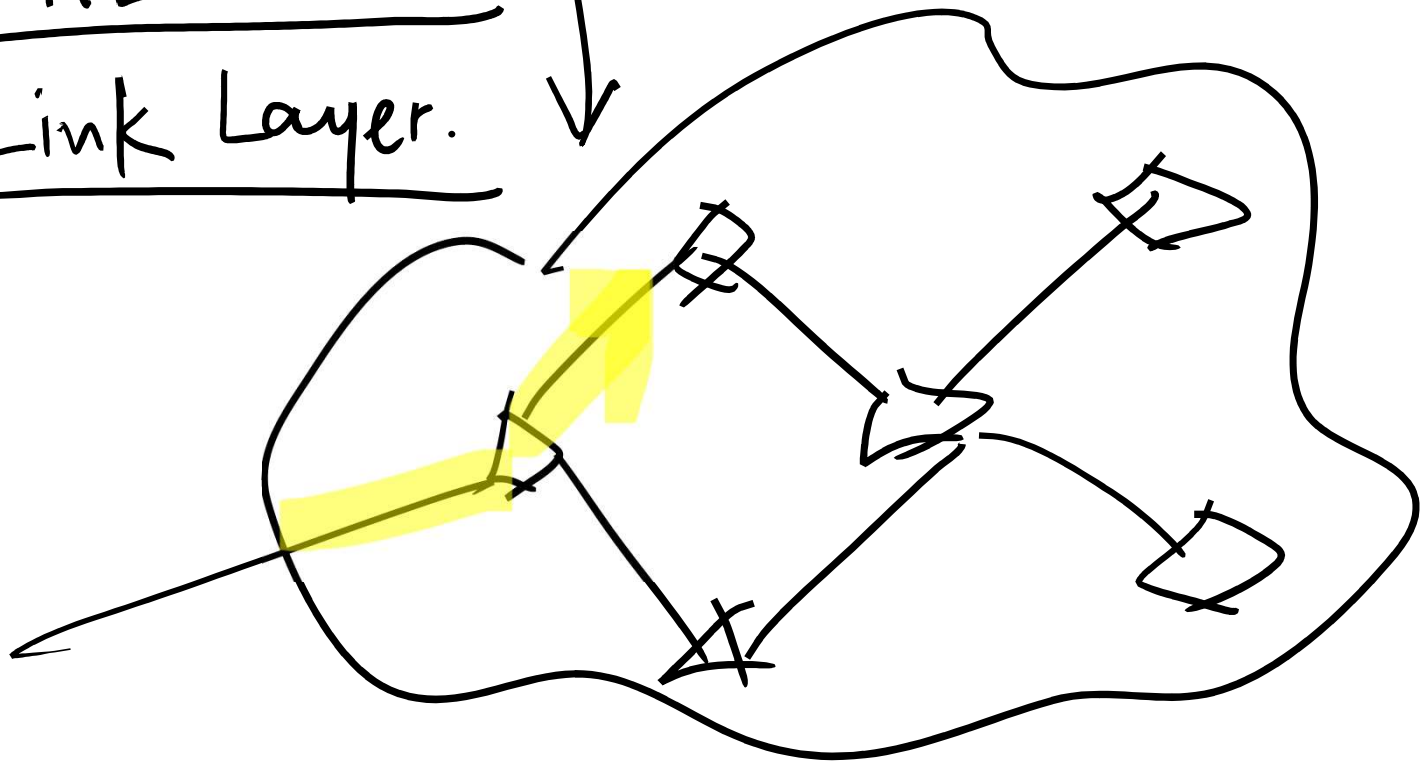
Appl Layer

TL

NL

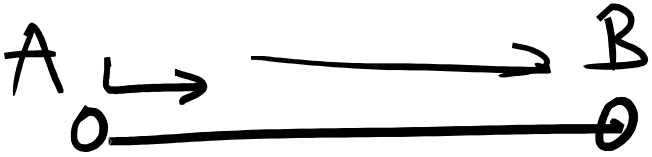
Link Layer.



