Start marks "week 8".

Why 64 Bytes minimum?

~~150~~
141

64 Bytes $\hat{=}$ 512 bits.

At 10 Mb/sec: $\frac{512}{10{,}000{,}000} = 51.2\ \mu sec.$

$= 25$

~~At $\frac{2}{3}$ speed~~

$\tau = 25.6\ \mu sec$

At $\frac{2}{3} * c$:

$\frac{2}{3} * c = \frac{2}{3} * 300{,}000\ km/s = 200{,}000\ km/sec$

$200{,}000 * .0000256 = 5.12\ km.$ (check)

OK for "couple of km".

10 Mb/s: Largest collission Domain 2.5 km
Repeaters add delay

But if bandwidth increases: ~~probb~~

~~It~~ 64 Bytes may not be enough!

The 64 Bytes minimum is there to ensure proper collission detection.

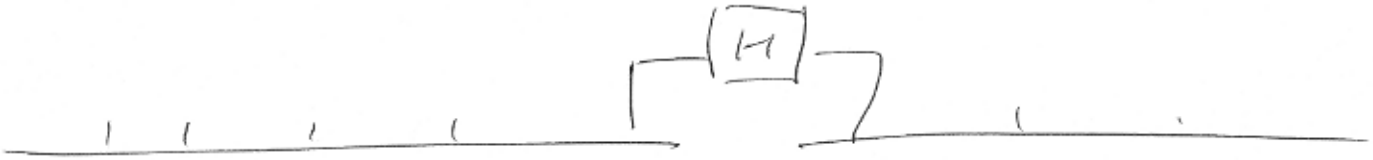
Hubs, Bridges, Switches.

Amplifier:

(1) ~~Ether~~ Extends Read.

(2) Amplifies Noise and Signal.

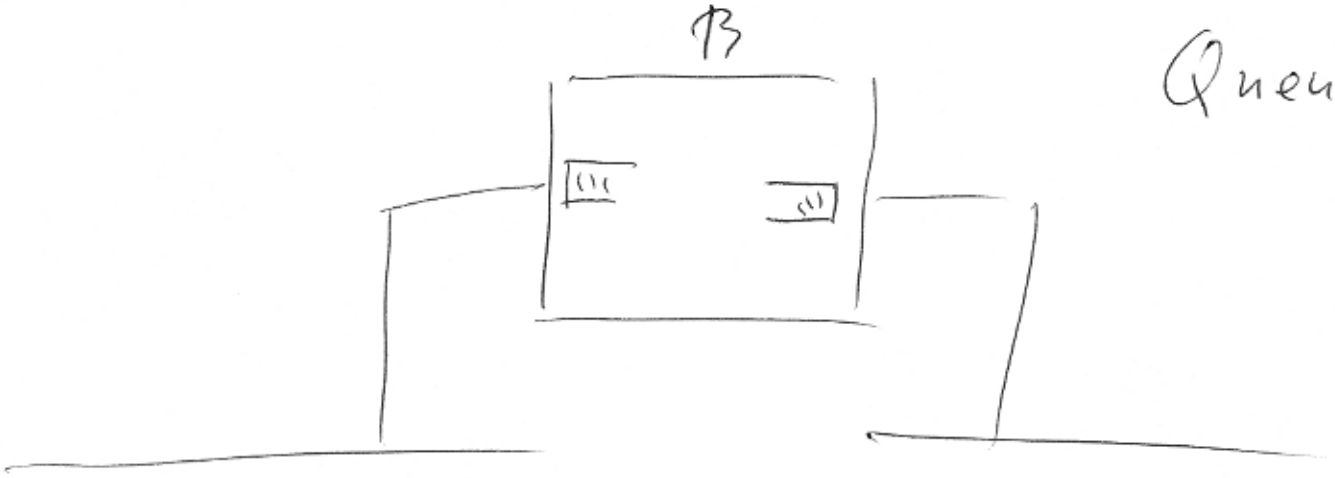
(3) One Collision Domain



cs 1

Bridge:
More intelligent

The bridge "knows" which ethernet addresses are on what side.

