

## Sensor systems: general considerations (2)

What is the input of a sensor system?

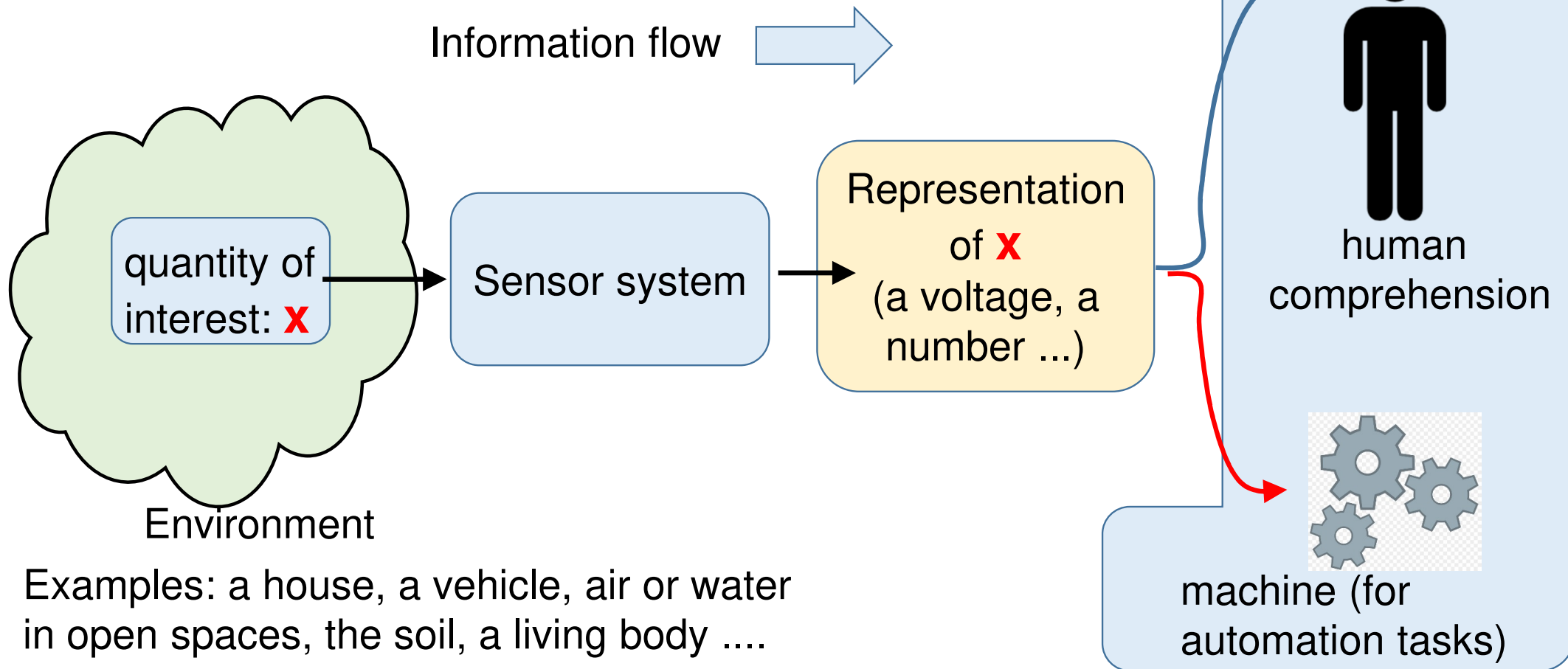
- **Non-electrical** quantities ( e.g. temperature, pressure, acceleration, flow, concentration of chemical species... )

but also:

- **Electrical quantities** that characterize a device or a process: impedance, current, charge ...
- **Biopotentials** (ECG, EEG , etc)

## Sensor systems: general considerations (2)

What does a sensor system do?