Link. — wifi (wireless) link

— (wired) link

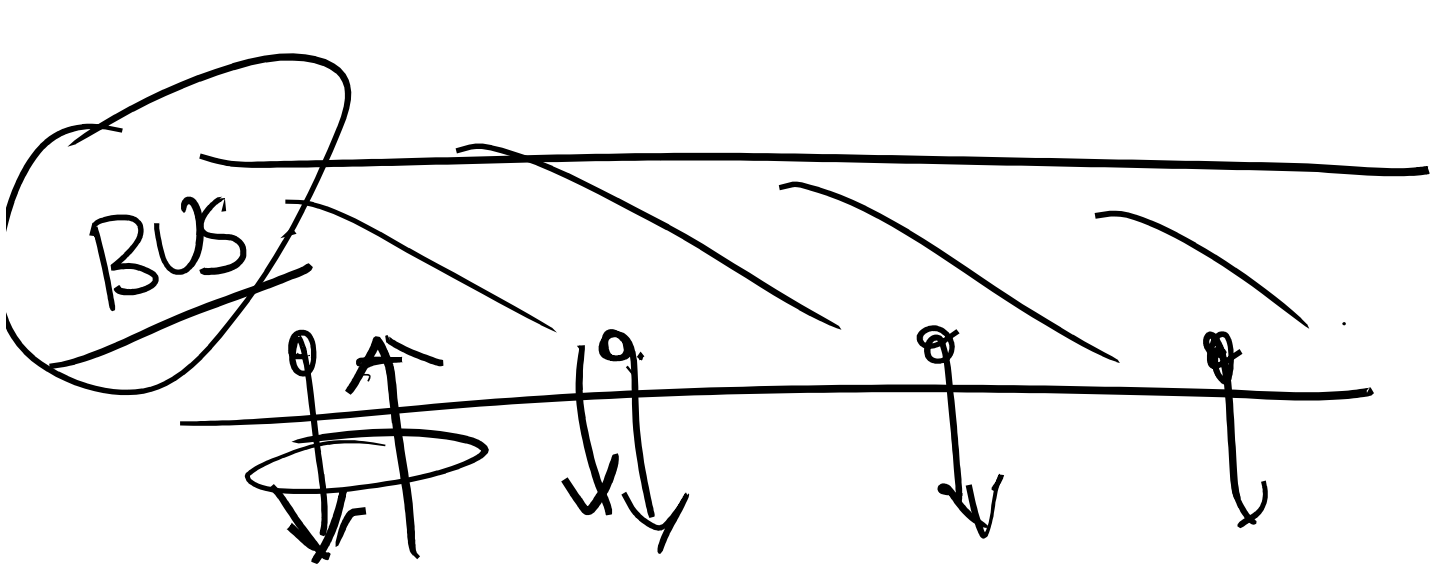
- point to point



- shared link.

signal → packet.