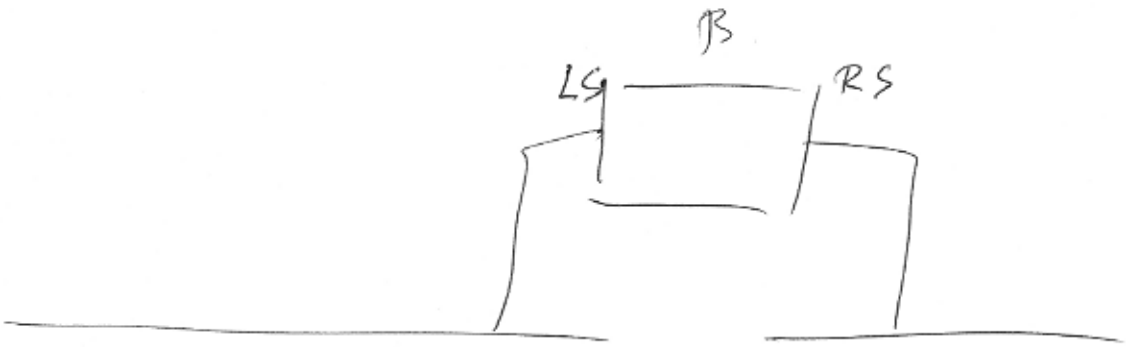


Queues.

Bridge: does <u>not</u> transmit <u>noise</u>.
transmits only packets that need transmitting.
participates in CSMA-CD !

<u>two</u> (or more) <u>Collission Domains</u>.

Learning Bridge :

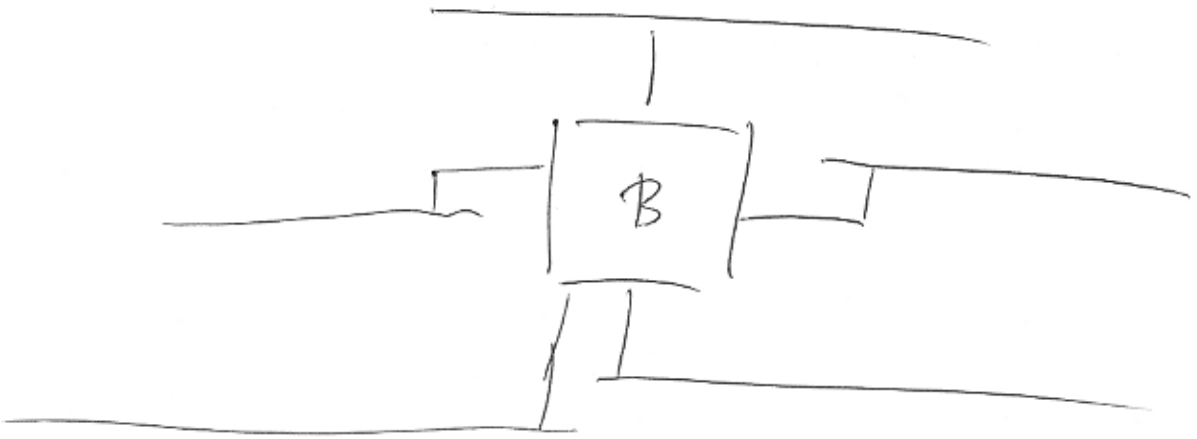


Every time it receives Frame at LS: it "knows" source address is on L.

if it knows dest addr: do right thing

if not: transmit (with time-out).

You can move workstations around without lots of "system" work.



