CIS 451.

Web browsers:
I use: Netscape Navigator at Univ.
Microsoft Explorer at home.

What happens if I type (or click on)

http://www.prenhall.com/~tanenbaum

?

First an aside:
This is the "place" where Tanenbaum has put extra material (slides etc) we can use in this class.
I will occasionally use these.
You will get them on your own. (Homework).
Who does not know how to get them?

http Hypertext Transfer Protocol.
"The" protocol used by your computer and the computer "www.prenhall.com" to communicate..

This is a misleading statement!

URL. Uniform Resource Location

www.prenhall.com / tanenbaum

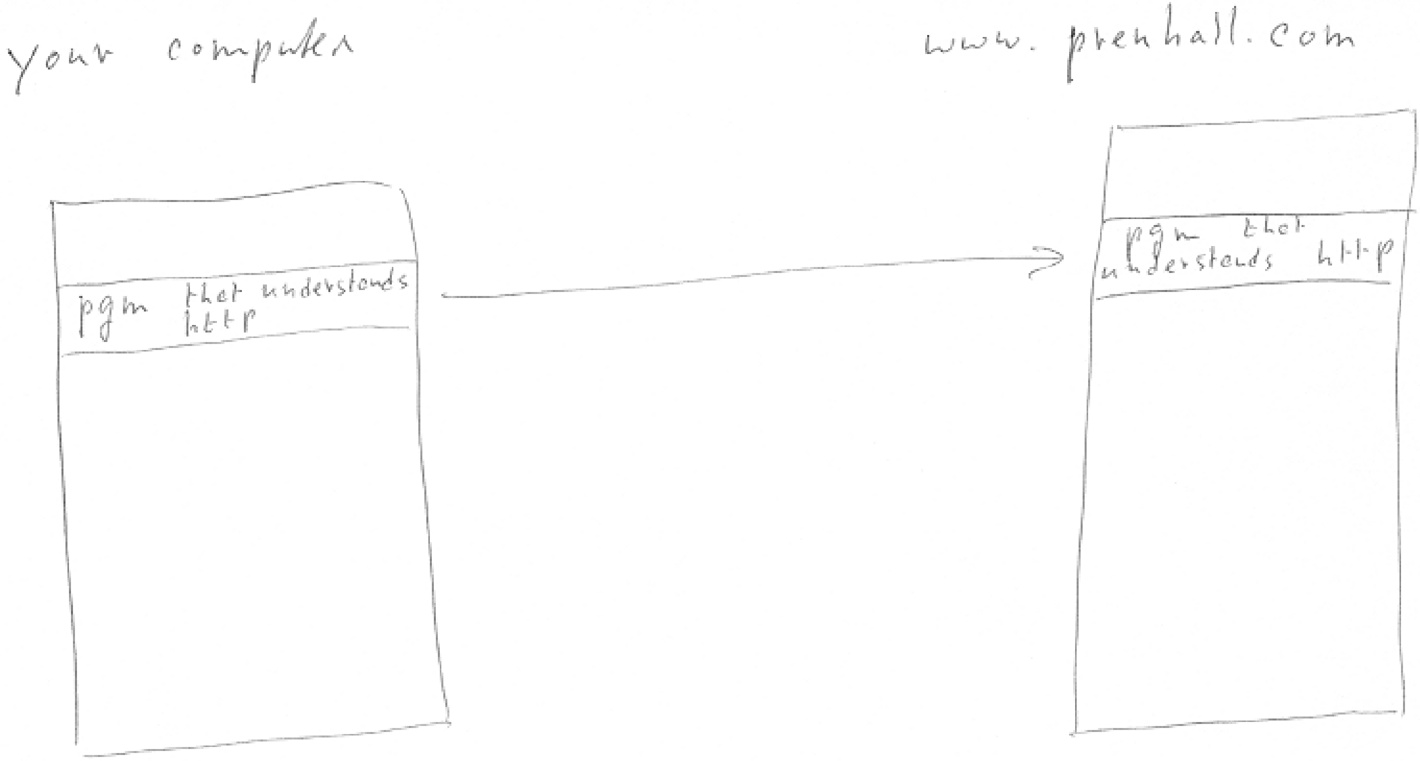
name of computer

name of directory or file in www.prenhall.com

(I am a UNIX person).

Q: Why was "~~This~~ http is *the* protocol" a misleading statement?

A: Because *multiple* protocols are being used. In a layered way.



