

M Term

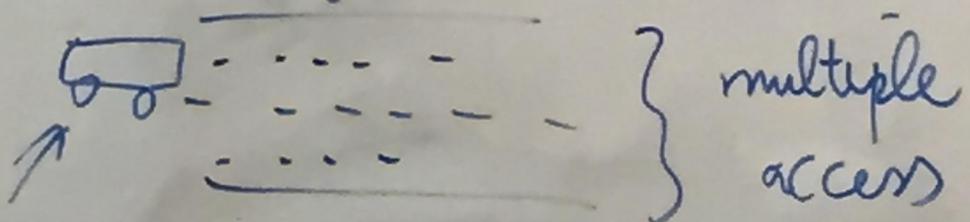
Feb. 16 : 5:30 pm - 7 pm

Rm : TBD

-
- Board notes & photos
-

Transportation systems

"physical channels = roads"



{ vehicles
types = { communication
objects

M Term

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Transportation systems

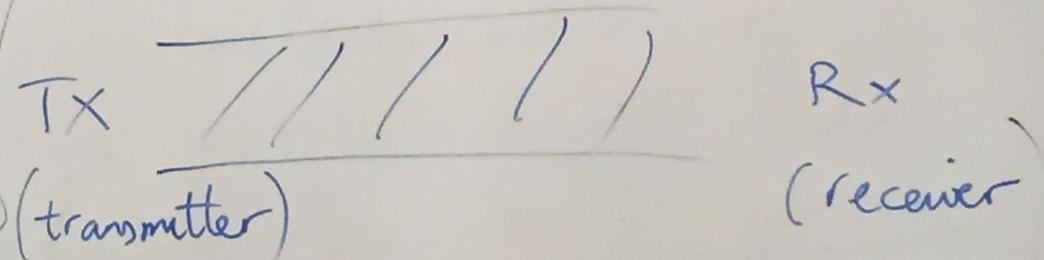
"physical channels = roads"



{ vehicles
types = communication objects

- protocols & rules (traffic lights)

→ focus of c. 1 - 3



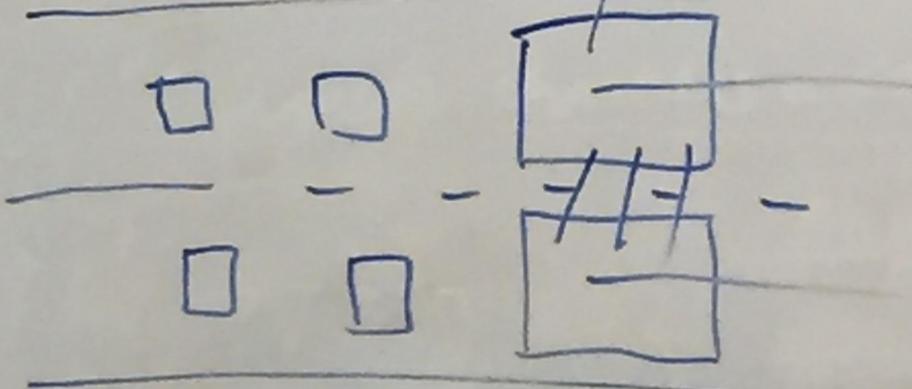
$$= \sum_{i=1}^N x_i$$

N-user

multiple access

(QoS)
quality of service

speed & size
of vehicle



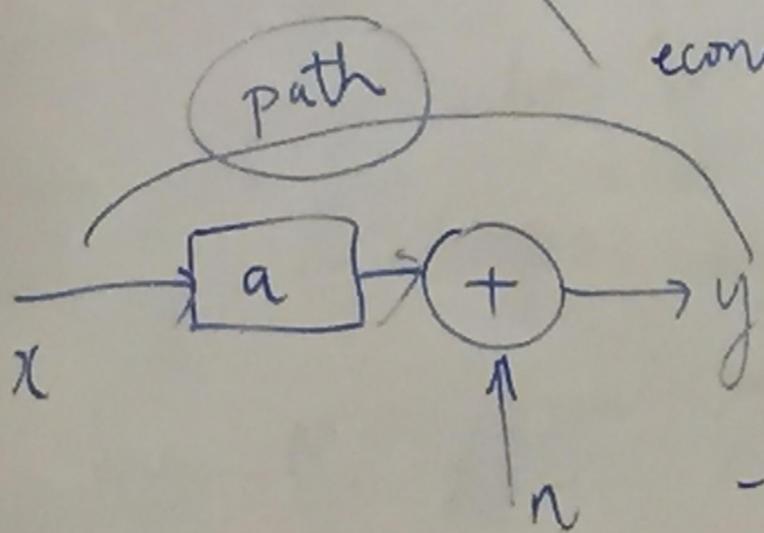
Media = "roads"

- type of signals

- bandwidth

- quality of service

- cost



$R_x \downarrow T_x \downarrow$

$$\rightarrow y = x + n$$

Gaussian noise

noise

interference

attenuation

computational

economic

$R_x \downarrow$ channel $T_x \downarrow$

$$y = a x$$

equilizer

(inverse system)

$$= a x + n$$

- time-varying
 $a(t)$

$$\hat{x} \rightarrow h_{inv}$$

minimize
 $\approx x + \text{error}$

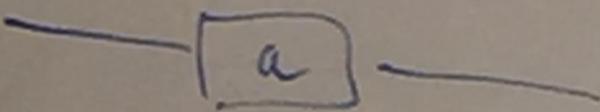
Medium = copper wire

"what hath God wrought"

DSL vs telegraph

· — } (Morse code)
— - - - } same road
— } system

Coaxial



(than)

wave system

$a < 1$
attenuation

increase a

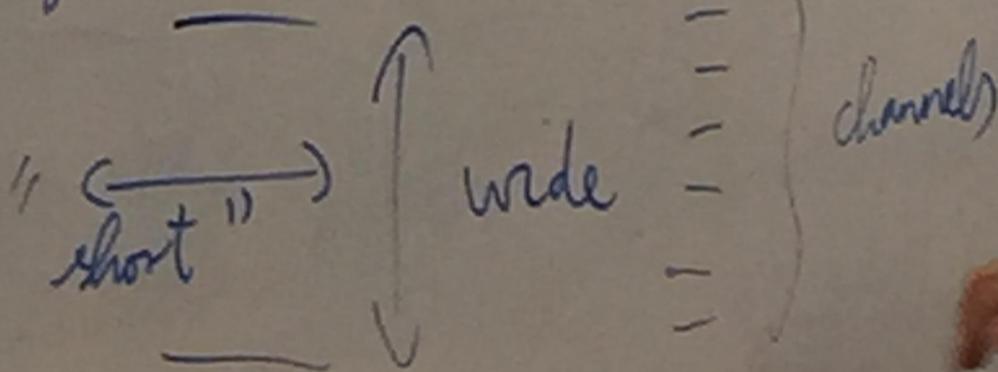
$$\approx \frac{1}{a} > 1$$

amplification



change media

e.g. conductive shield



Rx ↓
→ y
equal
(wave

A \rightarrow h

Medium = copper wire

"

what hath God

wrought "