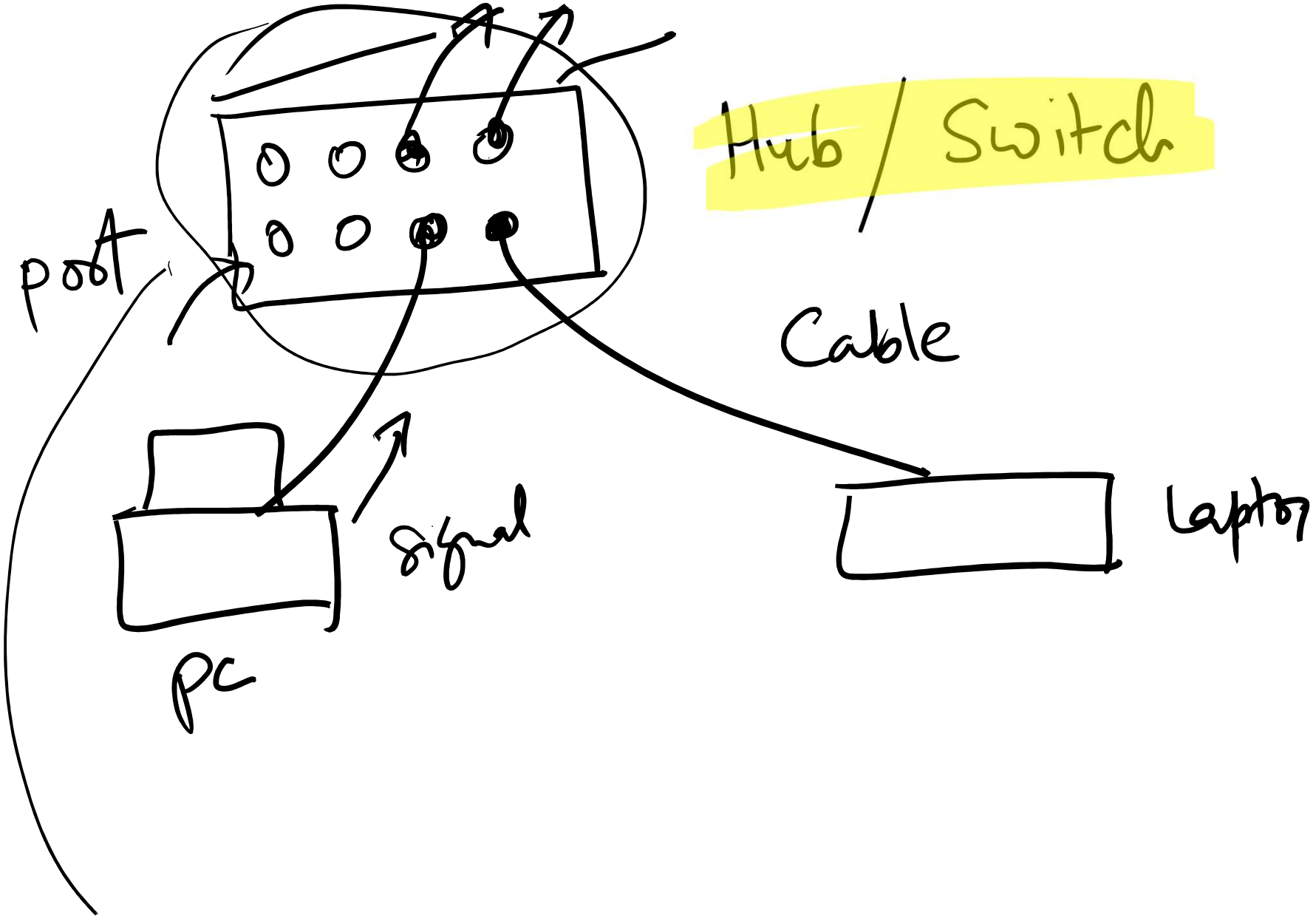
wireless. wifi 2.4GHz band

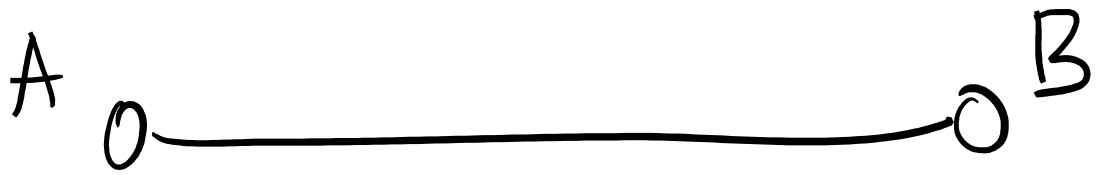


Wired
Sharing
Medium

Toys

BUS: Common channel to all
data signal goes


Hub / Switch
port
Cable
signal