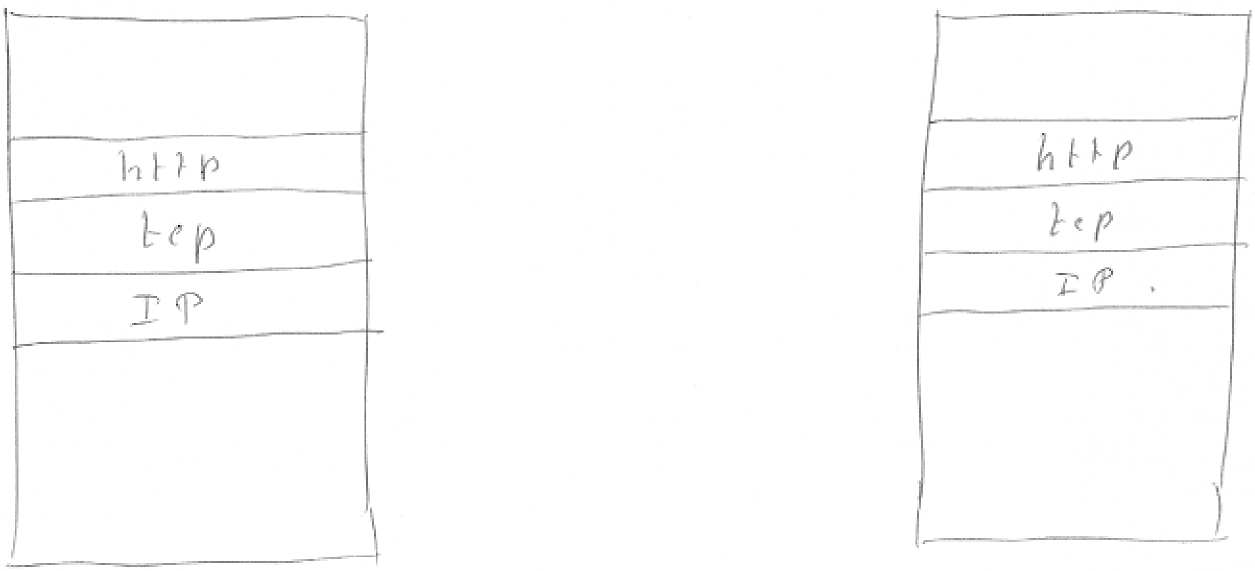
In ~~Your~~ your computer(s), there is a process (program):
"I have a message for the process in the computer www.prenhall.com that understands http, explaining it that I want the something from the file or directory tanenbaum."
(and explaining what I want).

How does the message get there?

<u>Oversimplified</u>:

your computer

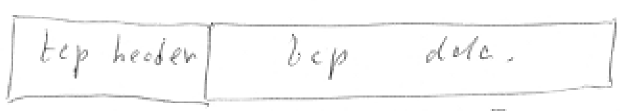
www.prenhall.com



http : hypertext transfer protocol.
tcp : transport control protocol.
IP : Internet Protocol.

http process in yc :
"I have a message for http in wpc"
gives it to tcp.

TCP: breaks it up into packets. } TCP packet.
adds its own header
"string of bytes".

