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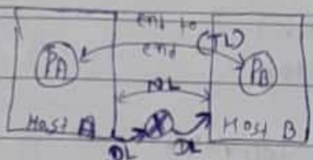
* CN :-

→ AN :-

- Overview ~~(Page: 97, 96,~~
- Switching (Page: 96, 97,
- TCP/IP vs OSI , Drawbacks
- Physical layer (Transmission media)
- Fiber optics
- Network layer
  - IPv4
  - classless, classfull
- Forwarding (ch: 6)
- Routing Table
- Address Aggregation
- Header ...
- Fragmentation

CN (APV)
7-12



TL ← Transport layer
NL ← Network "
DL ← Datalink "

CN
Tanenbaum...

require

IP add. (Logical add.)

Port No.

Router

⇒ TWO MODELS :-

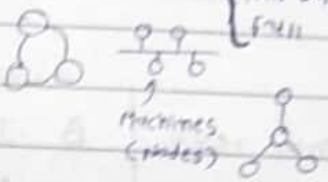
→ ISO - OSI (International Standard Organization; Open Systems Interconnection)

→ TCP / IP (Transmission Control Protocol)

⇒ Layers : (ISO - OSI)

A	Application	M	
P	Presentation	M^*	Modify (char. → ASCII etc.) (If required)
S	Session		
T	Transport	M^{**} | SP | RP	SP → Sender port No. RP → Receiver " "
N	Network	Message | I_S | I_R	
D	Data link	M_S | M | M_R	
P	Physical		

Physical → encoding
→ Mode of transmission ⇒ { Simplex – one way ; Half duplex – two " (one at a time) ; Full " – " " }
→ Topology



Machines (nodes) — { ways to connect machines }

Datalink → Framing
→ Flow control (controls speed of data transfer)
→ Error "
→ Access " (avoid collision)
→ Physical Addressing

(No. of bits together (in grp) "Frames")

Network → Logical Addressing
→ Routing (Algos.)
→ Congestion control

"Packets"

Transport → end to end delivery
→ Segmentation
→ Flow control
→ Error "
Conjestion "

"Segments"

Session → Check Pointing
→ Synchronization

Presentation → Encryption / Decryption
→ Character translation

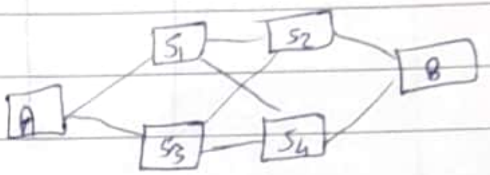
⇒ Layers :- (TCP / IP)