Still Co-ax,

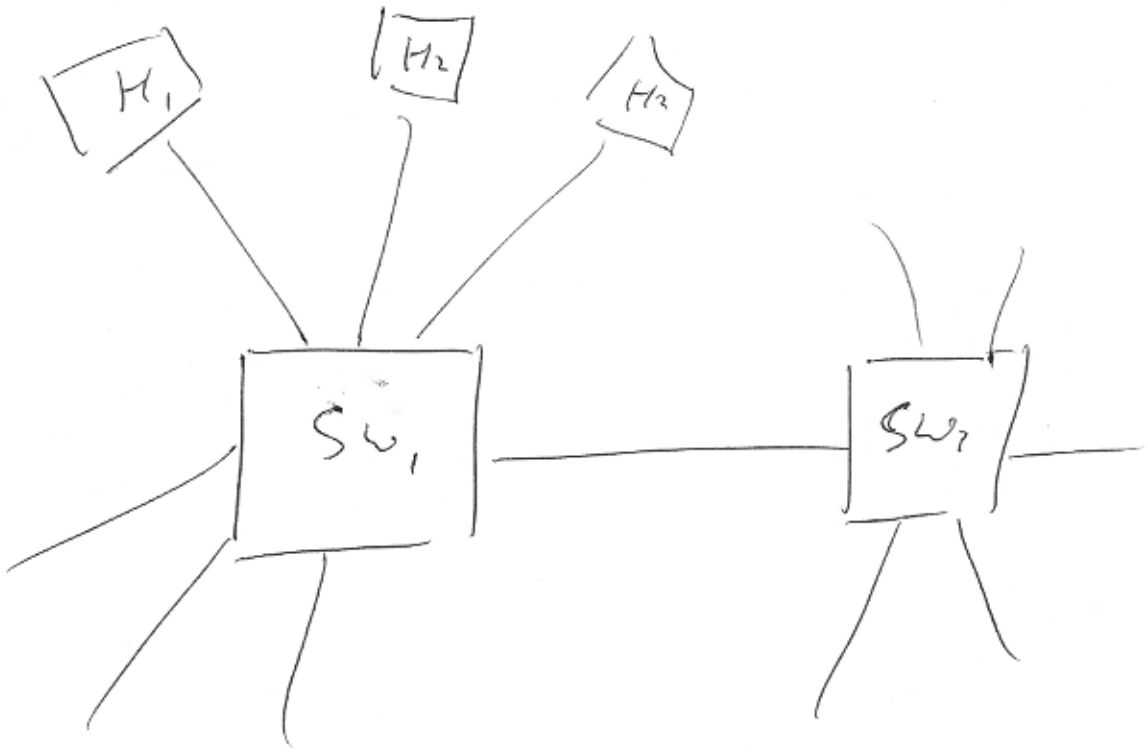
Same.

Now switches

(1) Like Bridge.

(2) One host per segment!

(3) No more co-ax



The cable now is a category 5 unshielded TP.
TP.
(4 pairs: 8 wires)

My Lab: 10/100 Base T.

Co-ax: half duplex.

(or: $\frac{1}{n}$ duplex ?)

of n hosts.

Ethernet switch: Full duplex.

No more collisions!

No more need to study
CSMA-CD and like protocols.

(But !)

Ethernet is a LAN
(Local Area Network)

There are other LANs.

There also are

MANs Metropolitan Area Network

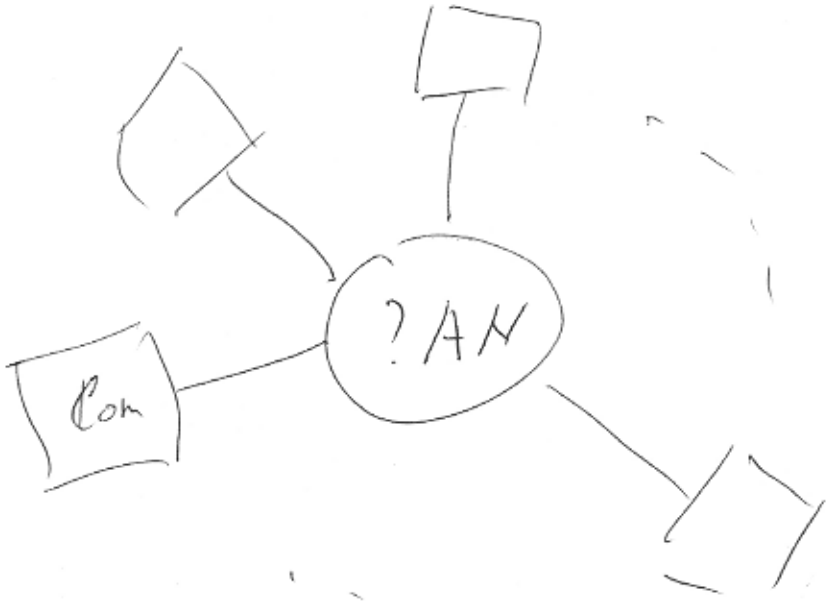
WAN Wide Area Networks

LANs, MANs, WANs
have a physical existence.