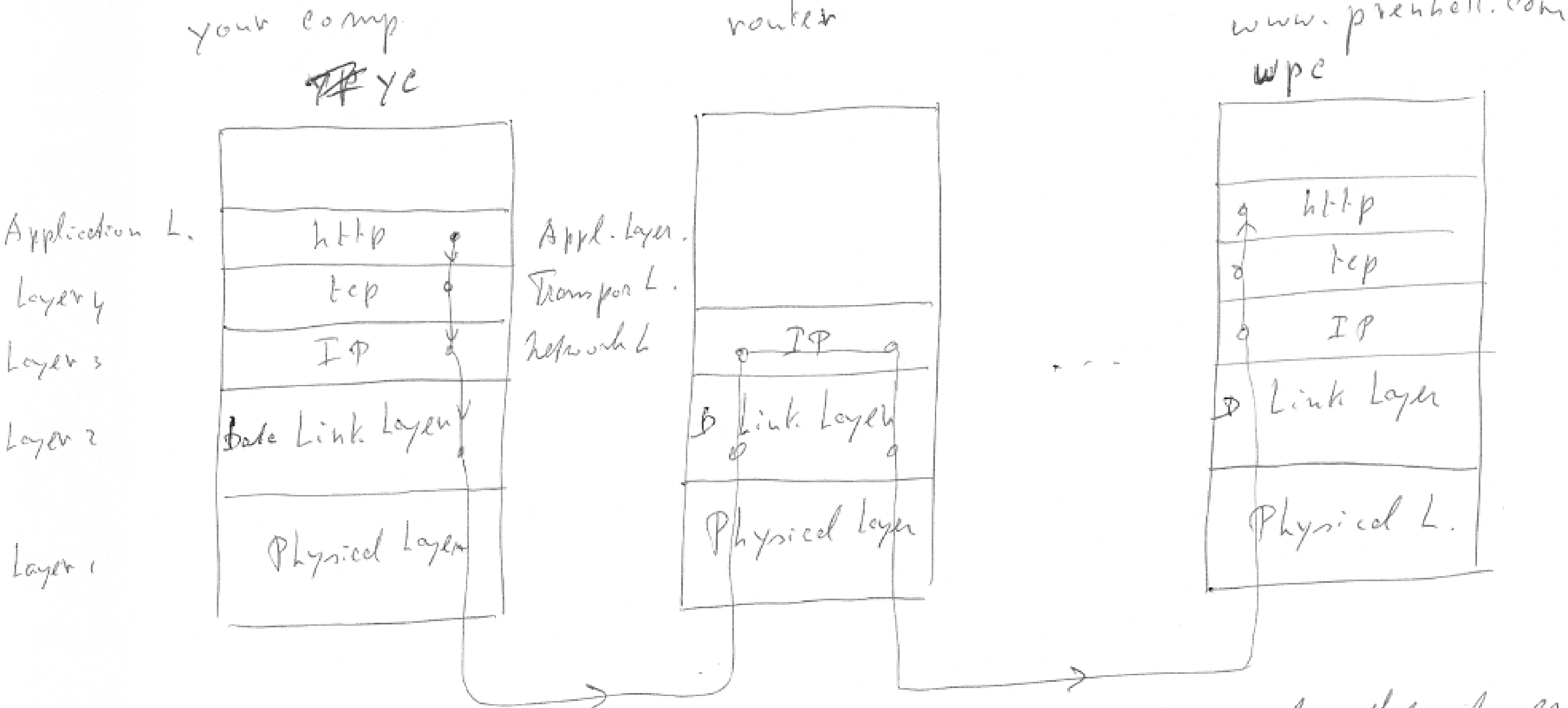


(tcp data: from http.

plus extra info..
tcp header: among other things: "this is for http".
outside of header:
This is for www.prenhall.com.

TCP gives packet + extra info to ~~TCP~~ IP-

IP:
Finds a way to translate the name
www.prenhall.com
in an IP address.
(This may involve help from other computers, using IP protocol, even TCP protocol!)