A	Application	
T	Transport	→ TCP
I	Internet	→ IP
H	Host to Network	

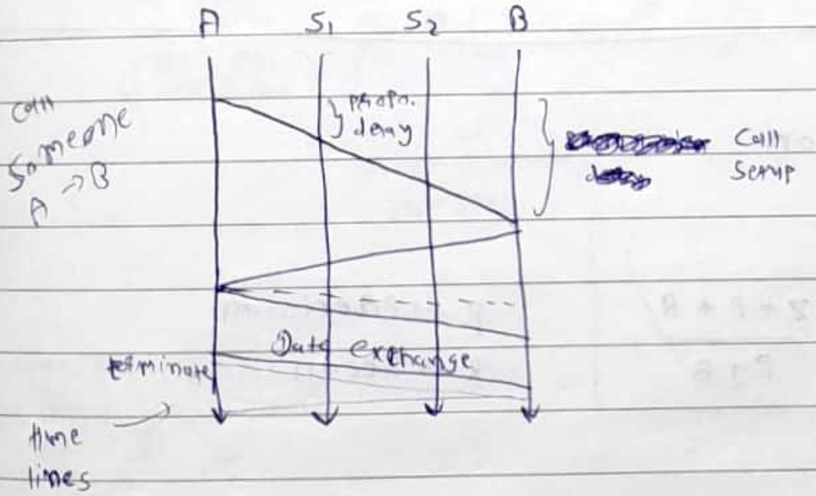
A
P
S
T
N
D
P

Ch (SMP) 10-12

1) Circuit switching
2) Message "
3) Packet "
- Datagram
- Virtual circuit



1) Circuit switching :-



Example: telephone

Reservation

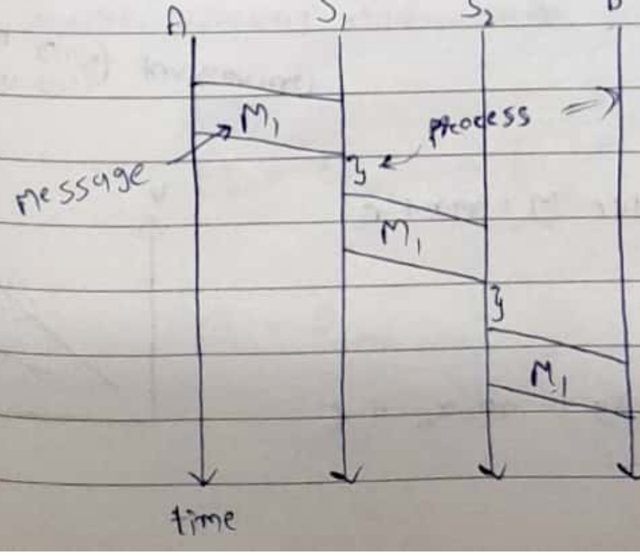
* 3 Phase of circuit switching :-

call setup

Data exchange

Termination

2) Message switching :-



process ⇒ find next switch
error checking
correct message or not

No reservation

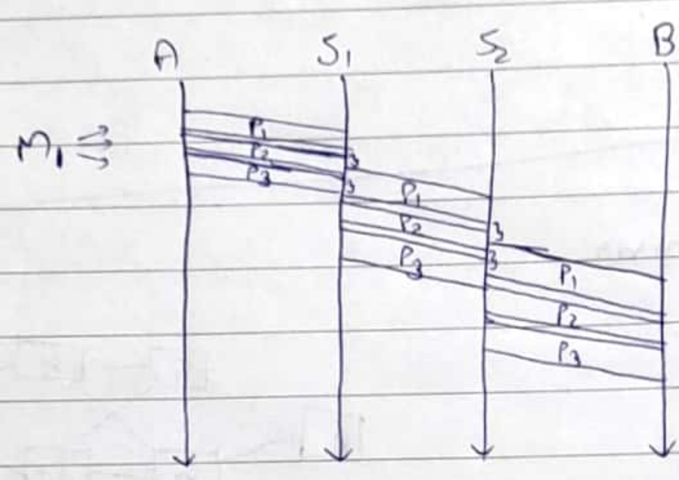
(Store, process, forward)

~~If message is large than~~

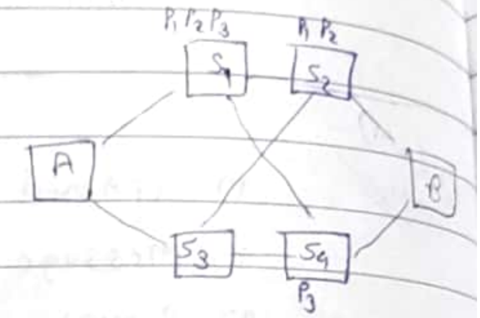
~~We decompose message~~

~~(divide in packets)~~

3) Packet switching :-



This case also possible



⇒ every Packet treated as ~~...~~ individually

⇒ If P_3 comes 1^{st}, B has to combine them in order.

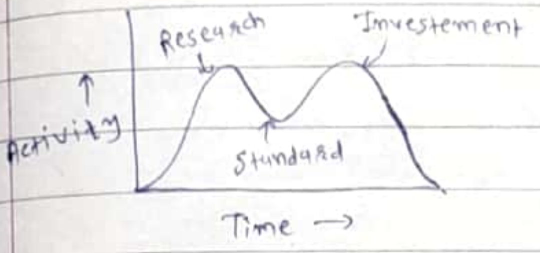
- No reservation
- All Packet may not follow same Path

⇒ This is "Datagram".

