2. Distance vector algorithm

2 Planes in Network layer : (functions)

1. Data plane –

   Forwarding : move packets from router's input to appropriate router's output

2. Control Plane –

   Routing : determine route taken by packets from source to destination

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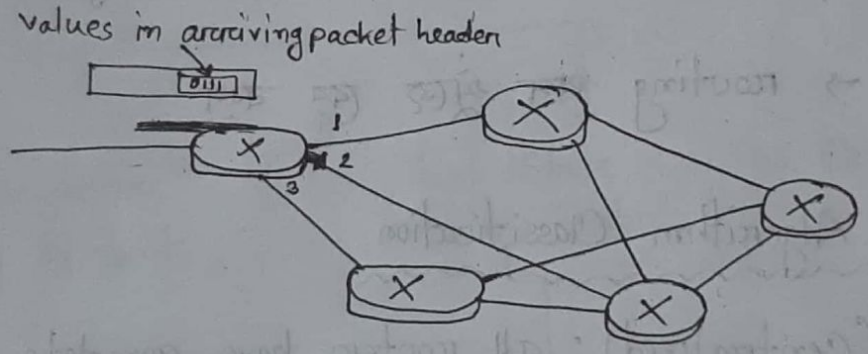
* Two approaches to structuring network control plane -

i) per-router control (traditional)

ii) logically centralized control (software defined networking)

* Per-router control plane

- individual routing algorithm components in each and every router interact in the control plane.



* SDN control plane (4G, 5G cellular phone ও use হয়)

- remote controller computes, installs forwarding tables in routers.

- logically centralized controller, (PCs) computes and distribute the forwarding tables to be used in every router.

- google already uses SDN to control the routers in the internal before global wide network that interconnects the data center.

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* Routing Protocols

- main goal: determine "good" path (short distance, less cost) from sending hosts to receiving hosts, through network of routers.

Path: sequence of routers, packets traverse from given initial source host to final destination host.

"Good" → least cost, fastest, least congested

Challenge → routing পথ খুঁজে বের করা

* Routing Algorithm Classification

link-cost info কার্যকর হলে

- Global (Centralized): all routers have complete topology, link cost info; Link state algorithms.
- Decentralized: iterative process of computation, exchange of info with neighbors; routers initially only knows link costs to attached neighbors; Distance-vector algorithms

route কিভাবে change হয়

- Static: routes changes slowly over time
- Dynamic: routes change more quickly; periodic updates or in response to link cost changes.