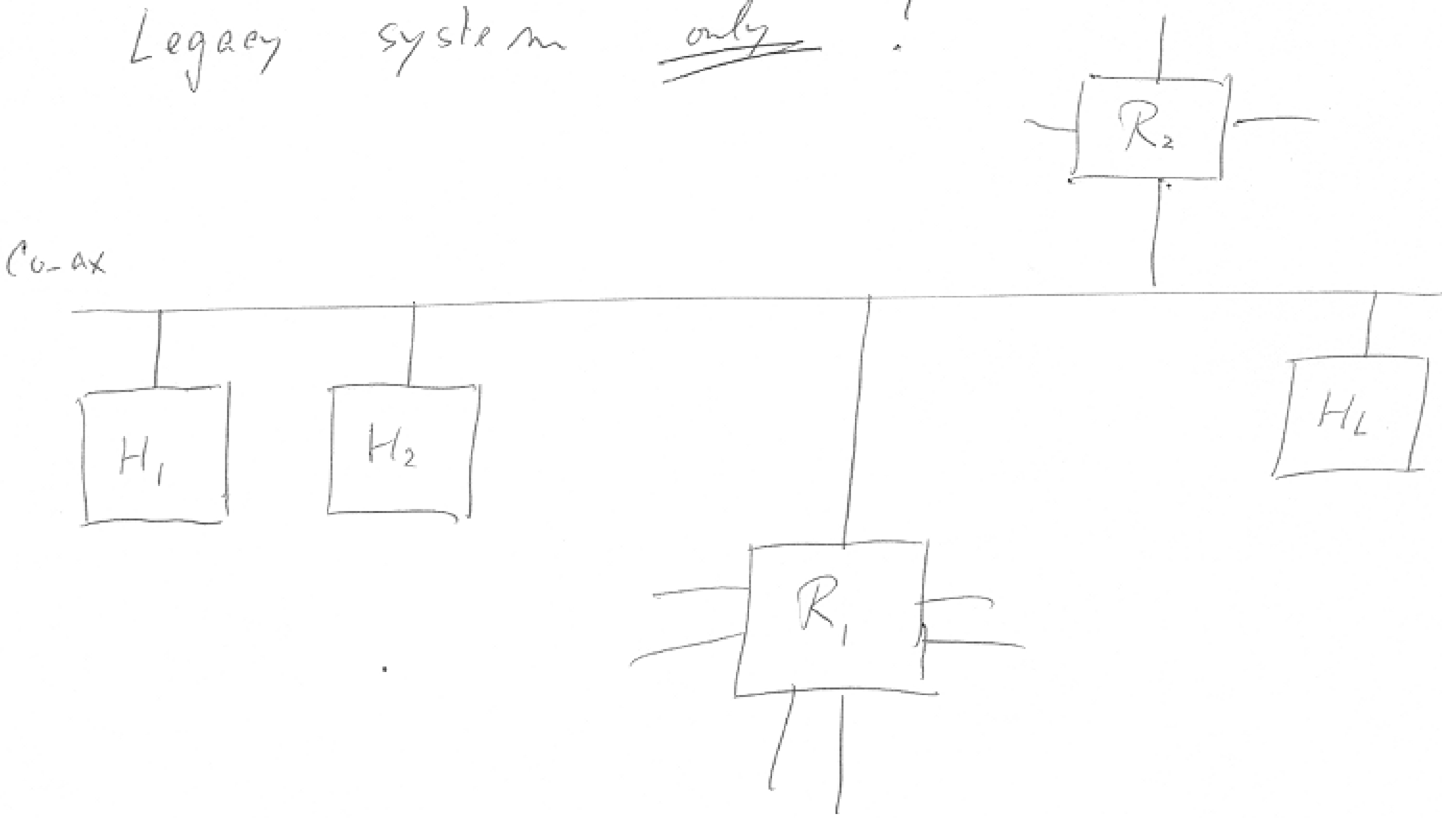
The IP process in "your "computer" finds a router that it can talk to directly, and that is "closer" to wpc. Sends it the IP packet. etc.

There are other "Network Layer" and "Transport Layer" protocols than IP, TCP, but these are by far the most important.

"Link" Layer and Physical Layer:

Most important example: Ethernet.

Classical Example:
Ethernet over coaxial cable.
Legacy system only!



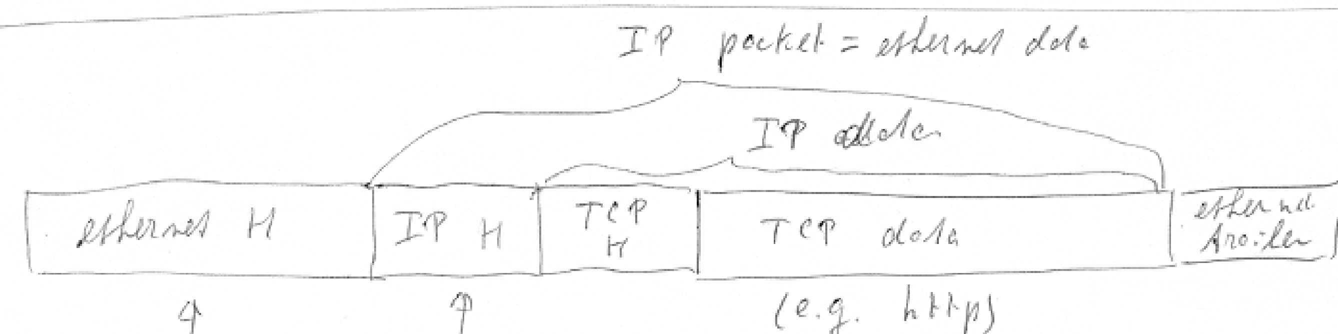
If <u>any</u> host or router transmits on co-ax, <u>everybody</u> can hear it.

How do they know: "this is for me"?

Answer:

<u>physical address</u>
(ethernet address). (layer 2 address).

As opposed to ~~I~~ !
<u>IP address</u>
(logical address) (layer 3 address).



contains <u>logical</u> addresses.
(source and dest)

contains
<u>physical</u> addresses
(source and destination).