* Drawbacks of both Models :-

① Critique of ISO/OSI :-

1) Bad timing (came out late)



Some people wasting time in research, but in TCP/IP its already started work.
(Like, UNIX free source, so popular)

2) Bad Technology (in terms of design)

- Session & presentation layers are have only few functionality. (nearly empty)
- Network & Transport " ~~[illegible]~~ overburden.
- Some func. are redundant

3) Bad Implementation

Like waterfall model, just to understand working, not for implement.

4) Bad Politics

can't came up popular, bcoz politics

② Critique of TCP / IP :-

1) Doesn't clearly distinguish behaviour, service, Interface

2) Only For TCP & IP
UDP

3) Host to network

* To overcome of both's drawback. There is idea of hybrid approach.

* chp :- 2. physical layer

- Handles actual data transmission (physically)

Transmission Media
- Guided
  - Twisted pair (1)
  - coaxial (cable) (2)
  - Fiber (3)
- Unguided (wireless)

=> (1) - Pair of copper wires (thin, so we can bend it)

- Helical form
- Twisted (why?) => To avoid electromagnetic interfearence, (In parallel design, it happens)

  So it can pass signals at long distance

- cat-3 / cat-5

  amount of twists (more twist long distance)

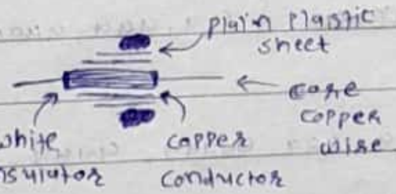
  combine, UTP + cat-5 good comb^n

- UTP / STP

  costly then UTP

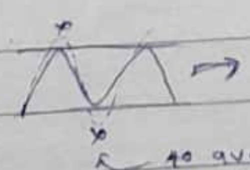
- Used in telephone system & obviously for internet

=> (2) - setup box cable (hard to bend)



=> (3) - made by { glass or good quality plastic

light form



signal received at photodiod

to avoid this, strong material needed

(APV) 12

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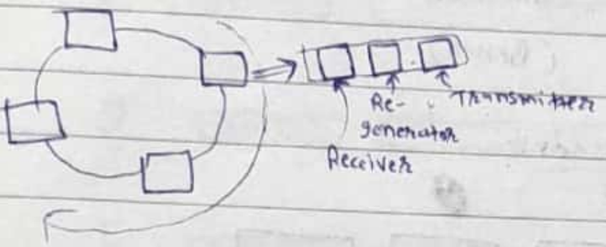
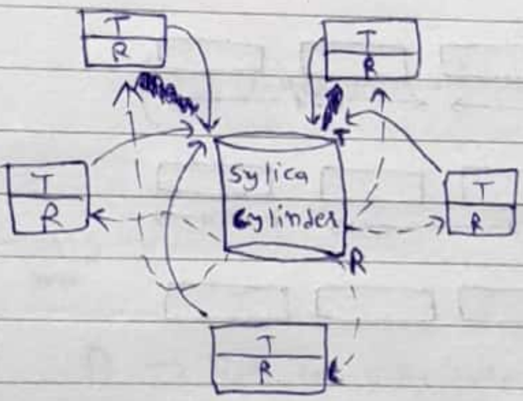
Fiber Optic Networks:-

1) Ring Network — Active Interface (For long distance)
2) Passive star — Passive " (send signal without any processing) (For short distance) (If machine is down, doesn't matter)





This design used for broadcast only

(~~Not for sending signal~~)

ch:19. forouzan

Network Layer:-

* IPV4 :- 32-bit address — $\leftarrow 32 \rightarrow$ — $2^{32} = 4$ TB — ~~This many~~ PC's we can connect to internet