DSL vs telegraph

(orthogonal frequency division multiplexing) -) (Morse code)

- - - -

{ Same road system

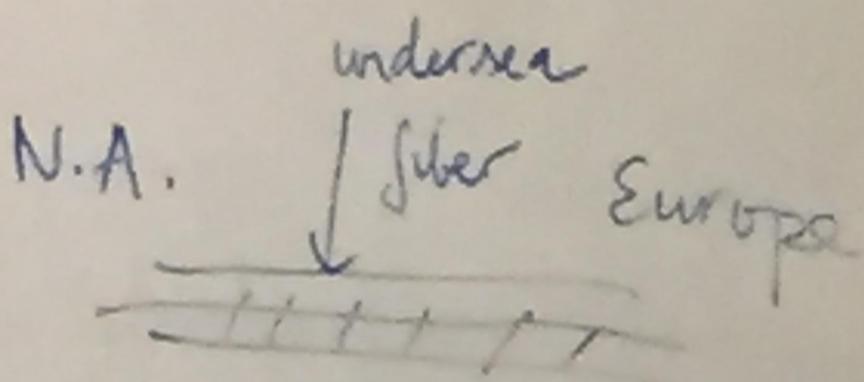
OFDM

↳ "newer" format

(Sasktel)

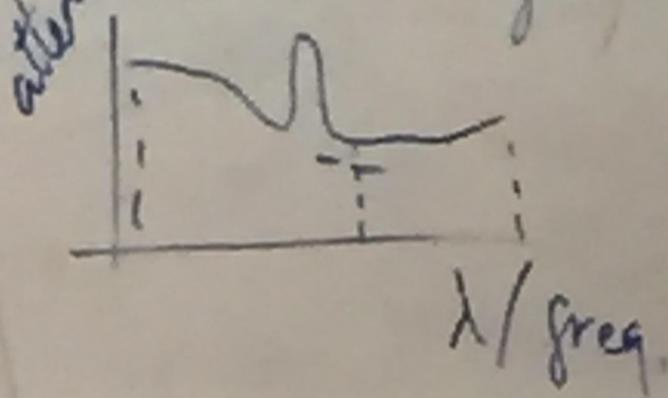
Fiber (Sasktel)

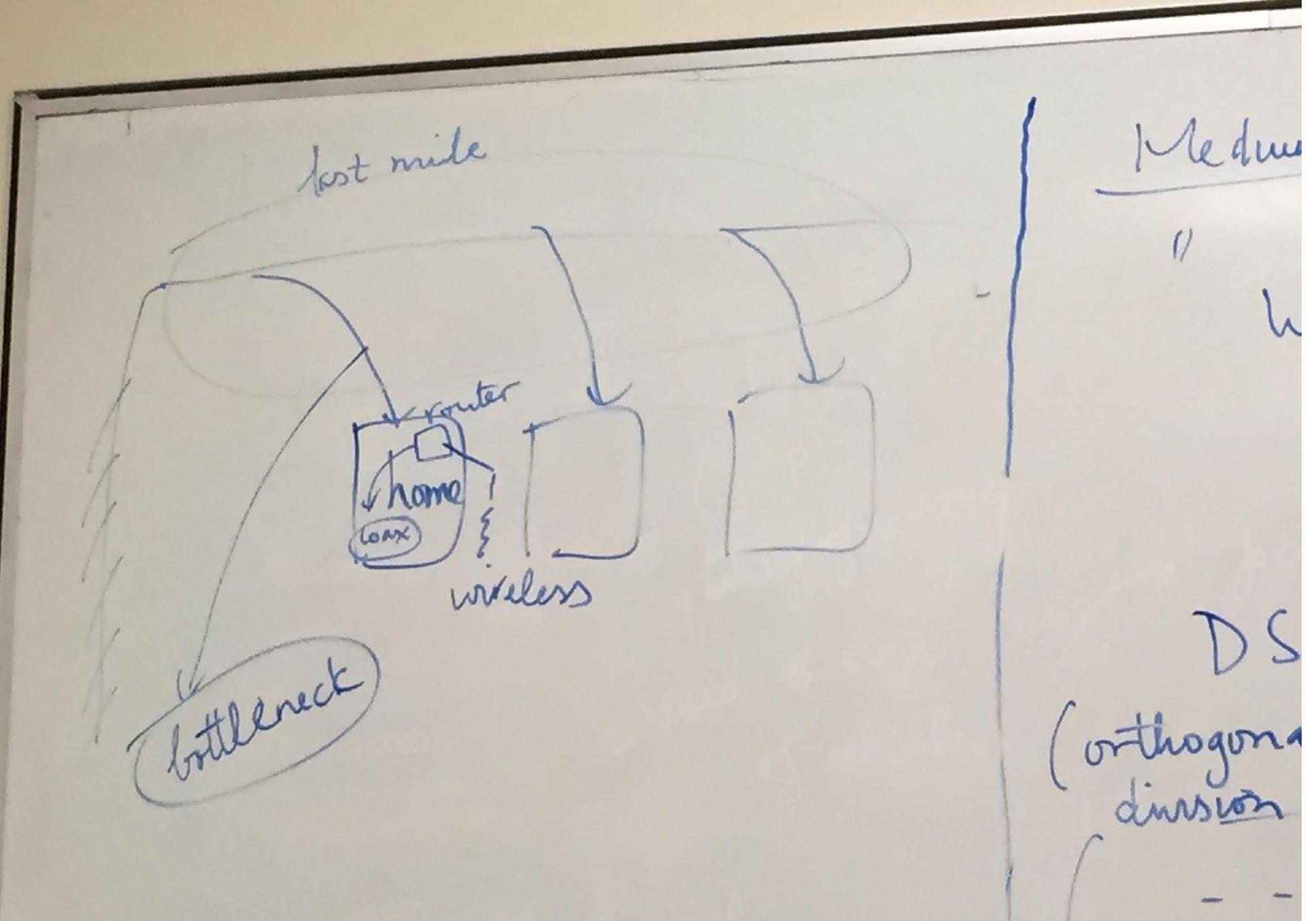
- light (optical)