Ethernet

IEEE 802.3 protocol.

		6		data + padding.	
8 bytes pre-amble	6 Bytes source addr	6 Bytes dest addr	2 Bytes ethertype.	46 - 1500 Bytes	4 Bytes CRC.

Data + padding: 46 - 1500 Bytes.

Data : 0 - 1500

if < 46: padding to 46 added.

ethernet ~~physical~~ physical addresses: 6 bytes each.

6 bytes = ~~8~~ 6 * 8 = 48 bits

$2^{48} \simeq 2.8 * 10^{14}$ different addresses. "enough".

More about ethernet addresses later.

Time being:
Every ethernet card has an ethernet address burnt in by manufacturer., unique.

(There also are special addresses, like broadcast and multicast : later).

Ethertypes.

Go to www.iana.org

click on "protocol number assignment"

click on "E".

click on "Ethernet Numbers"

Scroll.

Hex				Dec.
0800	(hexadec)	is IPv4	0000 1000 0000 0000	$8 * 16^2 = 2048$
0806	"	ARP	0000 1000 0000 0110	
86DD			1000 ~~1110~~ 0110 ~~1110~~ 1101 ~~1110~~ 1101	
(D = ~~14~~ 13)				
8035		RARP	1000 0000 0011 0101	

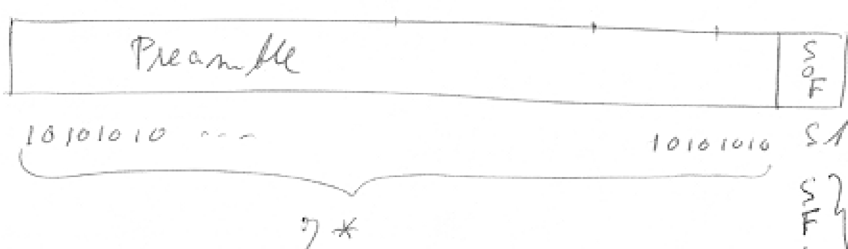
If the ethertypes is ≤ 1500 (dec) it gives the length of the ethernet packet.

~~Homework~~

Homework: Look through the list of ethertypes, see if you recognize any.

Do not hand in.

Pre-amble: 8 bytes



Start of Frame

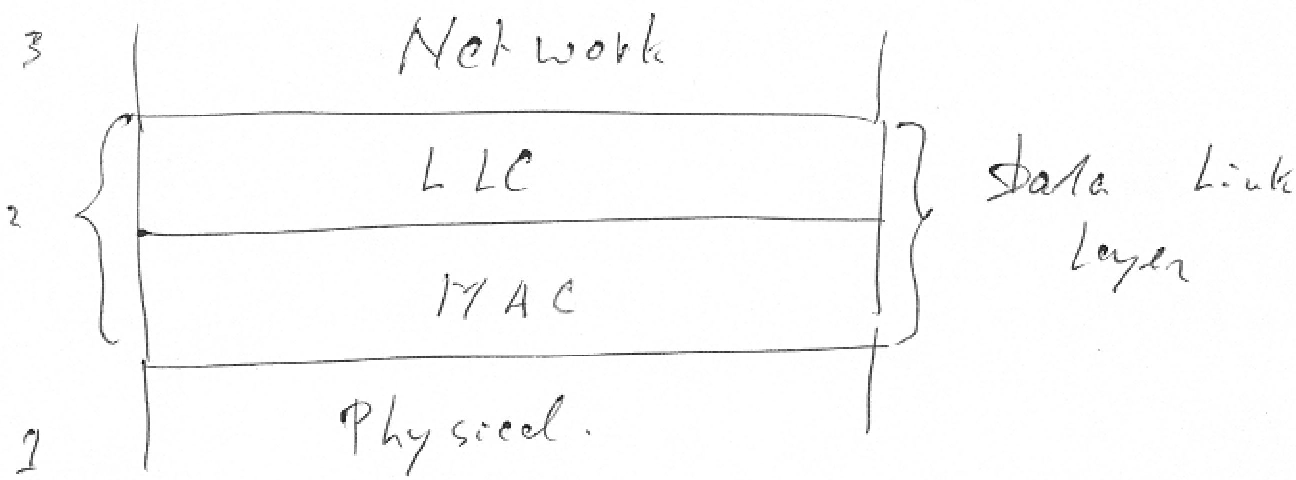
SFD Start Frame Delimiter

10101011

Preamble: used by receiver to synchronize clock.