- Notations
  - Binary
  - Dotted decimal

4-octets $\boxed{8}\boxed{8}\boxed{8}\boxed{8}$ ← 32-bits →

☐.☐.☐.☐ — 2^8 — Range: 0-255

111. 56. 045. 46 ✗ Not Valid

111. 56. 45. 46 ✓ Valid

221. 56.5.4.2 ✗

75. 257. 6.1 ✗

75.255.6.1 ✓

Scanned with CamScanner

* 2-types of Addressing:-

Classful

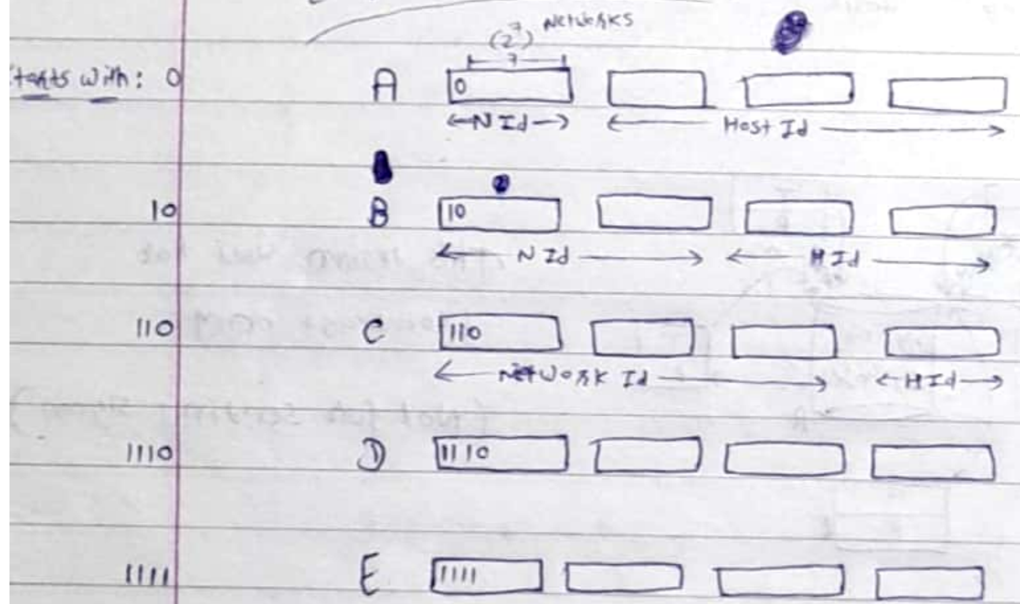
We divide add. in parts

Classless

Dynamic allocation (As per require)

(Better)

2^{32} divided in 5 classes:-



2^{28} pc's we can allocate in single network by D, E

(For Binary)

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A	0-127			
B	128-191			
C	192-223			
D	224-239			
E	240-255			

← generally scene (192. - -)

(For dotted decimal)

* PROS / CONS :-

(2^{24}) A → used for very large network
(But some add. get wasted)

B → less add. wastage than A

(2^{8}) C → like for university (300 machine)
" small organization & practical

D → For multicasting

E → Reserved for future use

Class A, B very large
class C seems small
⇓
Here, classful add. fails.
(So, we go for classless)

* Mask 32-bit :-

AND operation on IP add., with mask & get N-Id.

CIDR

Classless Intra Domain Routing

For A, A IP/8

B, /16

C, /24

=> "Subnetting" :- ① Divide network in parts

=> "Supernetting" :-

CN(APV)
20-12

⇒ When organization given, large block of class A or class B it can divide the add., into multiple contigues groups. Those groups called 'subnetwork'. ('subnets')

⇒ " " " , multiple block of class C it can combine the block. This is called 'supernetting'.

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Classful

We divide addresses into classes / parts.