laptop
pc



data (Msg) : "This is Comp. Networks Class"

Coding scheme: ASCII Codes.

Msg → binary number seq.

1010 1 — . —

Medium

Copper Cable

Air

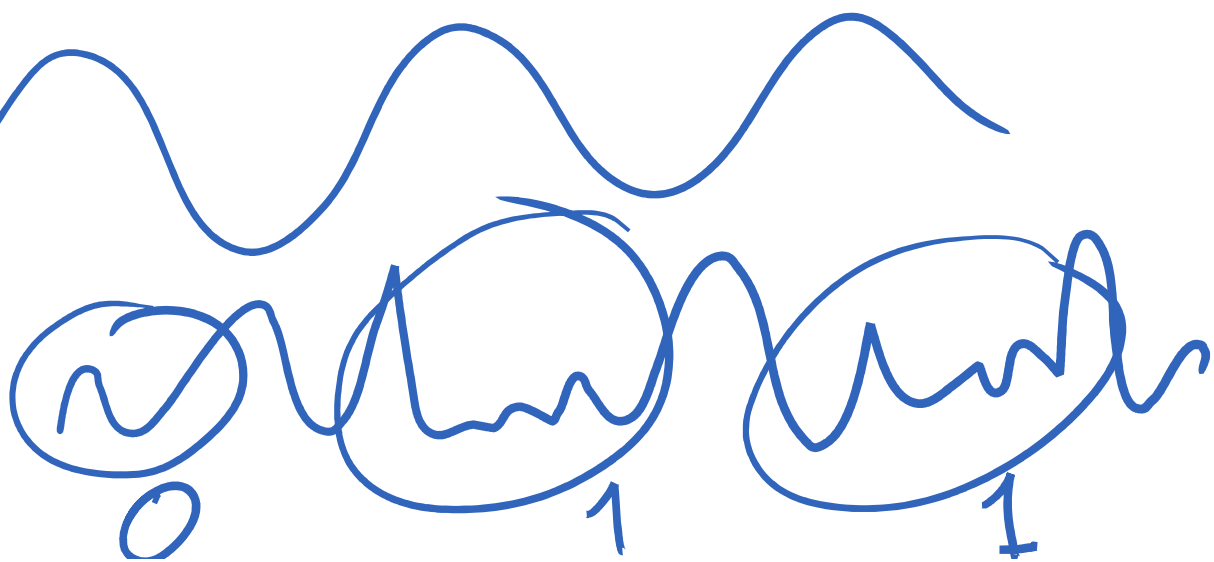
Space (EM Wave)