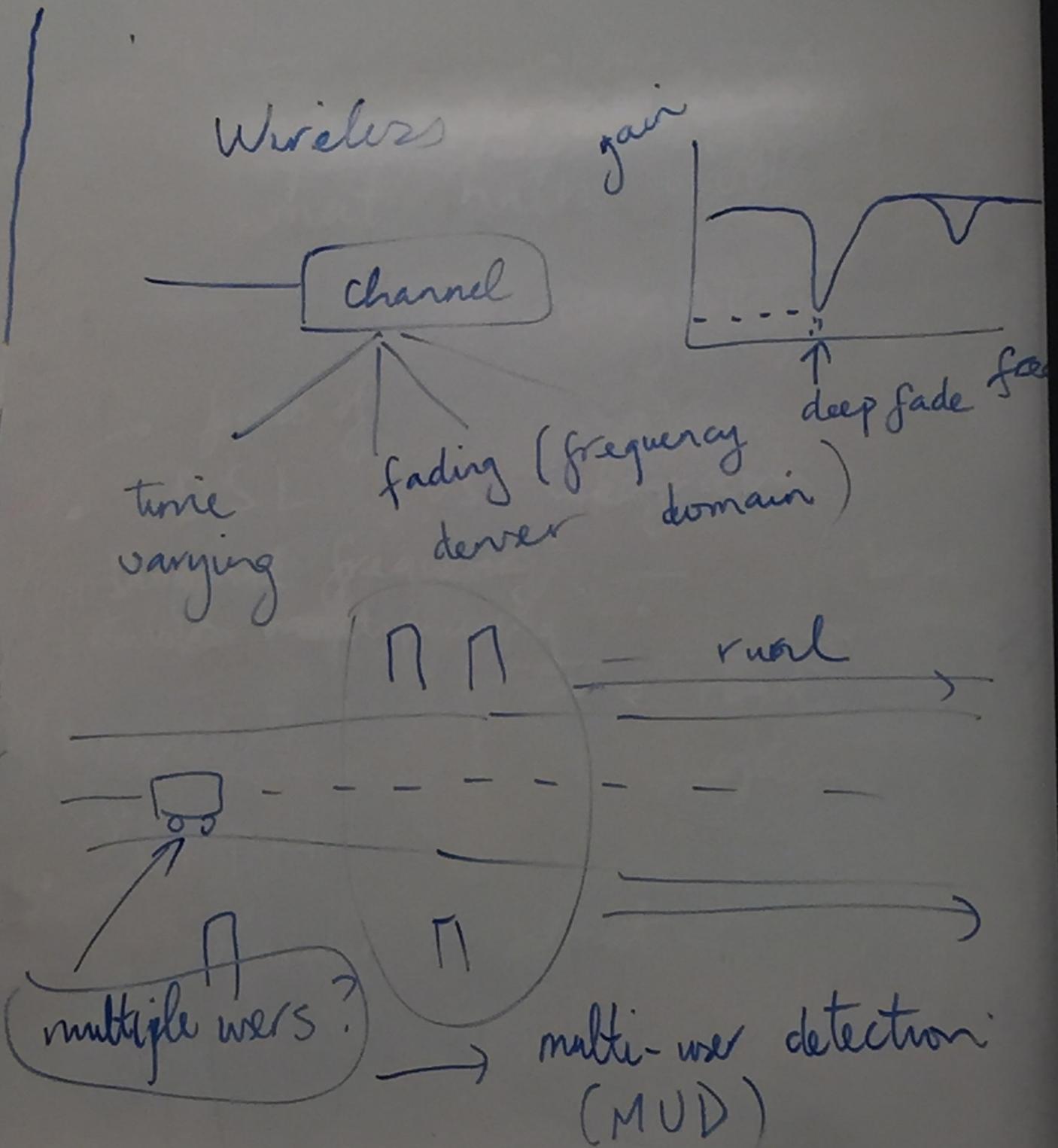


attenuation? ~ 0.2 dB/km

(on average)







Other "media" & protocols

- powerline communication

↓
electrical wiring

~60Hz (N.A)
interference 50Hz (Europe)

