

## SENSOR NETWORK

Similar to RFID but with some differences:

- SINK → point of net that receive data
- SENSORS → have batteries

Multi hop communication is possible

**SN** are composed of distributed devices that monitor environmental conditions sending data to a central node for analysis.

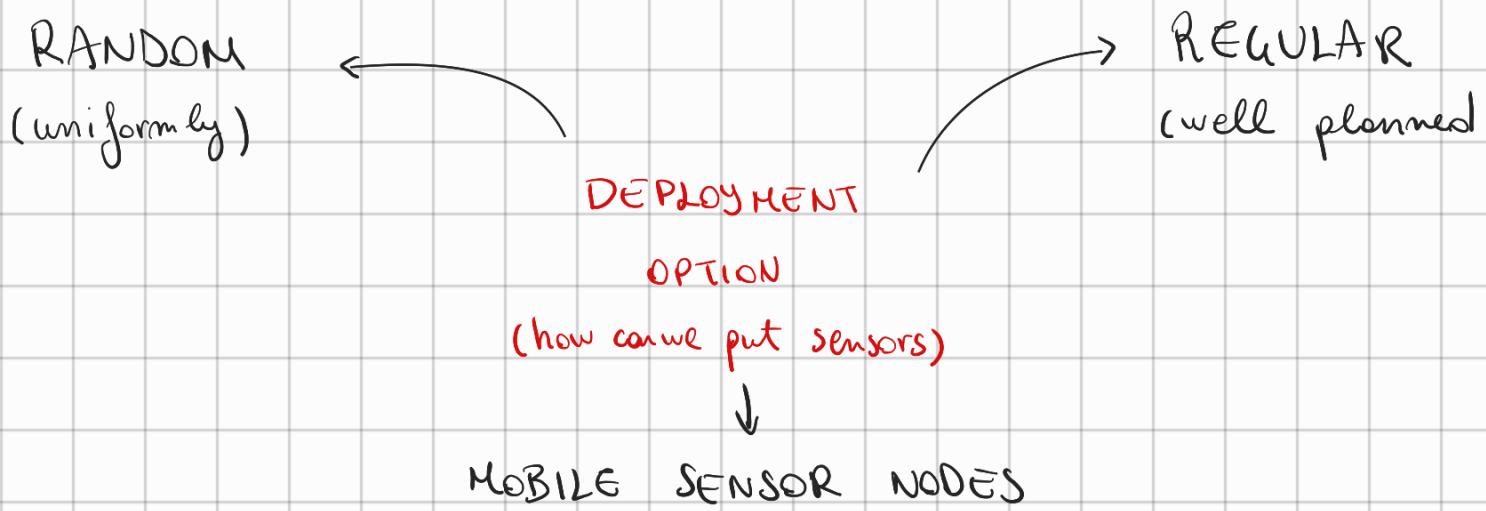
## PROS

- Collect data across vast geographic areas
- Sensors operate independently
- Immediate access to critical data

**Applications** → Everywhere there is a need for monitoring a physical space:  
industrial control, env monitoring,  
agriculture, sea monitoring...

## Roles of elements in a WSN

- SOURCE OF DATA → measure data
- SINKS → receive data
- ACTORS → control devices



## Characteristics of WSN

- Support large # of data
- Wide range
- Low cost / energy
- Re-programmable
- Robust against node fail
- Adopts to changes