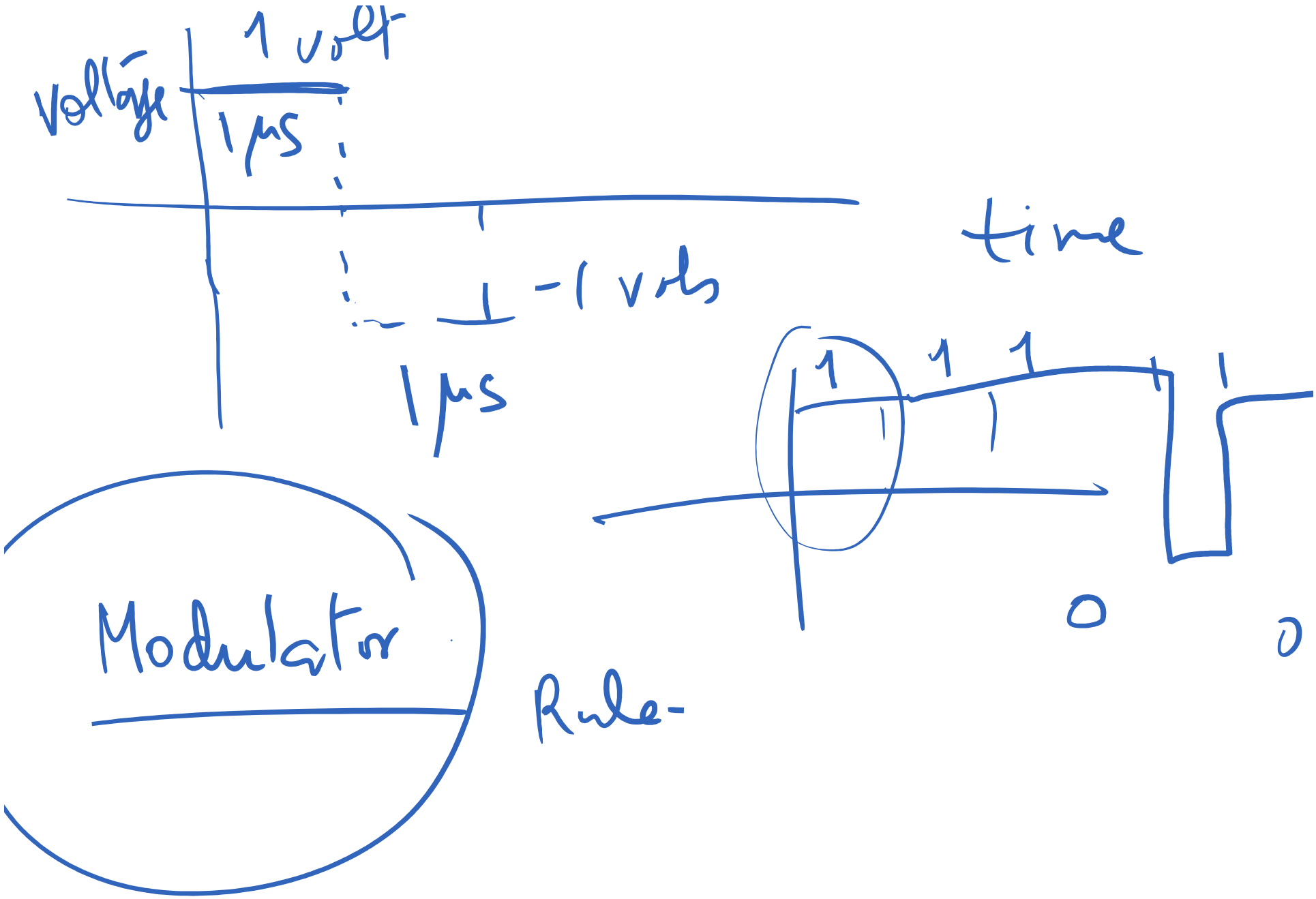
Fiber Optic Cable

Signals: "modified" Waves"

→ Coding

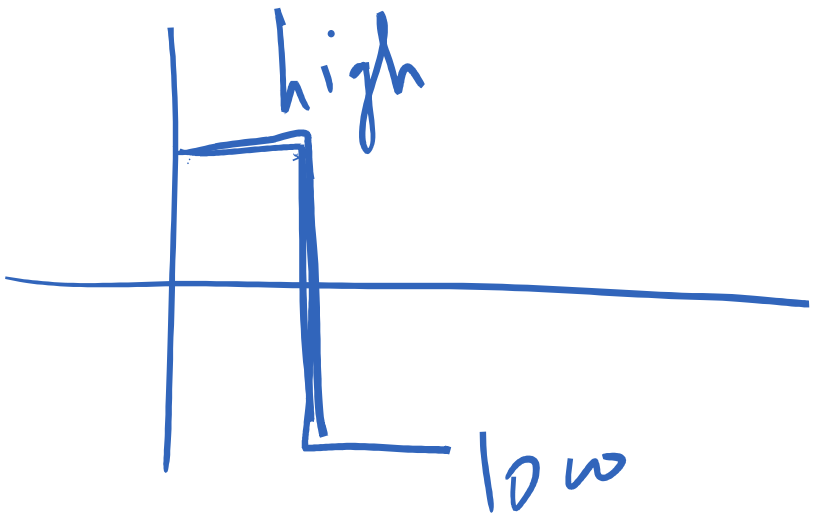
"Modulation"