* Classless Addressing :-

⇒ Restrictions :- Addresses should contigous
- No. of " in the block, must be power of 2.
- 1^{st} add. in the block, must be evenly divisable by no. of addresses

2^{16}, $\frac{\text{add.}}{16}$ ⇒ must give even value

Ex:

205.16.37.32
⋮
205.16.37.47

We can allocate it or not ?

- contigous ? ✓
- No. of add. ? = 16 = 2^4 ✓
- 1^{st} add. = $(256)^3 \times 205 +$
$(256)^2 \times 16 +$
$(256)^1 \times 37 +$
$(256)^0 \times 32$
$= x$

∴ x is divisable by 16. & gives even no. ✓

doubt

⇒ if 1^{st} add., 205.16.37.8
then last $cond^n$ ✗

Scanned with CamScanner

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Eg: $x\ y\ z\ w\ /\ n$, n is mask value

=> If random add. of block given & we want to find 1st add. then,

like, 205.16.37.39 / 28 (means there are 28 1's, remaining 4 0's)

=> convert to binary,

For 39, $\underbrace{0010}\underbrace{0111}$ last '4' bits, convert to '0'

∴ 0010 0000 (32-n = 32-28 = 4)

so, starting add. ___ . ___ . ___ . 00100000

=> For last add.,

0010 0111

∴ 0010 1111 (set last 32-n = 4 bit to '1')

So, range is,

205.16.37.32
⋮
205.16.37.47

=> 16 addresses ✓

same

So, no. of add., $\underline{2^{32-n}} = 2^4 = 16$ ✓

Formula to ~~cross~~ check

Date
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⇒ For simplicity, 1^{st} add. of block reserved as 'Network add.',
last " " " " for 'broadcasting'.

So, there are only "n-2" effective addresses.

Eg: 64 add., 17.12.40.0 / 26
Subdivide this network in parts. (ex. of subnetting)

64 → 32, 16, 16 (3 blocks)

⇒ For 32, 2^5

$$2^5 = 2^{32-n_1}$$
$$\therefore \underline{n_1 = 27}$$

⇒ rand. add. = 17.12.40.0 / 27

∴ $n_1 = 27$ (so, 32-27 = 5, last 5 bits to '0' & '1')

∴ First add. = 17.12.40.0 / 27
∴ last add. = 17.12.40.31 / 27

} 32 add. = 2^5

⇒ For 16, 2^4

∴ $n_2 = 28$

bcoz last of '32' section is "17.12.40.31

⇒ add. = 17.12.40.32/28

last '4' bits to '0' & '1'

range = 17.12.40.32 / 28
17.12.40.47 / 28

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⇒ for last 16, 2^4

$n_3 = 28$

last '4' bits '0' & '1' , add. = 17.12.40.48 / 28

Range = 17.12.40.48 / 28

17.12.40.63 / 28

Eg: 17.12.40.29 / 27 , this is subnetwork, find starting add.

⇒ $n = 27$

last 5 bit '0' & '1'

17.12.40. / 27

Eg: 17.12.40.45 / 28 , start & last add.

⇒ last 4 bit

0010 1101

∴ 0010 0000 & 0010 1111

1st → 17.12.40.32 / 28

last → 17.12.40.47 / 28

TCP/IP
Behrouz Forouzan

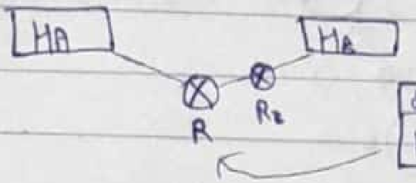
Ch. 6

Topic: Forwarding

(Ch:-6)

* Forwarding :-

There is lots of packets, so to manage we require data structure. 'Routing Table'