SFD:
necessary because receiver may not get synchronized immediately, may not know exactly how many ~~bx~~ bits passed.

In 802.3 (ethernet) the
Data Link Layer
consists of <u>two</u> parts:
LLC (Logical Link Control) and
MAC (Medium Access Control).



LLC: receives packet from Network layer + Extra Info.
Makes Data Link Layer Packet. (incl. CRC) & gives it to MAC. (& VV).

MAC: Takes care of the issue that many ethernet cards share (used to share) one medium: the co-axial cable.

to here 09/02/2003.

09/05/2003. (new students: borrow notes!)

See my web page:

http://web.njit.edu/~ott.

Who could not get in? or Tenenbaum's page?

Look at CIS 451 material.

Has changed since last time: Read.

Did everybody do the reading for next week?

How much of what we did Tuesday did you already know?

Book Reading and classnotes do not go in parallel. At the end they will come out close. It is good to see the same stuff twice. Go fast to "project".

I like questions.

Checksums.

First: Parity Bits.

in ASCII, every character is represented by 7 bits.

0 (character zero) = 011 0000

1 (character one) = 011 0001

⋮

A = 1000001

a = 1100001

etc.

$2^7 = 128$ different characters.

---

when ~~stored~~ transmitted often a parity bit is added.

~~ASCII~~ 1 represented as $\underbrace{011\ 0001}$ $\underset{\text{parity}}{1}$

even number of ones.

---

1 bit error: always detected. :

(odd number of bits error: detected.

even number of bits error: Error!).

The parity bit is obtained from the other bits by <u>adding modulo 2</u>

$$\left(\begin{array}{l} 0+0=0 \\ 0+1=1 \\ 1+0=1 \\ 1+1=0 \end{array} \right).$$

The sum of all bits (mod 2) must be zero.

CRC   Cyclic Redundancy Check.

in ethernet: 2 bytes. ~~8~~ 16 bits.

(1) 16 bits <u>computed from</u> the original bits. attached ~~added~~ at end.

(2) Easy check on <u>whole packet</u> to see whether "checksum is correct".

(3) If 1 or a few bits flip:
Test will come out negative. (packet bad) (drop packet). (flips in <u>original</u> data or CRC: does not matter)

(4) If <u>many</u> bits flip:
Chance the test comes out positive is only $\sim 2^{-16} \approx .000015$
(Undetected error).

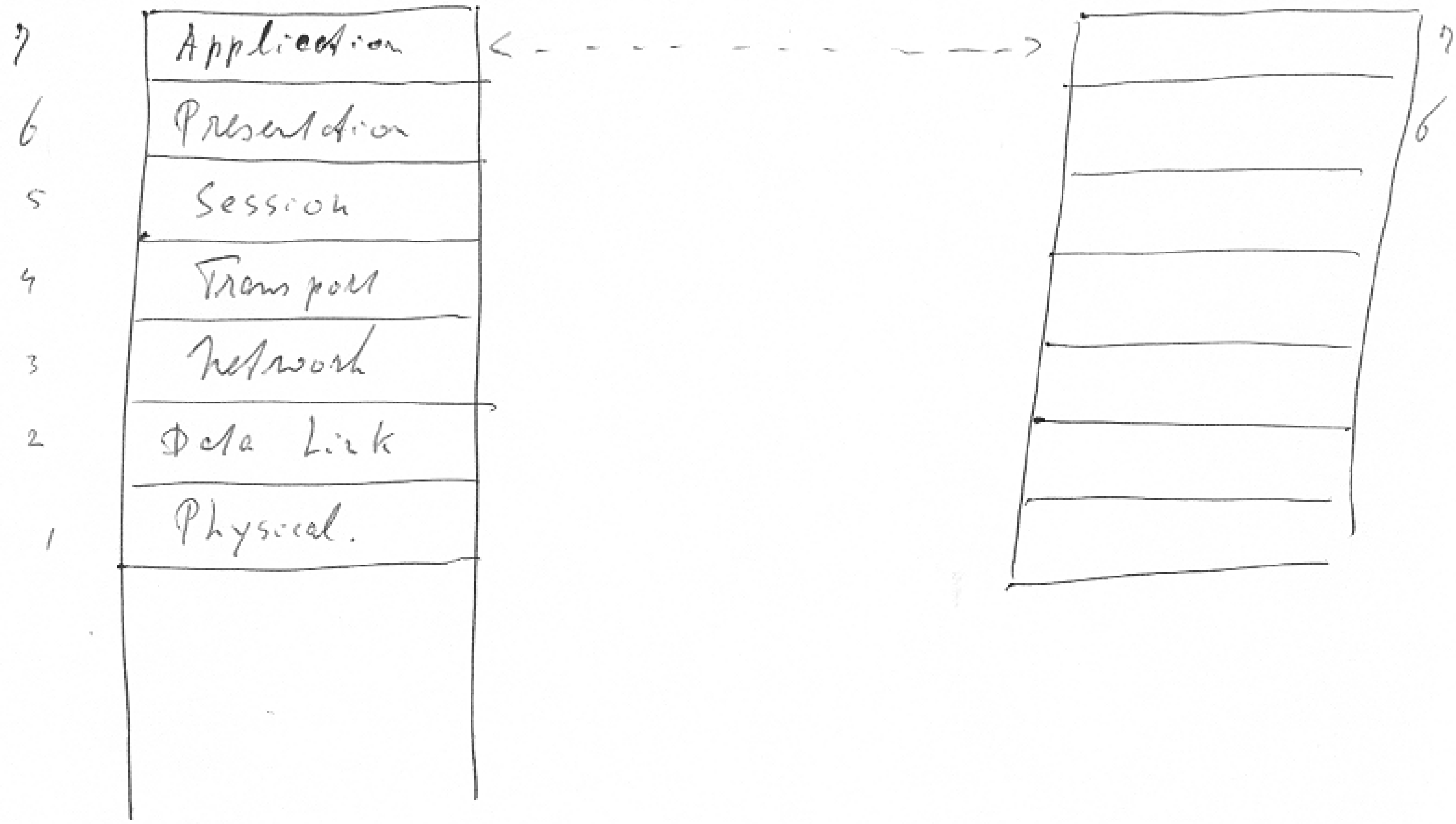
There are <u>several</u> checksum mechanisms.