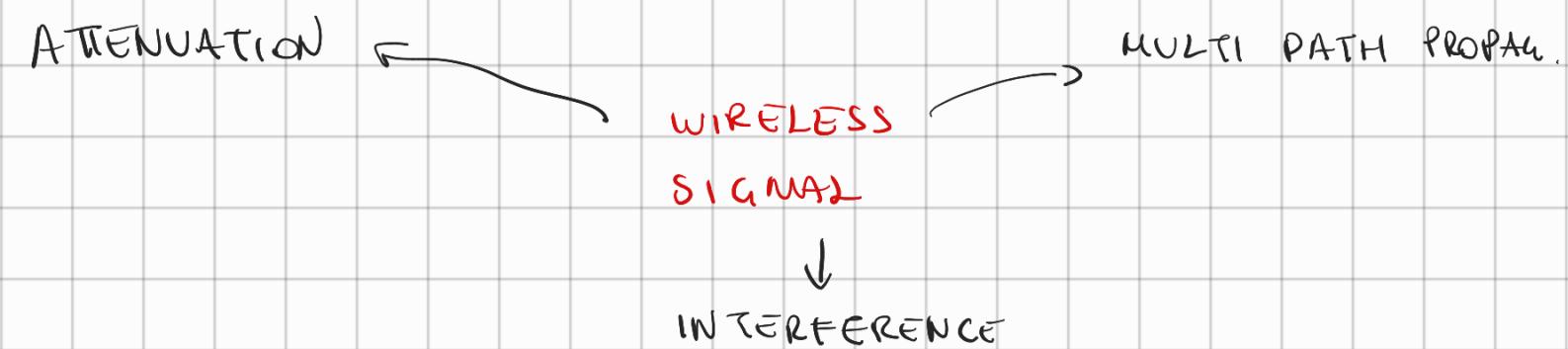
## 4 PHASES

1. COLLECT infos from the envir.
2. COPLE the end users directly to the sensor meas.
3. PROVIDE infos precisely localized
4. ESTABLISH a bi-dir link with physical space

## Components of SENSOR

- Antenna
- RF transceiver
- memory
- CPU
- Sensor unit
- Power Source
- OS

Sensors capture signal corresponding to a physical phenomenon; then the signal is prepared to be translated in a digital signal by ADC.



Signal to Error Rate (SER) → ratio of good to bad signal

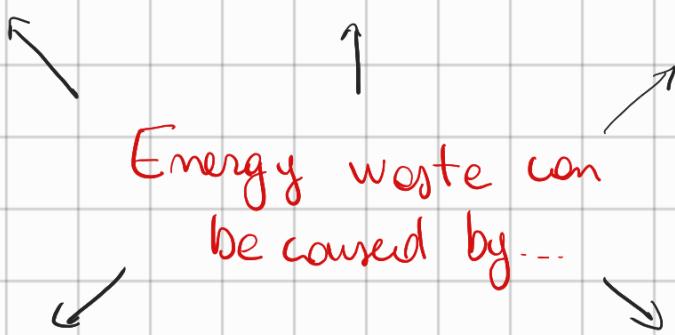
## MAC PROTOCOLS

Controls when to **SEND A PACKET** and when to **LISTEN TO A PACKET**

**CHARACTERISTICS** → Collision avoidance, Energy efficiency, Scalability, Latency ...

### COLLISIONS

Use too many control packets



### OVERHEARING:

a node receives a packet destined to another node

### IDLE LISTENING

Send a message to a not ready node

2 types of communication

- 1 to all
- All to 1

## Techniques for WSN MAC

### CONTENTION BASED



Sense the carrier before transmission

Scalable, No central authority

IDLE LISTENING

COLLISION

ENERGY CONSUMPTION

### SCHEDULE BASED



The schedule specifies for how long each node may transmit

Energy Efficient  
Avoid collisions

CENTRAL AUTHORITY

## CSMA/CA → Collision Avoidance

In wireless network it is not possible to detect collision

Goal: If u can't detect collisions then you must try to avoid it.

### How it works?

- A station senses the channel
  - IDLE → wait time  $t = \text{IFS}$  then transmit
  - BUSY → continues to monitor the channel
- When TRANSMISSION IS OVER → delays another IFS.
- PRIORITIES are defined through different inter frame spaces

SIFS → high priority      DIFS → low priority

### PROBLEMS with CSMA/CA

- Hidden Terminal → 2 nodes A & C can't see each other but can communicate with a node B → COLLISIONS
- Exposed Terminal → a node B is transmitting to A, but C don't transmit to B even though it would not cause a collision

## SOLUTIONS

RTS (Request to send) and CTS (Clear to Send)

- ✓ Now collisions can only occur in control messages
- ✓ Exposed / hidden terminal problems solved