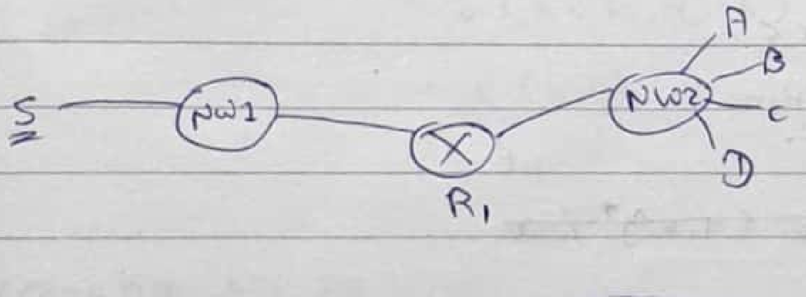
destn	Next hop
H_B	R_2

defn

- Place a packet on its path to destination.

⇒ two types :- ① Host specific method

② Network " "



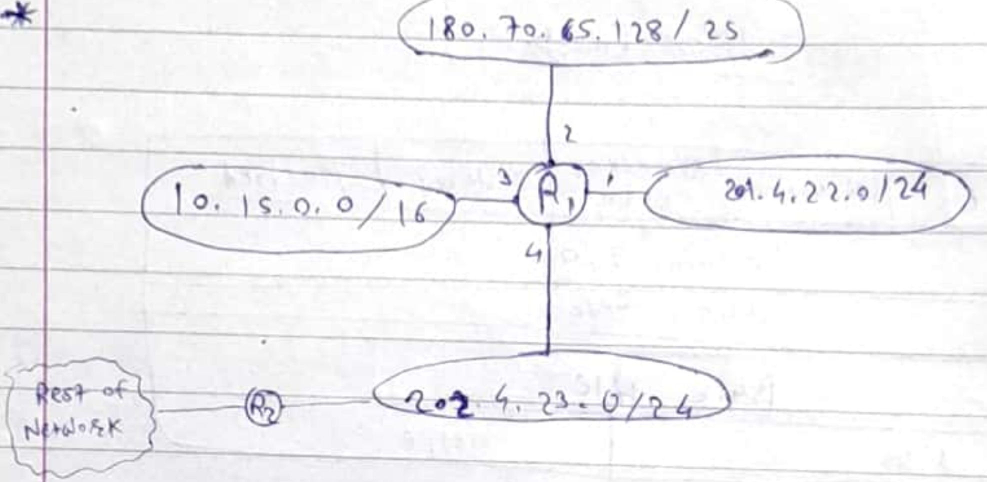
RT for S,

Destn	Next Hop
A	R_1
B	R_1
C	R_1
D	R_1

D	NH
NW 2	R_1

CN (APV)
26-12

*



Largest mass 1st (max no. of 1's)

Mask	NID	Port	Next Stop
/25	180.70.65.128	2	– (null)
/24	201.4.22.0	1	–
/24	202.4.23.0	4	–
/16	10.15.0.0	3	–
/0	0.0.0.0	4	R_2

⇐ Routing Table

Incoming 10.15.3.4 → Dest^n Id
201.4.22.10 → Source Id

10.15.3.00000100 (10.15.3.4)
255.255.255.10000000 (255.255.255.128)

10.15.3.0

checked for "/25" {25 1's

10.15.3.00000100

255.255.00000000.00000000 , Check for /16 {16 1's}

, No need to calculate for, /24 & /24

{∵ same no. of 1's}

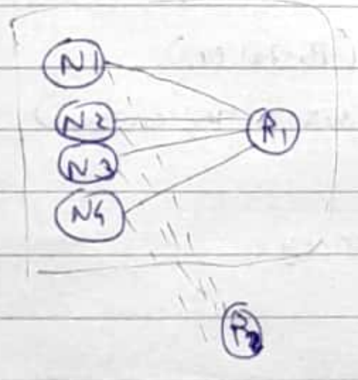
// If no matches, go for "/0"