LANs, MANs, WANs:

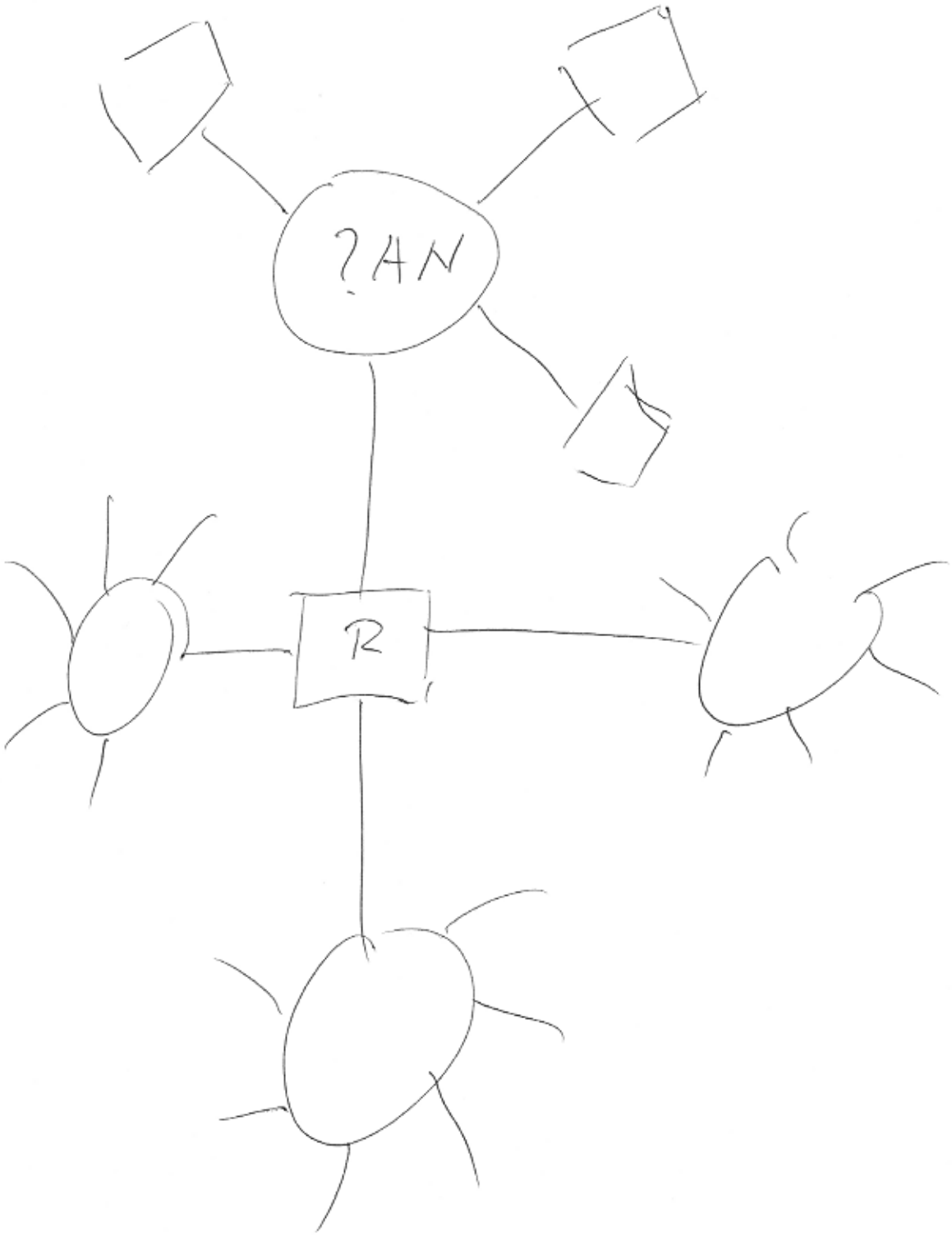
"physical".

or



etc.