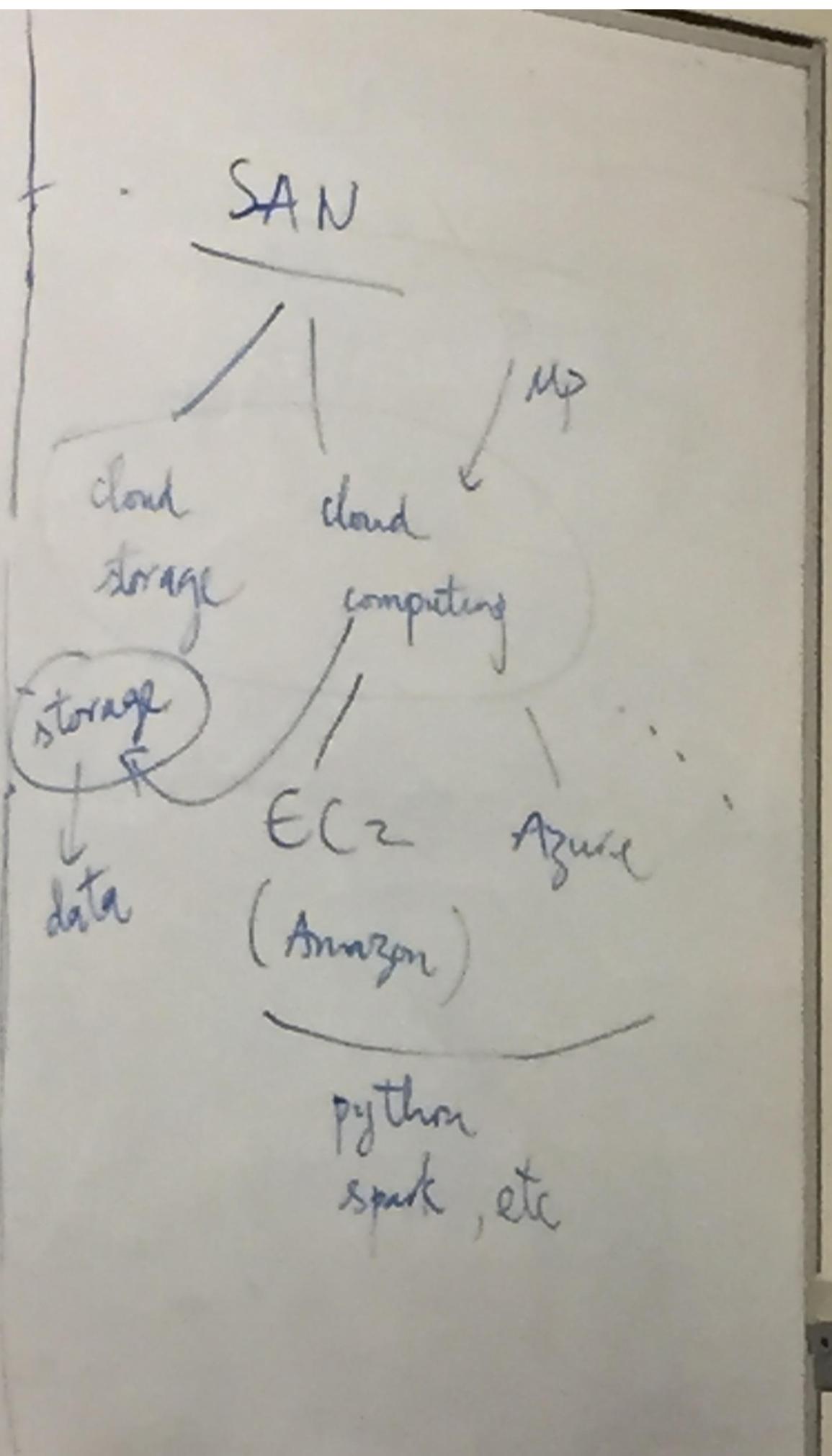
- wireless

RF
BT
WIFI

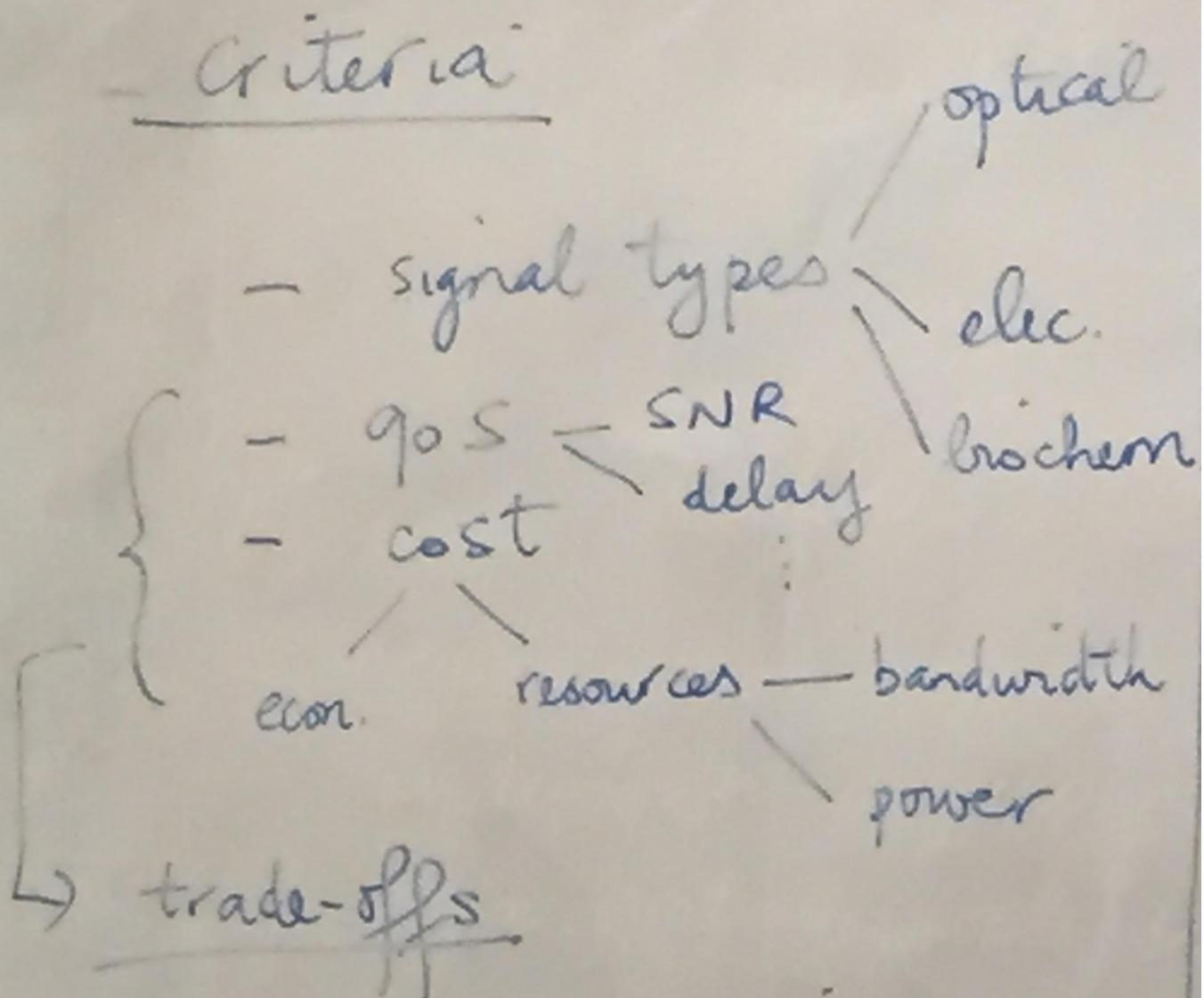
optical
— Infrared

Visible light
comm.
(VLC)

- nano-cell — biochemical communications



Summary of last lecture



- optimization prob.: minimize
resource consumption while providing QoS

- Copper wire (UTP)

simple
binary
coding

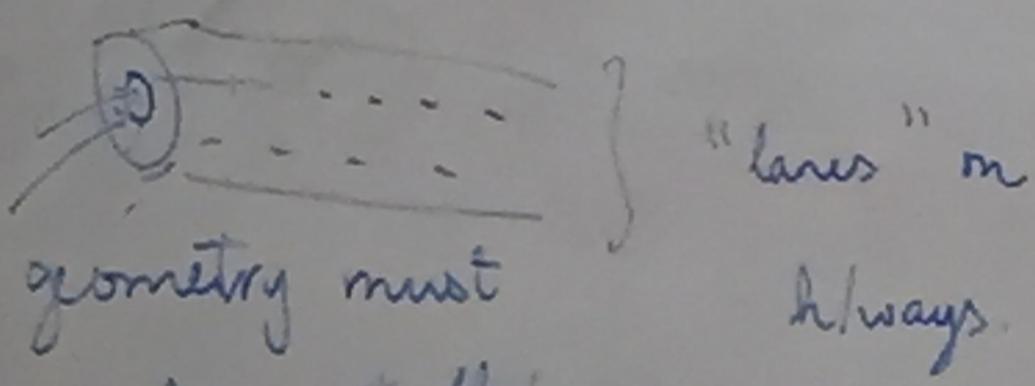
vs

OFDM
(FFT)

↓↓↓ resource consumption
& robustness.

- coaxial cable

Cable labs → OFDM
(vacuum)



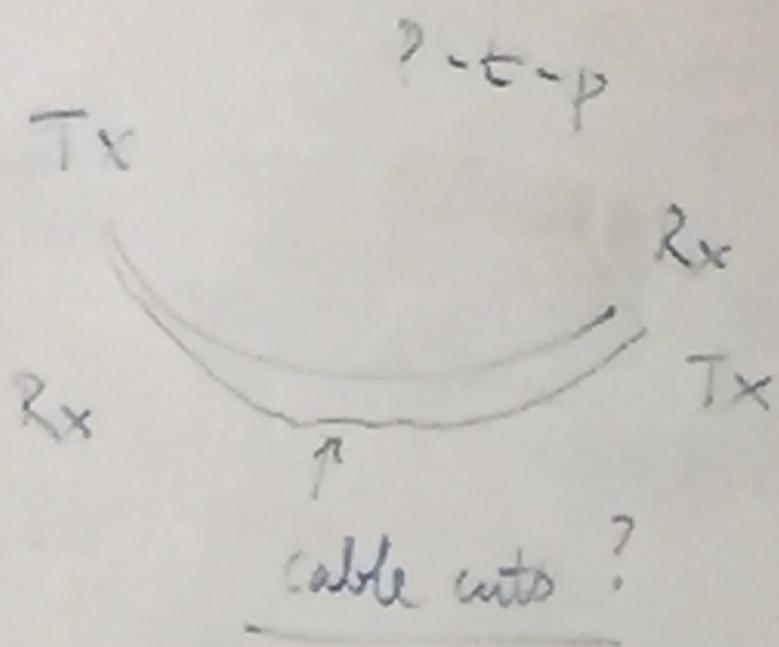
geometry must
be controlled
in manufacturing
organization