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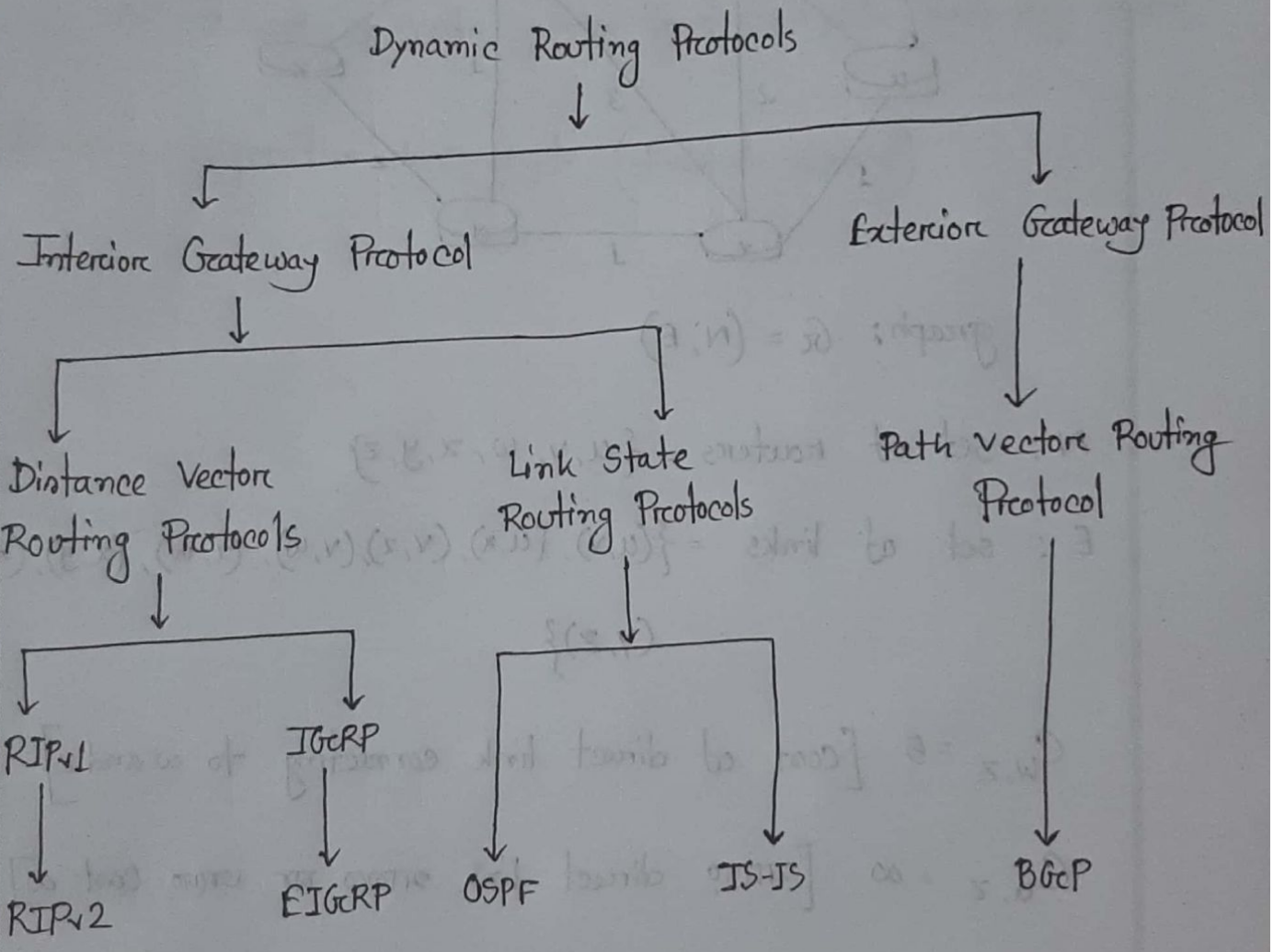
* Types of Routing

1. Static Routing
2. Default Routing
3. Dynamic Routing



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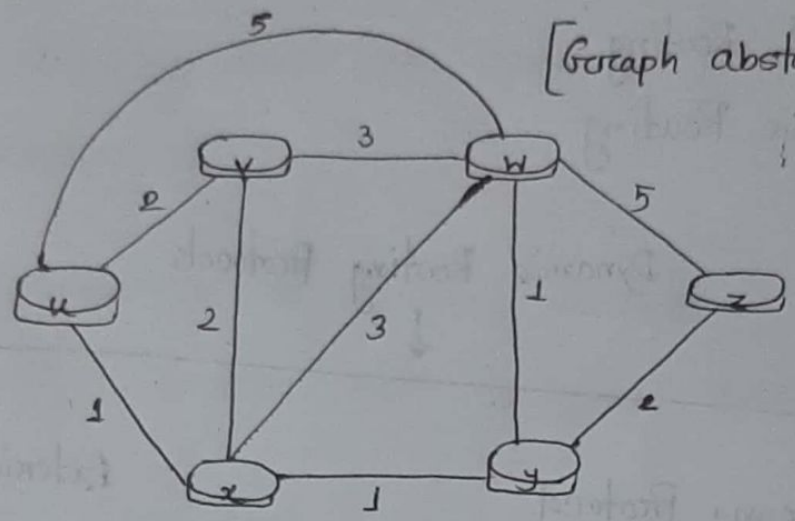
* Link State Routing Protocol

- Graph theory-র উপর base করে কাজ করে



[Graph abstaction: Link cost]

graph: $G = (N, E)$

N : set of routers $= \{u, v, w, x, y, z\}$

E : set of links $= \{(u,v), (u,x), (v,x), (v,w), (x,w), (x,y), (w,y), (w,z), (y,z)\}$

$C_{w,z} = 5$ [cost of direct link connecting to w and z]

$C_{u,z} = \infty$ [যাদের direct link থাকবে না তাদের cost ∞]

* Dijkstra's Link-state routing algorithm

- centralized
- computes least cost paths from one node to all other nodes.
- itercative : k itercations

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Notation

$c_{x,y}$ → direct link from node x to y.

$D(v)$ → current estimate of cost of least-cost-path from source to destination v.

$P(v)$ → predecessor node along path from source to v

N' → set of nodes whose least-cost-path definitely known.

Dijkstra algorithm - example (final ও থাকবে)

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