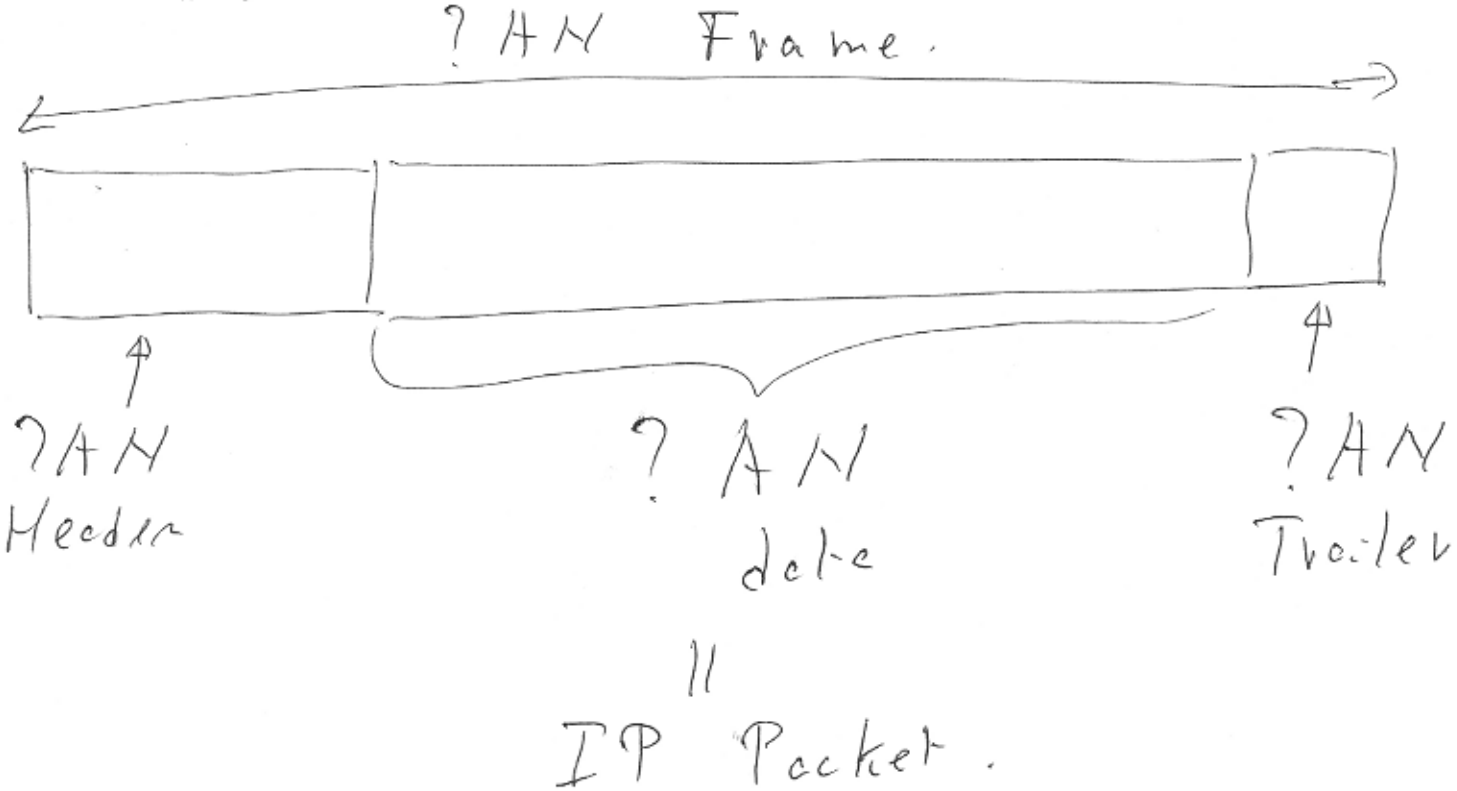
Some of these computers are routers (or gateways).



Some computers have multiple ports, on multiple ?ANs.
(Multi-Homed).

Some of those Multi-Homed Computers act as Routers (Gateways).

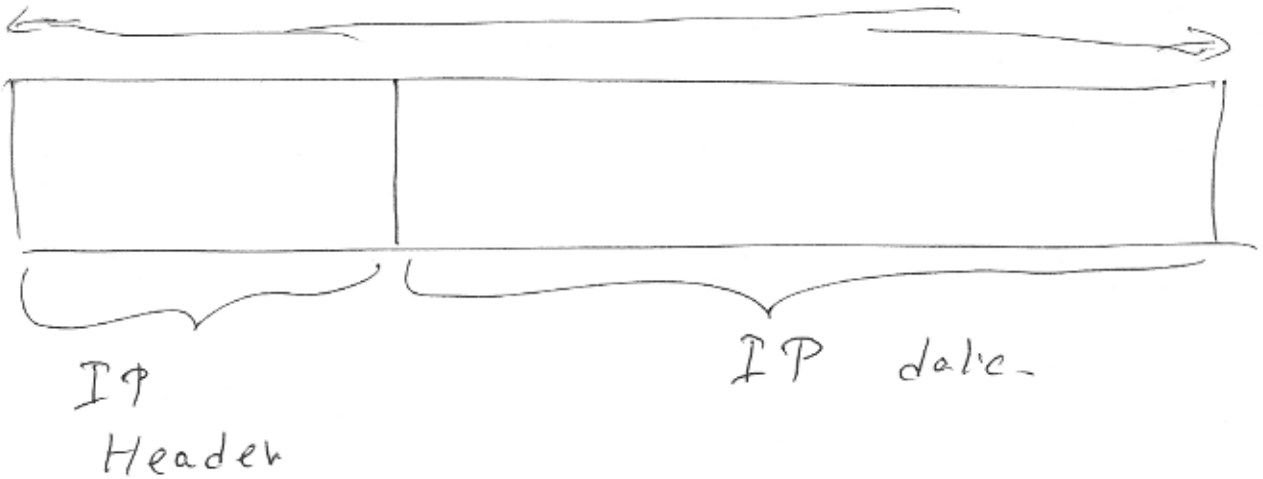
With IP:



=

IP Packet.