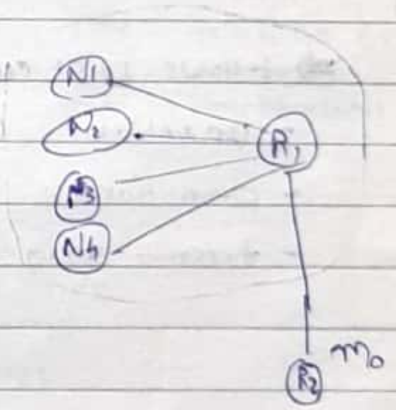
Routing :-

Constructing Table

* Address Aggregession :-

If don't have this concept | In Case of add. aggregessi





N1 192.168.0.0/24

N2 192.168.1.0/24 ← decided by same

N3 192.168.2.0/24 authorities

N4 192.168.3.0/24

N1 192.168.00000000.00000000

N2 192.168.

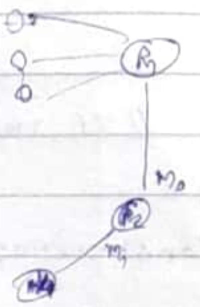
N3 192.168.

N4 192.168.

forwarding techs.
" example
Add. Aggregession
longest mask matching
from TCP/IP...

Table for R_2

Mask	NID	Port	Next stop
/22	192.168.0.0	m_0	?
/24	192.168.3.0	m_1	



Chp: 20 (Forouzan)

both books by forouzan

* IPv4

For IP, packets called "datagram".

⇒ follows best effort delivery (Postal ex.)
- Unreliable (∵ doesn't contain error & flow control)
- Connectionless
- ~~doesn't~~ may get packet unsequency

* IPv4 datagram format :- (Structure of IPv4)

|← 20-65536 bytes →|

Header	Data

Header ↓ 20 to 60 bytes

$2^{32} = 65536$

Date ______
Page ______

Header

(VER)	Header length	8-bit
Version	HLEN	Service
4-bits	4-bits	

(20-60)

multiply by 4 & get length

Service ⇓

3-bits | 4-bits

Precedance bits | TOS bits

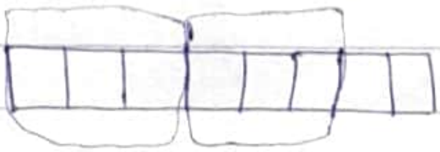
(one 1 at a time)

0000 ← default
0001 ← min. cost
0010 ← reliability (max.)
1000 ← min. delay
0100 ← max. throughput

(APV)
7-12

service type

Differentiated service



~~3 rightmost bit is '0'; then~~

Textbook

⇒ Total length: (16-bits)

length of data = total length − header length

Structure of header only

4	4	8	16
Identification		(3) Flags	(13) Frag. offset
TTL (8)	Protocol (8)	checksum (16)	
SIP (32)			
DIP (32)			
options			

20 bytes

40 bytes

Example in book (checksum)

⇒ Without options (20 bytes)

⇒ With options (max.) (60 bytes)

20-60 range proved

HLEN = 1000

8 × 4 = 32

⇒ TTL

⇒ Protocol layer specifies the final destⁿ protocol to which datagram is delivered.

Eg: HLEN is 5, total length 40

→ 20 bytes header
(5×4)

length of data = total length − header length

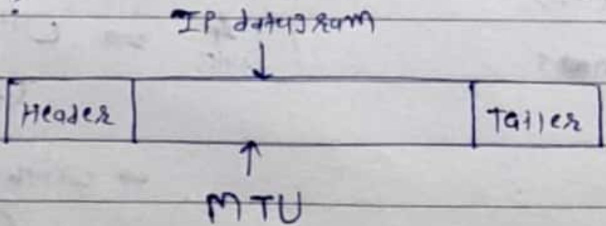
~~header~~ length of data = 40 − 20 = 20

Eg: 0x45000028 00010000 01|02

← 16-bit →

IGMP Protocol

* Fragmentation :-



(Max. transport unit)

↑ ~~How much data we can send~~ in one frame

length

Hyperchannel ⇒ 65535

Toke__ ⇒ 17914

→ Identification + SIP

⇓

Unique