O. Fiber network

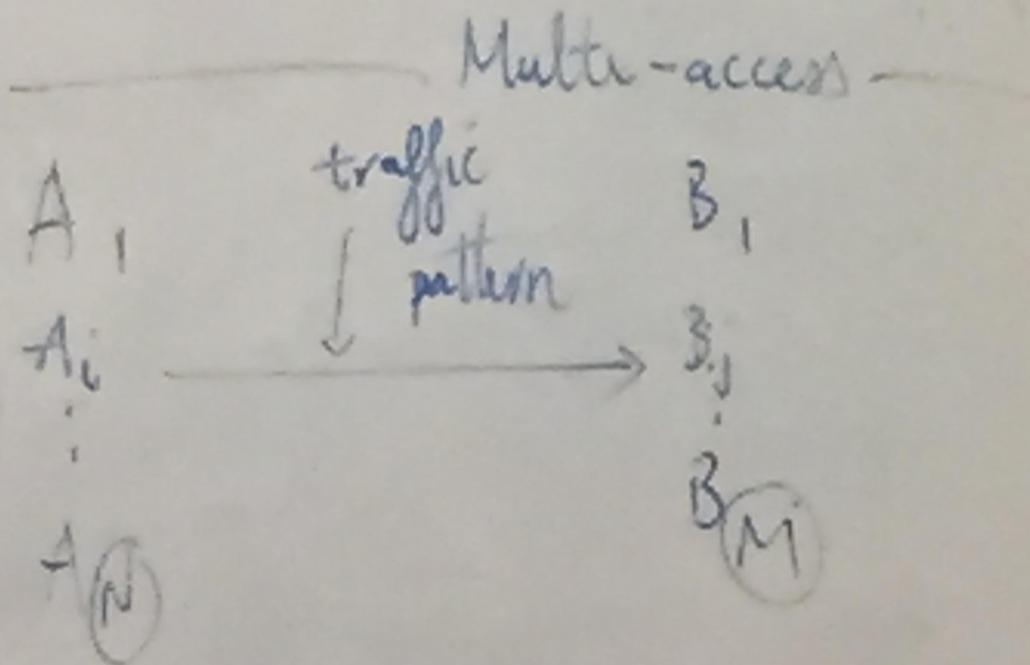
N.A.

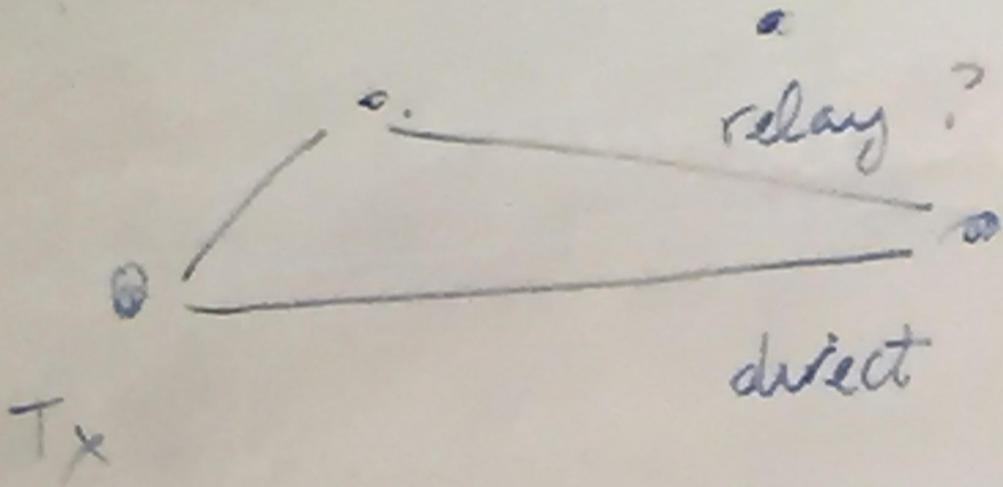
protected
physically

Europe



- duplex vs half-duplex





shortest path?

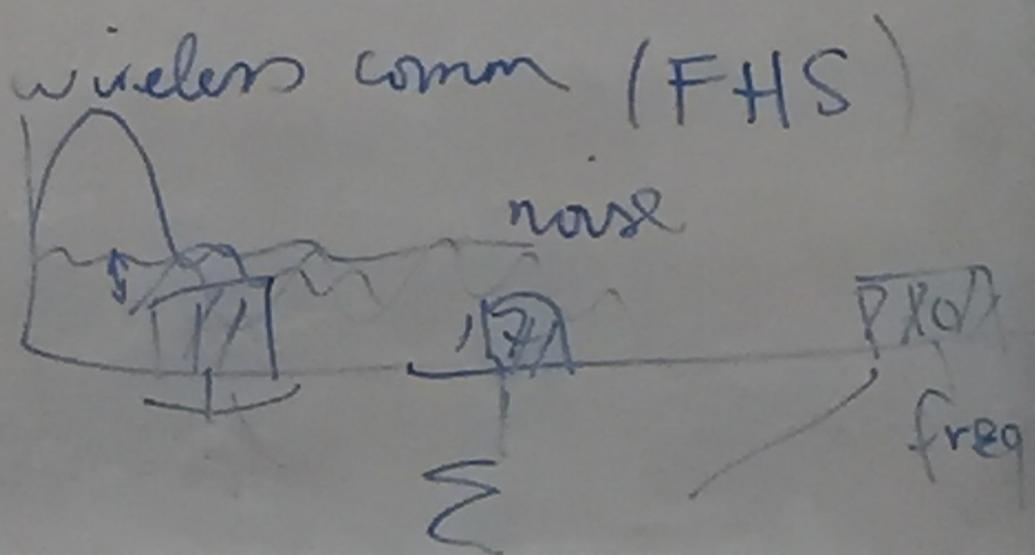
temporal \approx geographical

$$\begin{aligned} & \overline{1\text{km}} \\ & \sim 0.2\text{dB/km} \end{aligned}$$

Connection & Topology

- scalability : 10 vs 1M users?
- reliable : cable cuts ?

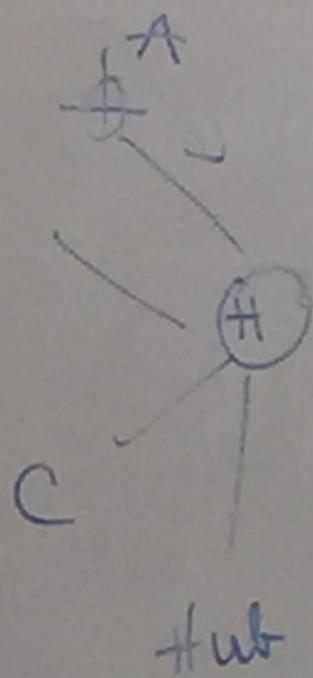
CDMA



(a)