IP Packet:



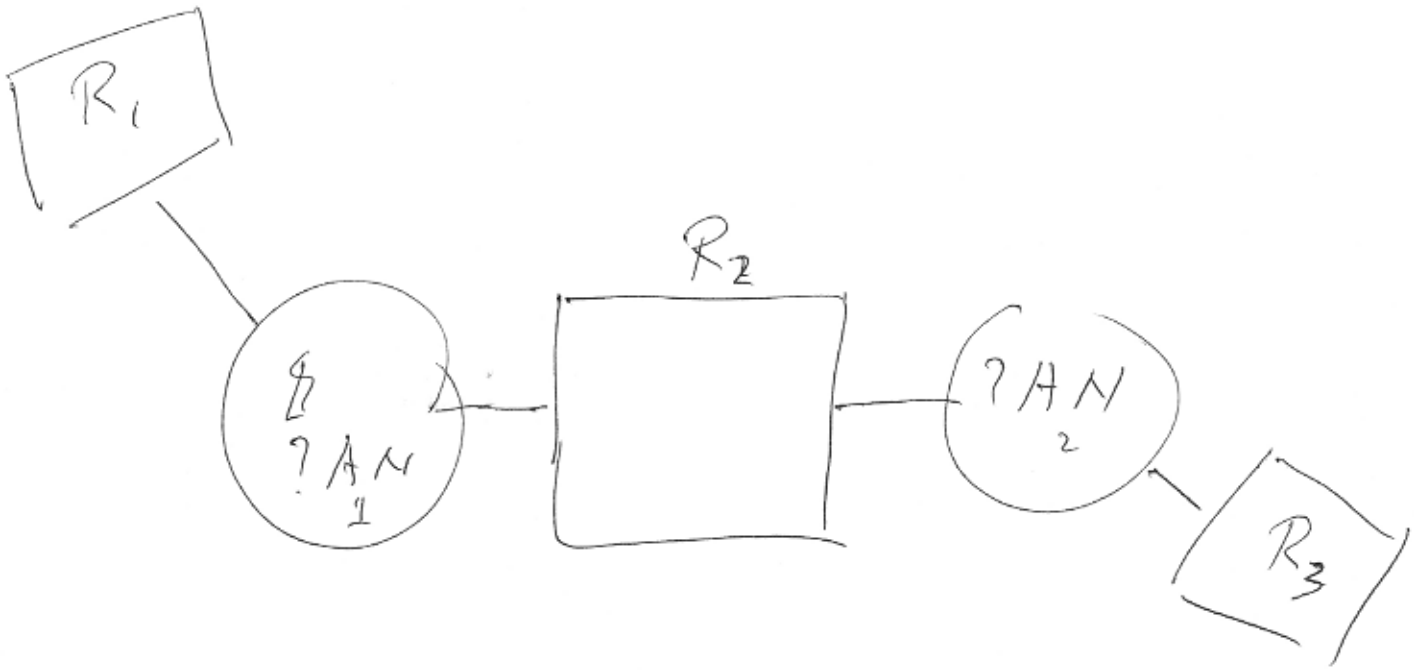
IP Header:

In IPv4 (~~ver~~ IP version 4):

Addresses are 32 bits long.

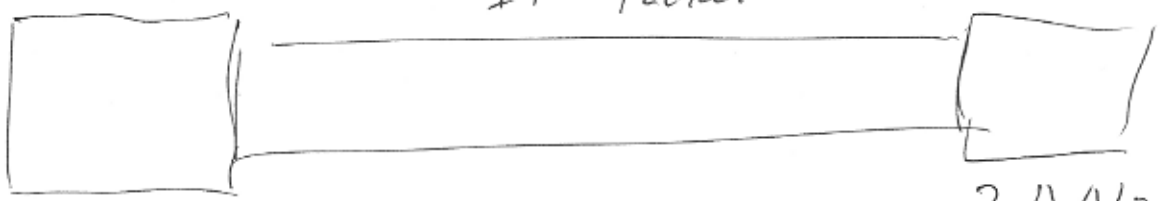
~~Tanne~~

Tanenbaum p 434.