1 volt
Voltage
1 μs
-1 volt
1 μs
time
1
1
1
1
0
0
Modulator
Rule-

LAN Ethernet

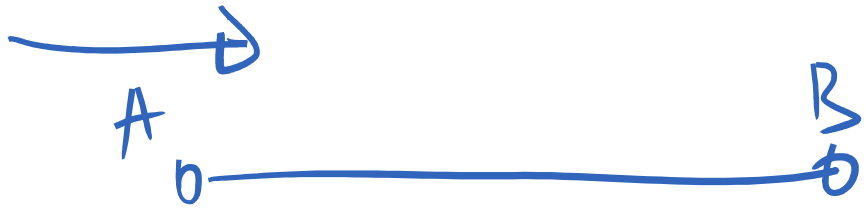
Manchester Encoding



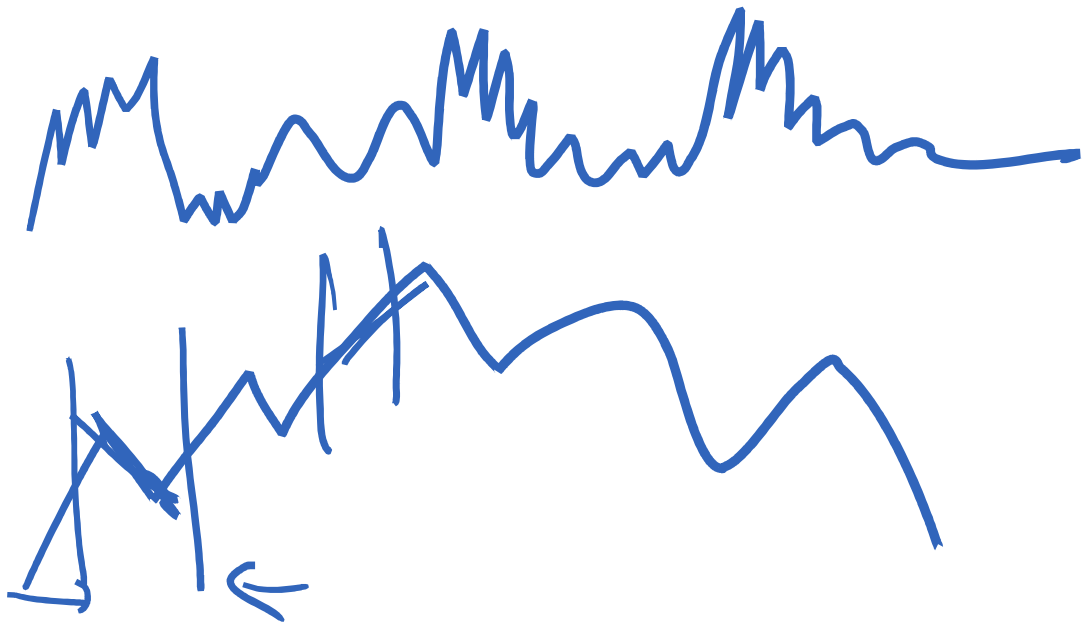
hi-lo trans → 1

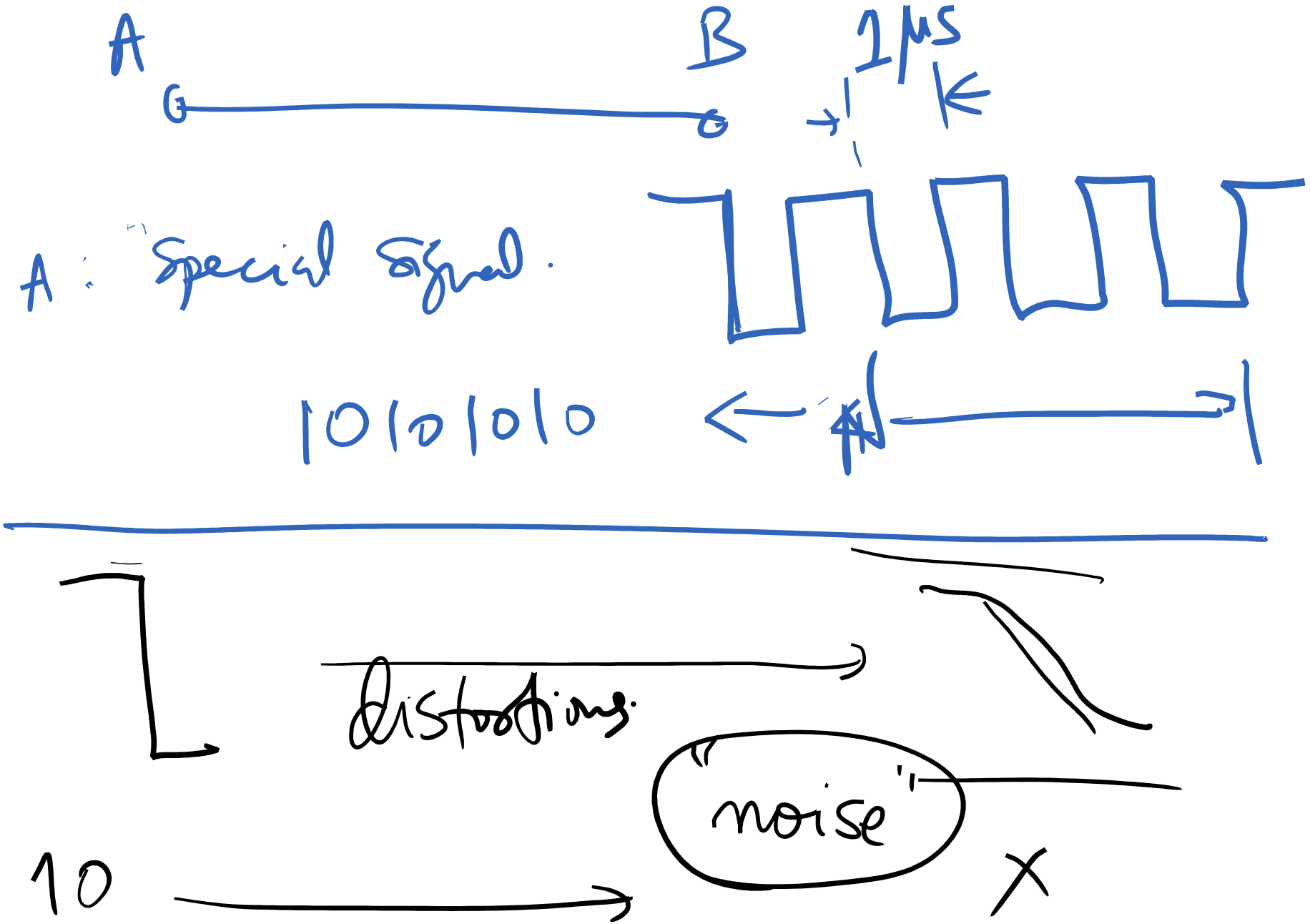
lo-hi trans → 0

- Self-synchronizing signal



Synchronization




A
B
1μs
A: Special signal.
10101010
distorting
noise
10
X

- Interference
- Diffraction
- Scattering
- Fading

distortion

+ Thermal Noise →

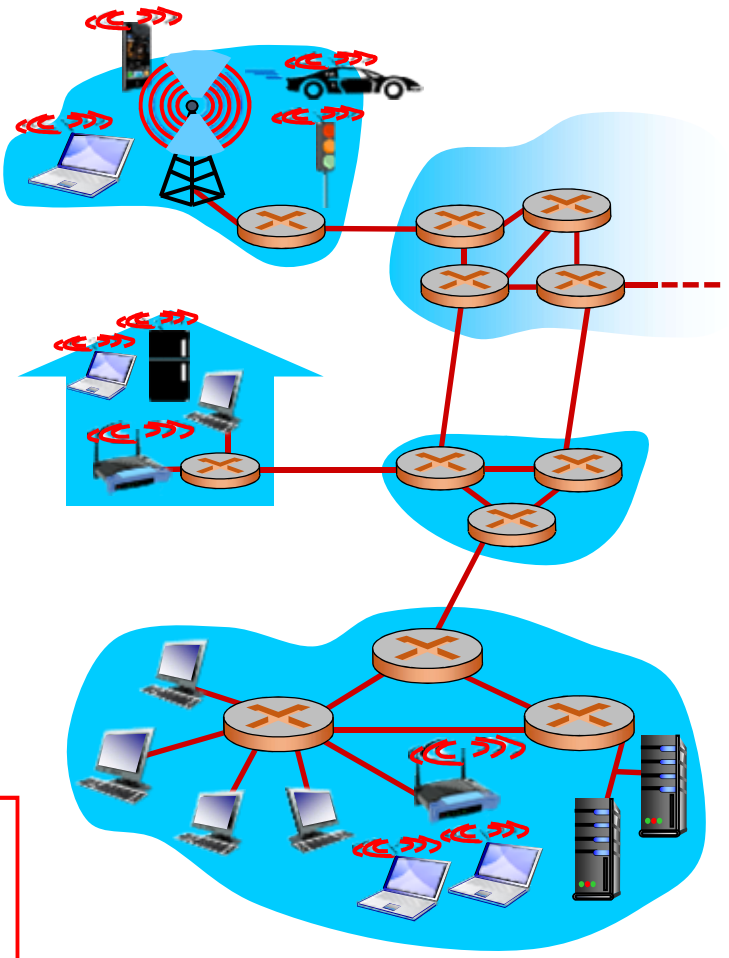
+ External Noise

Spontaneous Signal

Link layer: introduction

terminology:

- hosts and routers: nodes
- communication channels that connect adjacent nodes along communication path: links
  - wired links
  - wireless links
  - LANs
- layer-2 packet: frame, encapsulates datagram



data-link layer has responsibility of transferring datagram from one node to *physically adjacent* node over a link

Link layer: context

- datagram transferred by different link protocols over different links:
  - e.g., Ethernet on first link, frame relay on intermediate links, 802.11 on last link
- each link protocol provides different services
  - e.g., may or may not provide rdt over link

transportation analogy:

- trip from Princeton to Lausanne
  - limo: Princeton to JFK
  - plane: JFK to Geneva
  - train: Geneva to Lausanne
- tourist = datagram
- transport segment = communication link
- transportation mode = link layer protocol
- travel agent = routing algorithm

Link layer services (more)

- *flow control:*
  - pacing between adjacent sending and receiving nodes
- *error detection*:
  - errors caused by signal attenuation, noise.
  - receiver detects presence of errors:
    - signals sender for retransmission or drops frame
- *error correction:*
  - receiver identifies *and corrects* bit error(s) without resorting to retransmission
- *half-duplex and full-duplex*
  - with half duplex, nodes at both ends of link can transmit, but not at same time