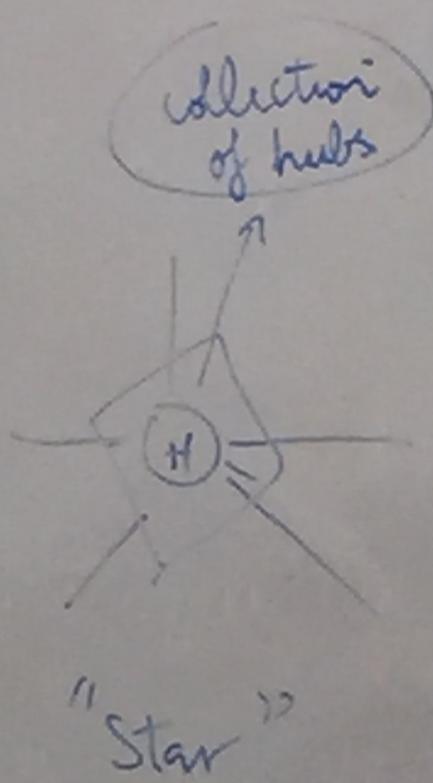
T_x — R_x

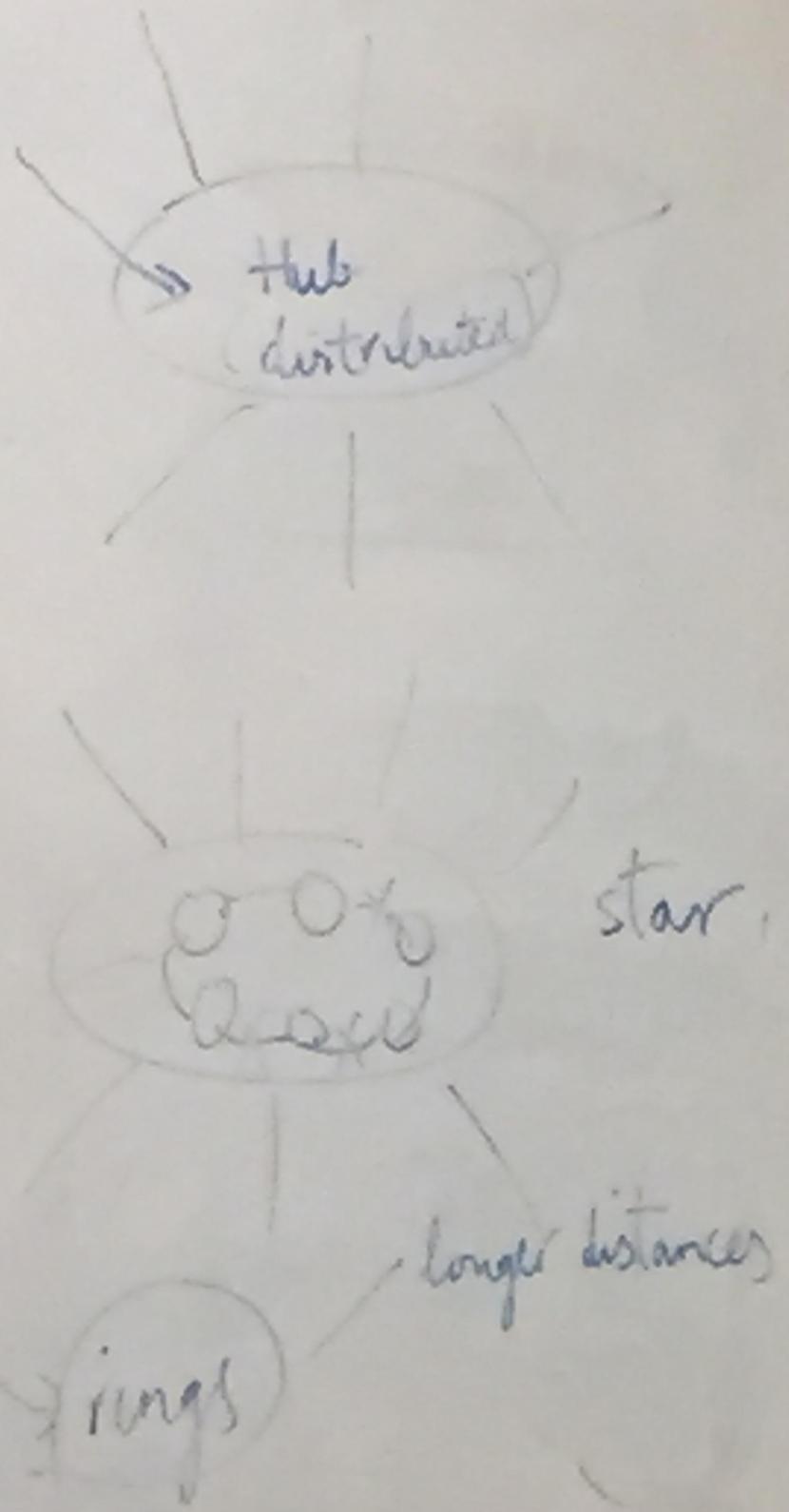
(b).

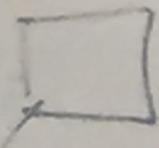
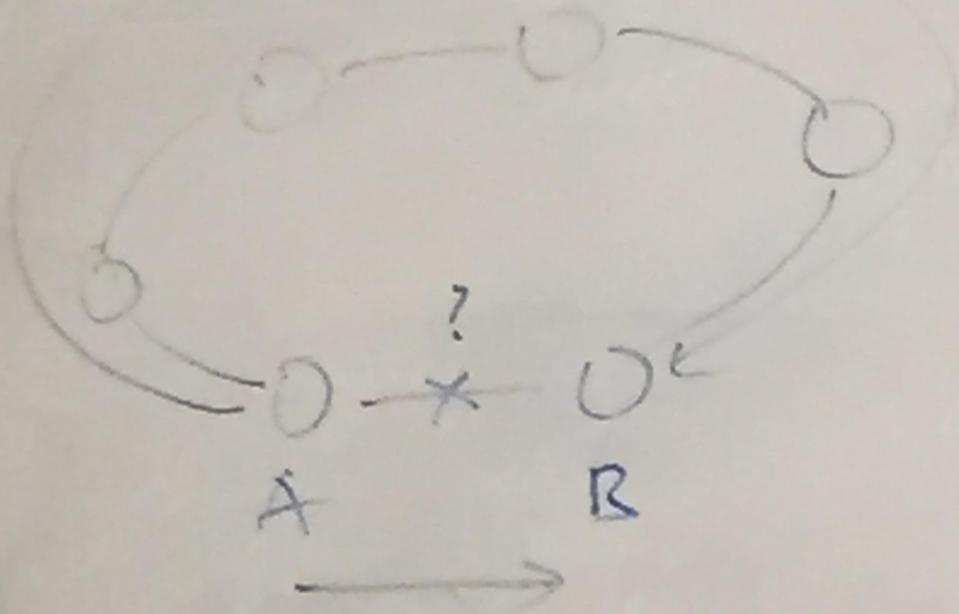