$R_1 \Rightarrow R_2$

$R_2 \Rightarrow R_3$:



etc.

Internet Protocols:

Control how IP packets

move From Host to Router to Router

to R ... to R ... to Host,

"over anything

(Ainy ? AN).

LAN protocols control how

Frames move across a ~~LA~~ ? AN.

A LAN Frame may contain

an IP Packet. (often does).

"IP over anything"

"IP over everything"

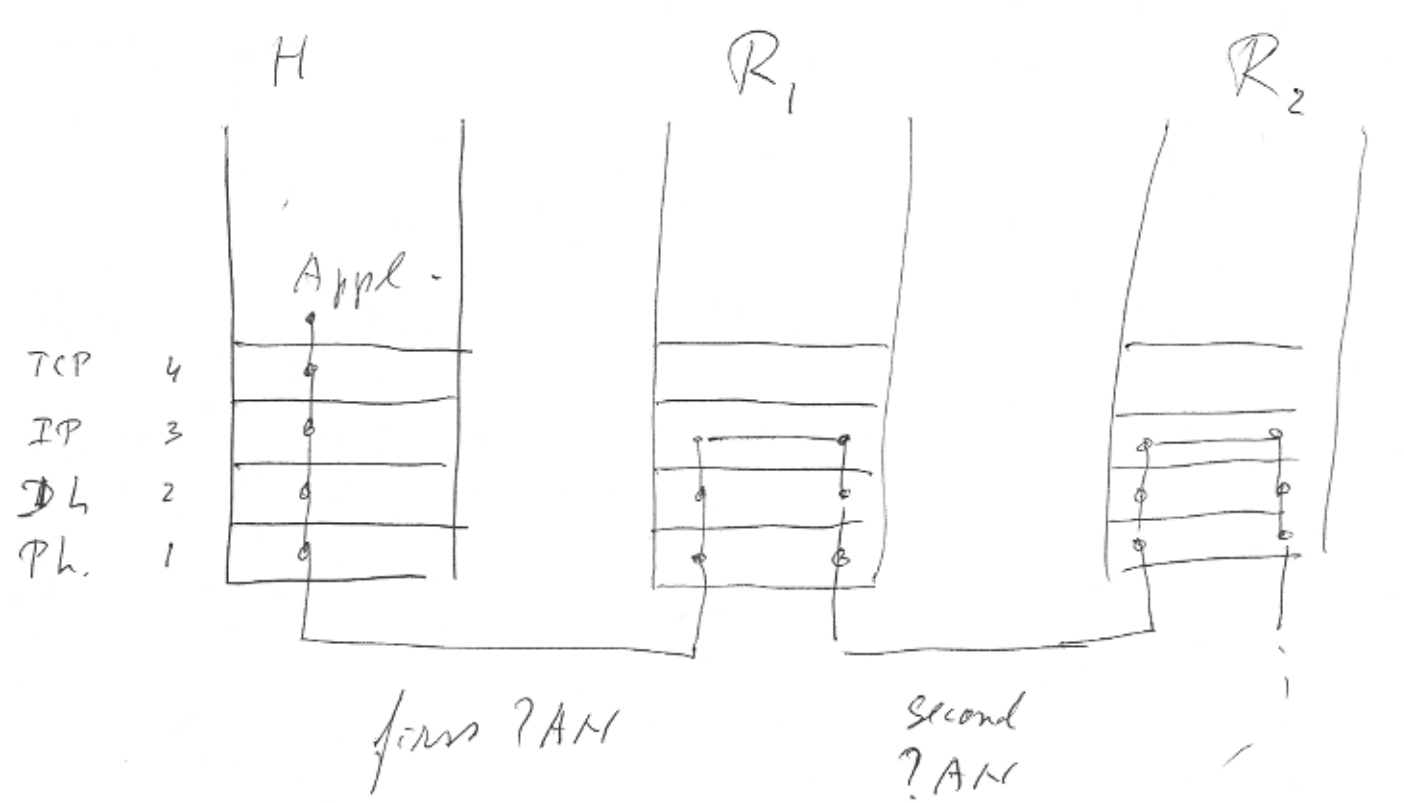
An IP packet,
on its way from here to there,
will be encapsulated in a
different LAN frame on
every hop.