Ethernet uses CRC
(Cyclic Redundancy Check).

IP, TCP use a different checksum mechanism.

~~CR~~
ethernet CRC: to be handled in a few weeks.

OSI Reference Model.
Tanenbaum, p. 39.



The "real" communication is
"peer layer to peer layer"
7 ⇔ 7
6 ⇔ 6
etc.

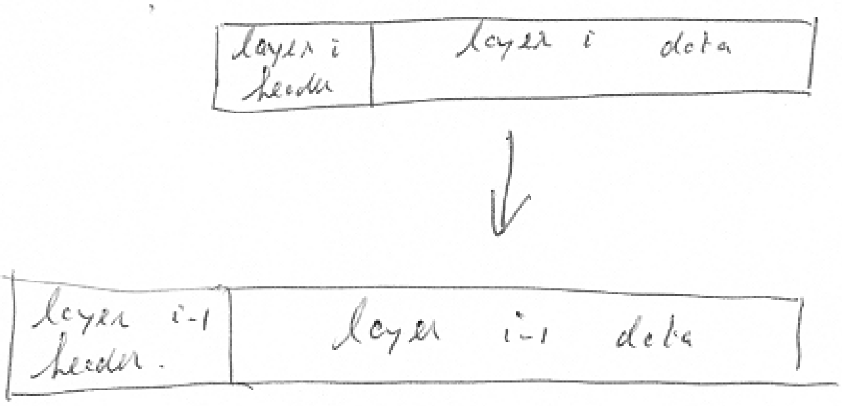
Open Systems Interconnection. OSI

ISO: International Standards Organization
1983, revised 1995.
Very detailed. Museum piece. "Talking Points".

When layer i (of one side) wants to communicate with layer i (other side) it uses the services of layer (i-1).

"Typical":

layer i



(plus a small amount of info

Typically: between layer i and layer i-1 the interface is defined in the standard. Actual implementations of the layers is up to the implementor. !

Result: Modularity.

The OSI stack "never made it".
It is widely used as "conceptual model",
but hardly anywhere or nowhere used as ~~as~~ defined
in the standards

IP stack

For example: http

5	Application			CIS 456
4	Transport TCP	(UDP)	TCP/IP.	
3	Network IP			
2	Link layer	(many: ethernet, PPP, ...)		CIS 451
1	Physical.	(many).		

~ 1988: US Government announced:
"we will use OSI".
Did not mean it.