Hierarchy

↳ OSI protocol



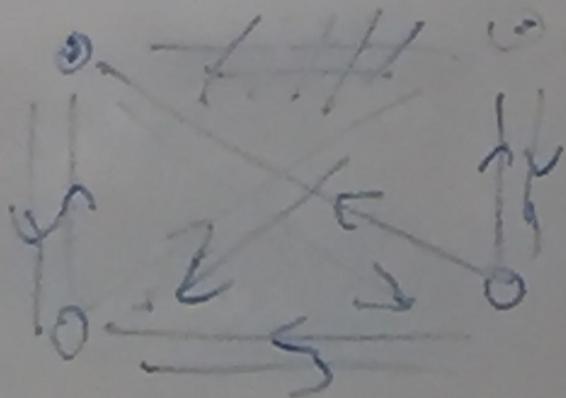




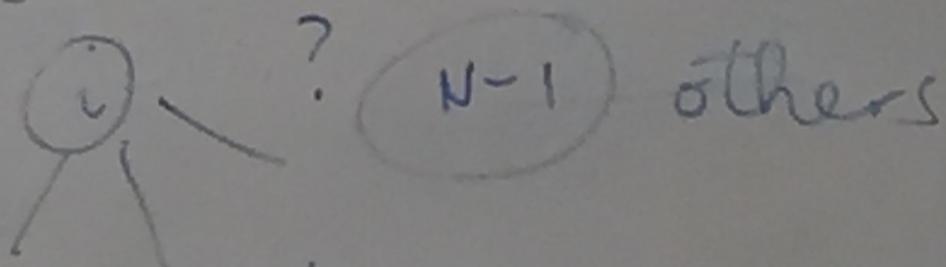
- "package" data) different layers
- routing

The

N nodes?



each



There are N users

$$2 \times N(N-1) \approx O(N^2)$$

↑
duplex

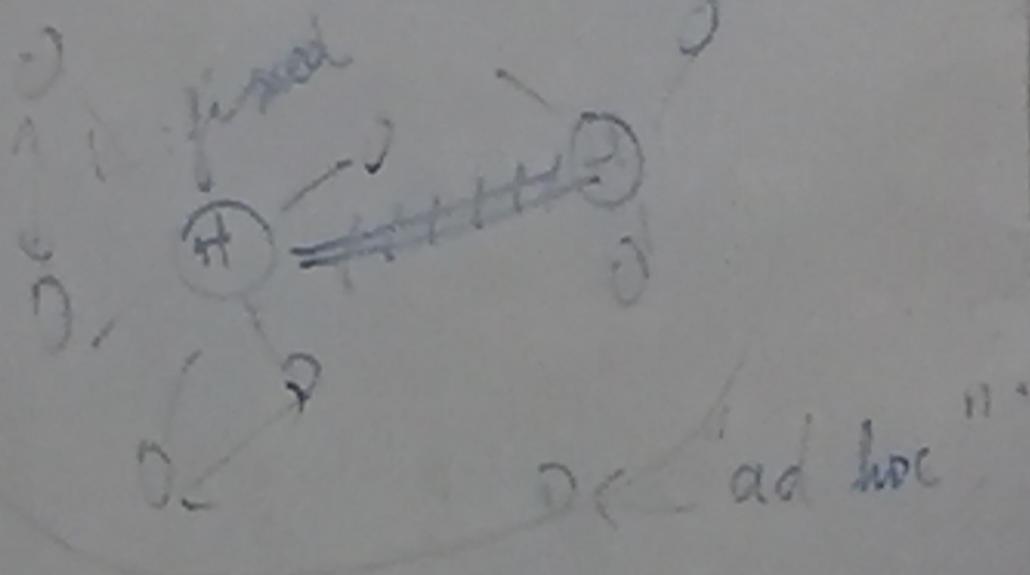
Relay vs. wired links?

wireless sensor networks



cyber physical system

environmental
network



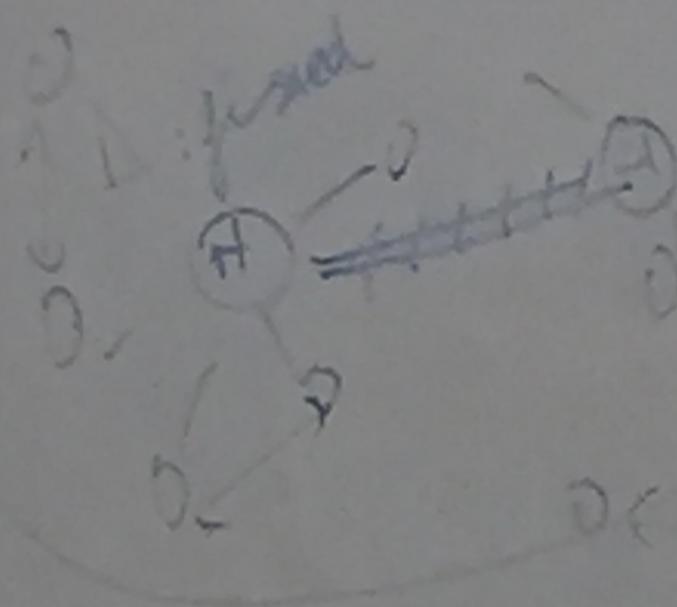
Relay vs wired links?

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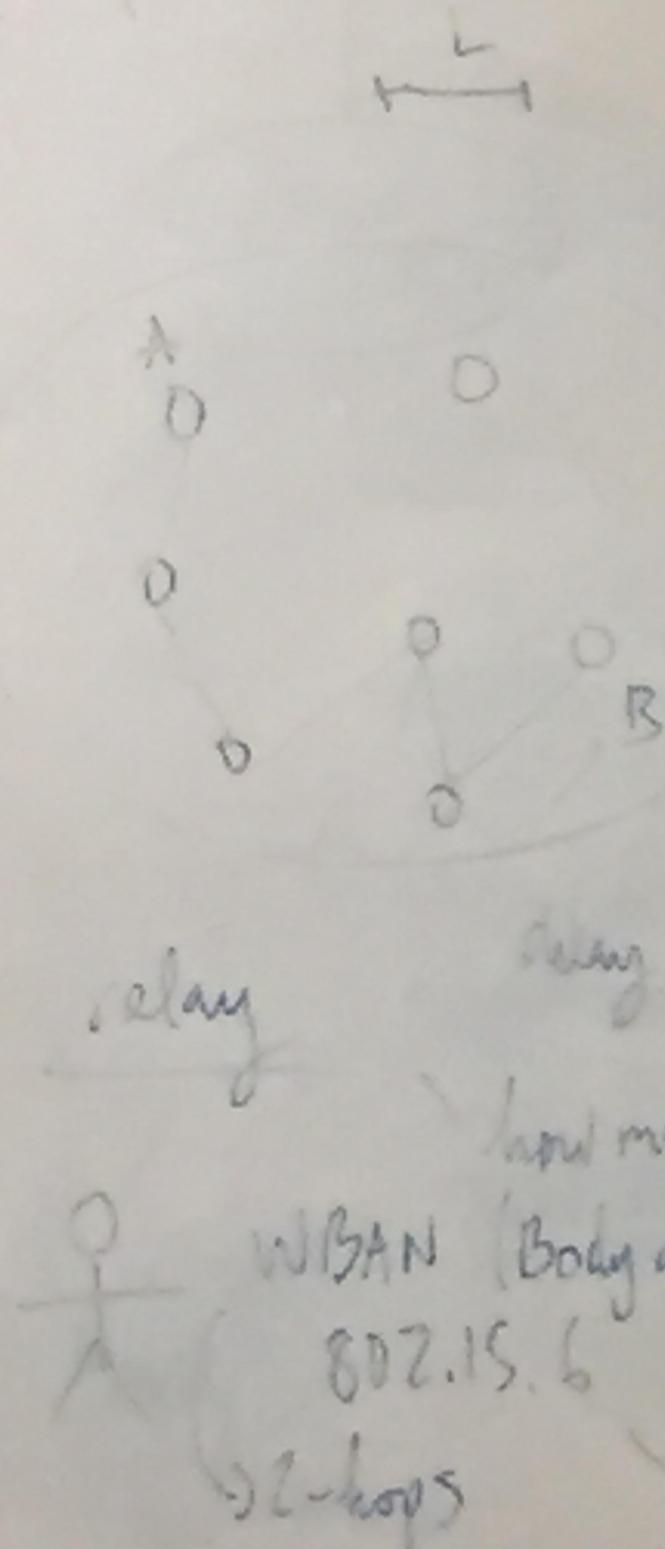