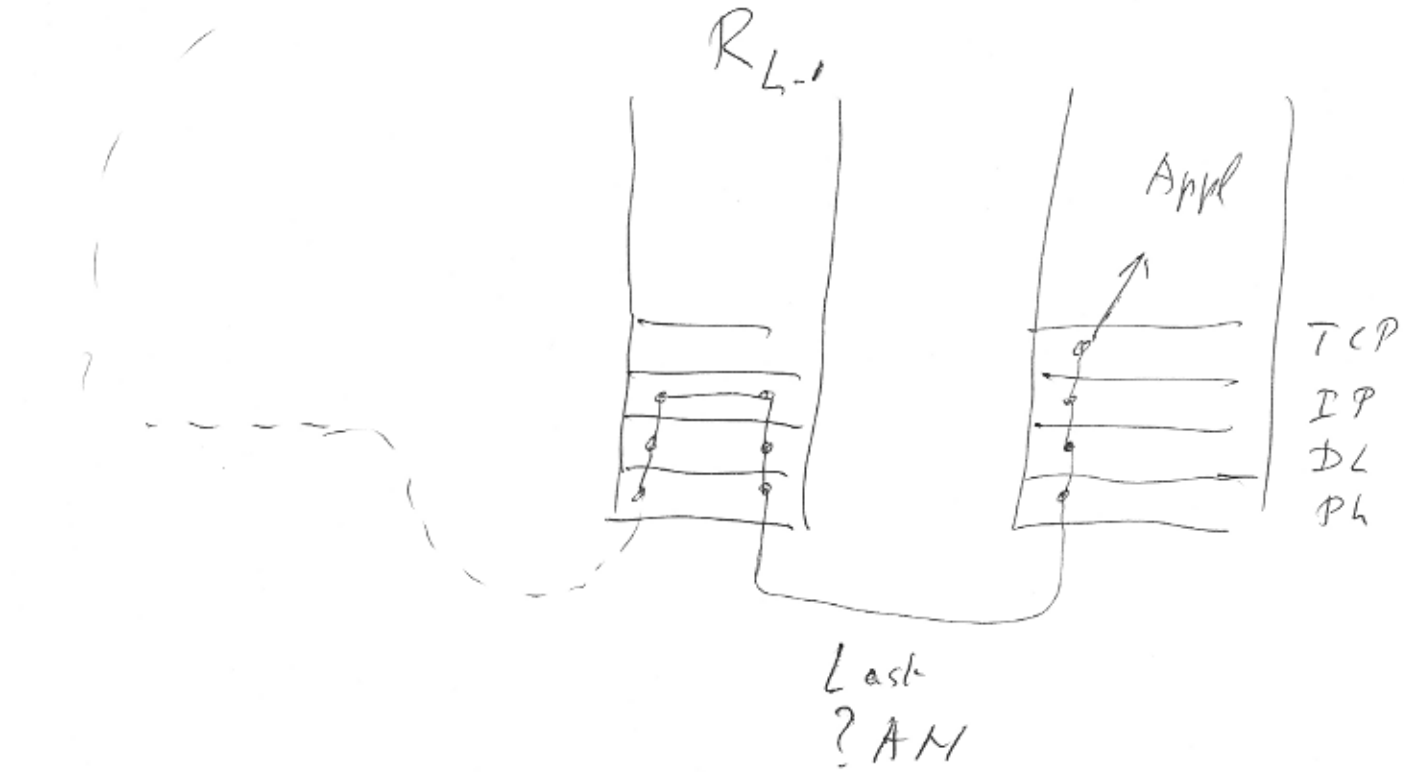
Quite likely: different
types of LANs.
(ethernet, wireless, MANs, WANs,
token rings, ...).

The Internet:

(1) The set of <u>computers</u> that can be reached using IP protocols.

(2) The set of <u>services</u> you can receive using IP protocols.


H
R1
R2
Appl.
TCP 4
IP 3
DL 2
Ph. 1
first PAN
second PAN


RL-1
Appl
TCP
IP
DL
Ph
Last PAN

Every Router:

(1) Takes off ? AN wrapper.

(2) Looks at IP dest address.

(3) Determines Next Router (or)

(Determines output port,
Next IP Address
Next Physical Address)

(4) Puts new ~~on~~ ? AN wrapper around.

& Ships.