Other Data Link Layers:
(with corresponding different physical layer):

~~Etc~~
PPP Point-to-Point.

Used by modems.

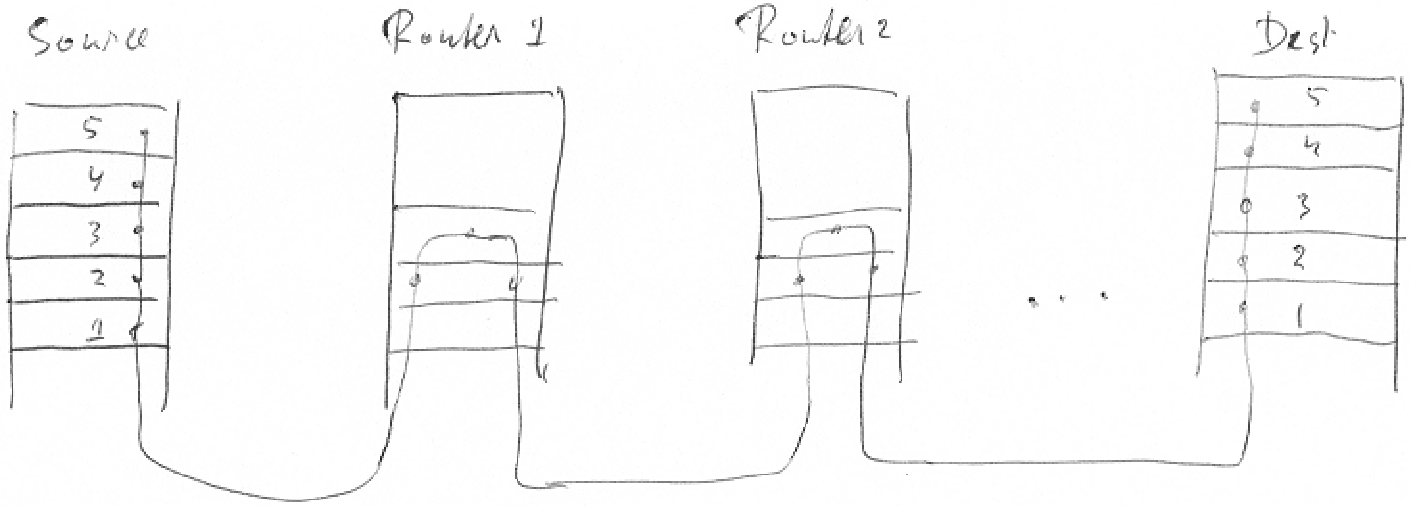
(Two ports only).

802.3 ethernet. ←

802.11 Wireless LAN ~~(different~~
802.16 Wireless MAN, Wireless Local Loop.

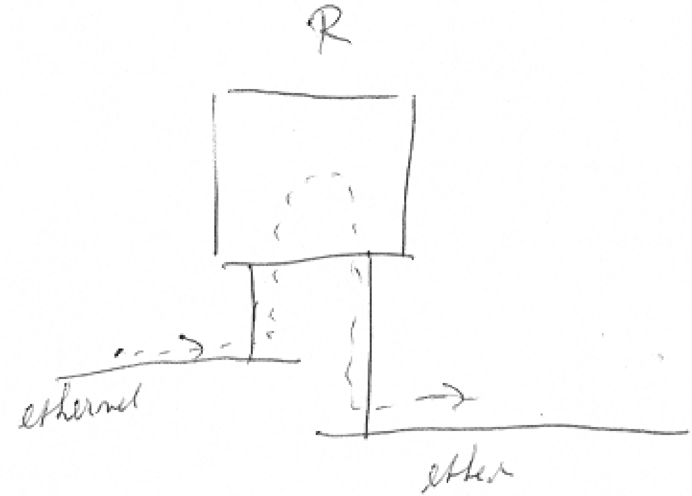
and many more.

These are IEEE standards.



~~D~~ Possibly different
Link Layers!

Even if same
Link Layer:
Almost certainly
different ~~source~~
physical source,
dest,
addresses.



Two different ethernet addresses

This course (CIS 451)

mostly physical layer
link layer,
some more stuff.

CIS 456: layers 4, 5, some higher.

~~(IP~~

(IP, TCP, UDP, ARP, RARP, ~~BooTp~~, BOOTP, DHCP, DNS, ...).

CIS 408: Cryptography and Security.

Did anyone ever use https ?
(secure http).

Fri 09/05/2003
ended here.