cyber physical systems

environmental
network



ad hoc



delay

delay

how many?

WBAN (Body area network)

802.15.6

2-hops

relay

七

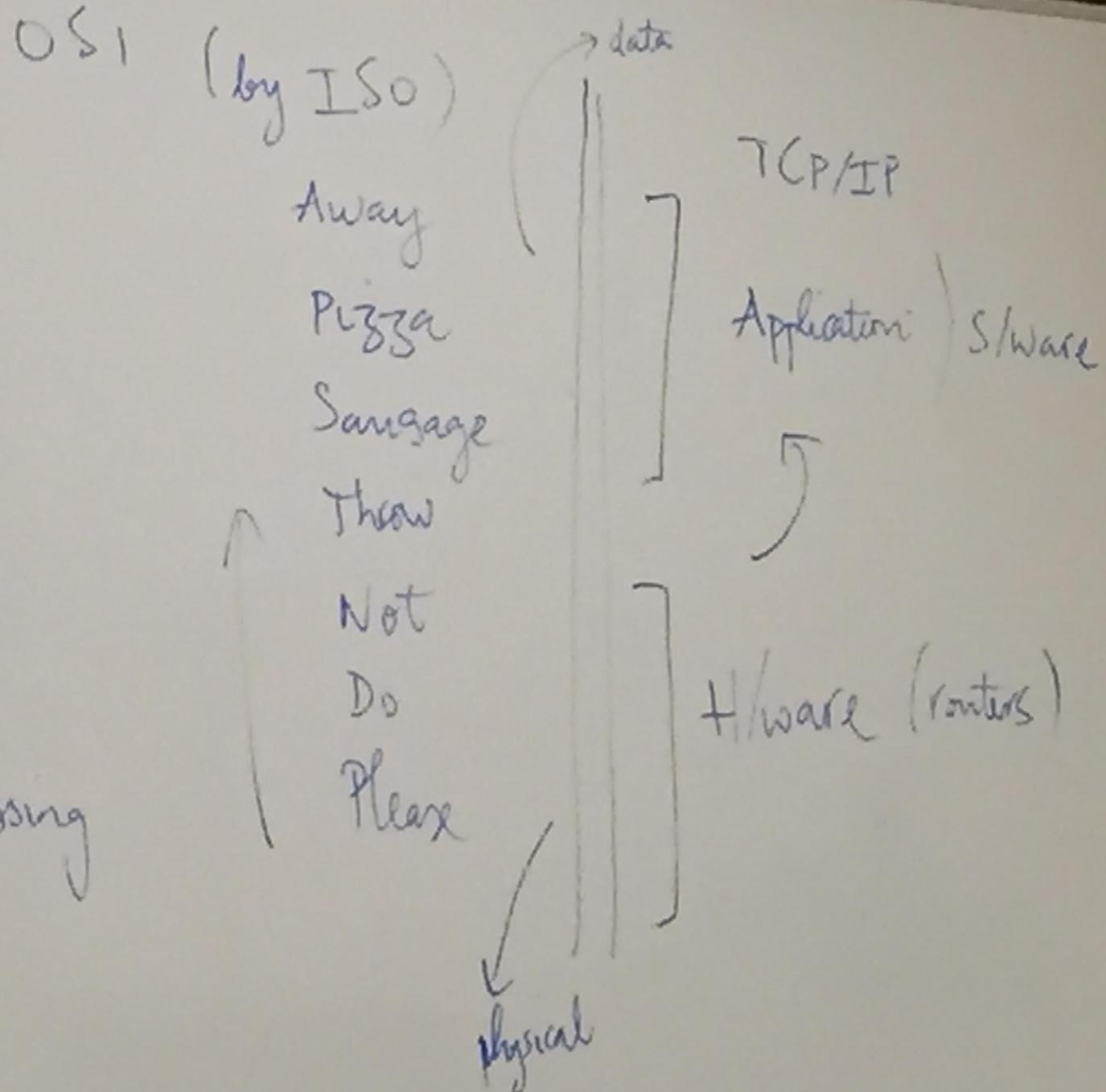
How many?

WBAN (Body area networks)

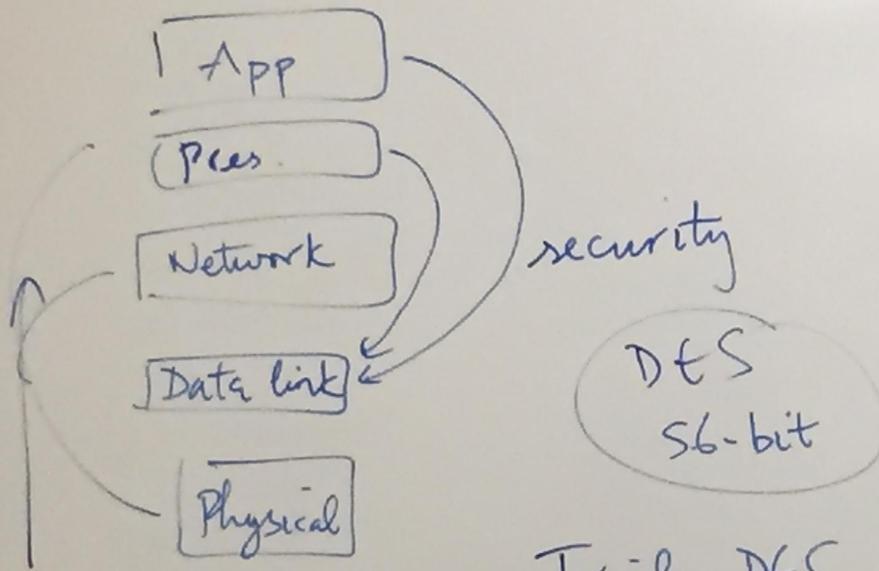
802.15.6

32-1005

All
People
Seem
To
Need
Data
Processing



Cross-layer design



security

DTS
56-bit

Triple-DTS

~
Quantum computing

very large primes

$$P_1 * P_2 = P$$

Broadcast