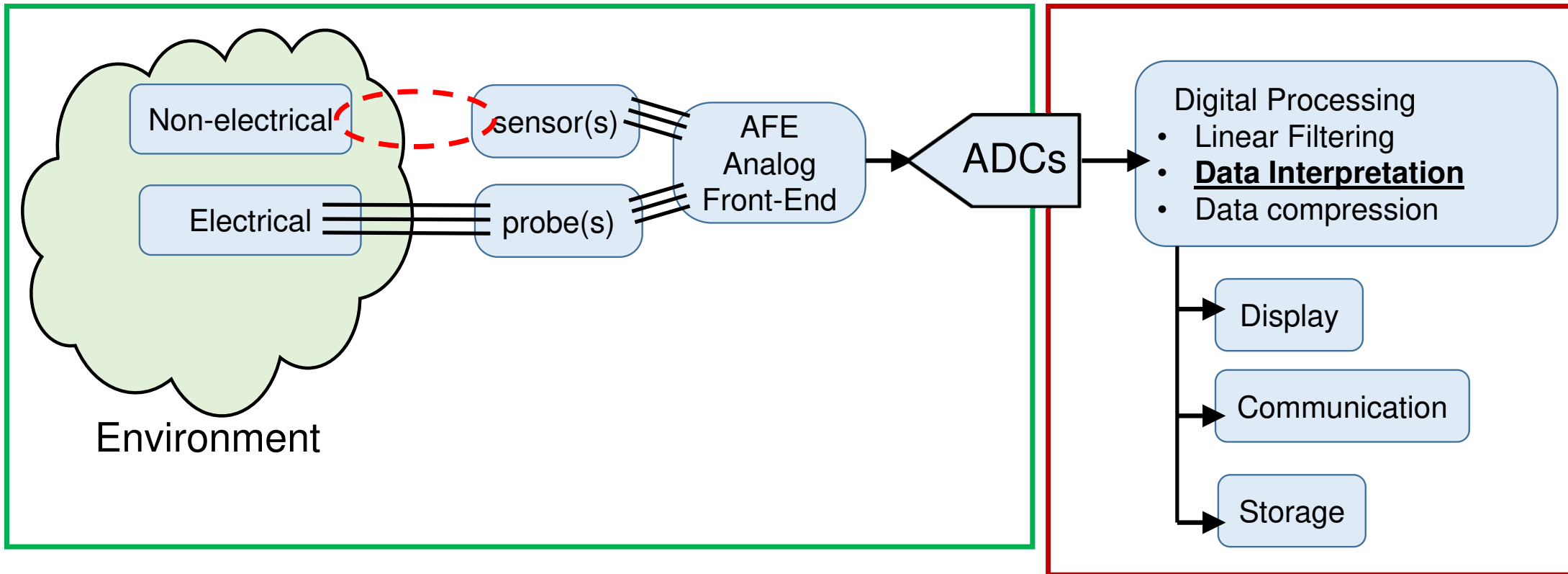


# Sensor systems: general definitions (3)

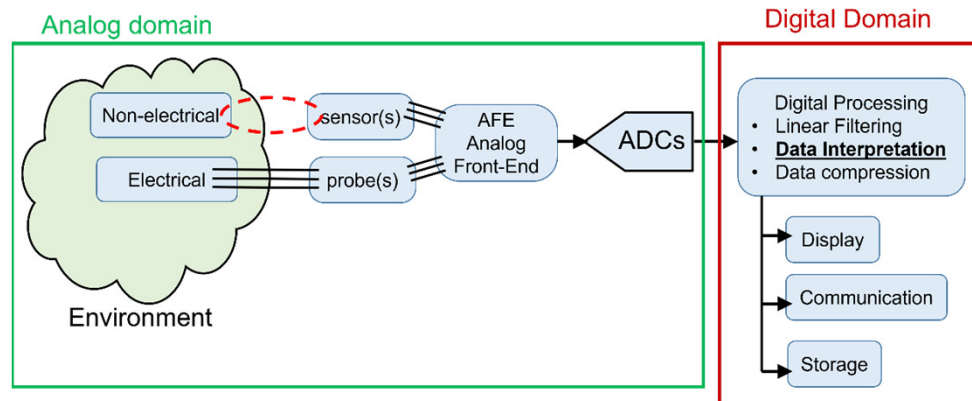
## Information flow in a sensor system

Analog domain

Digital Domain

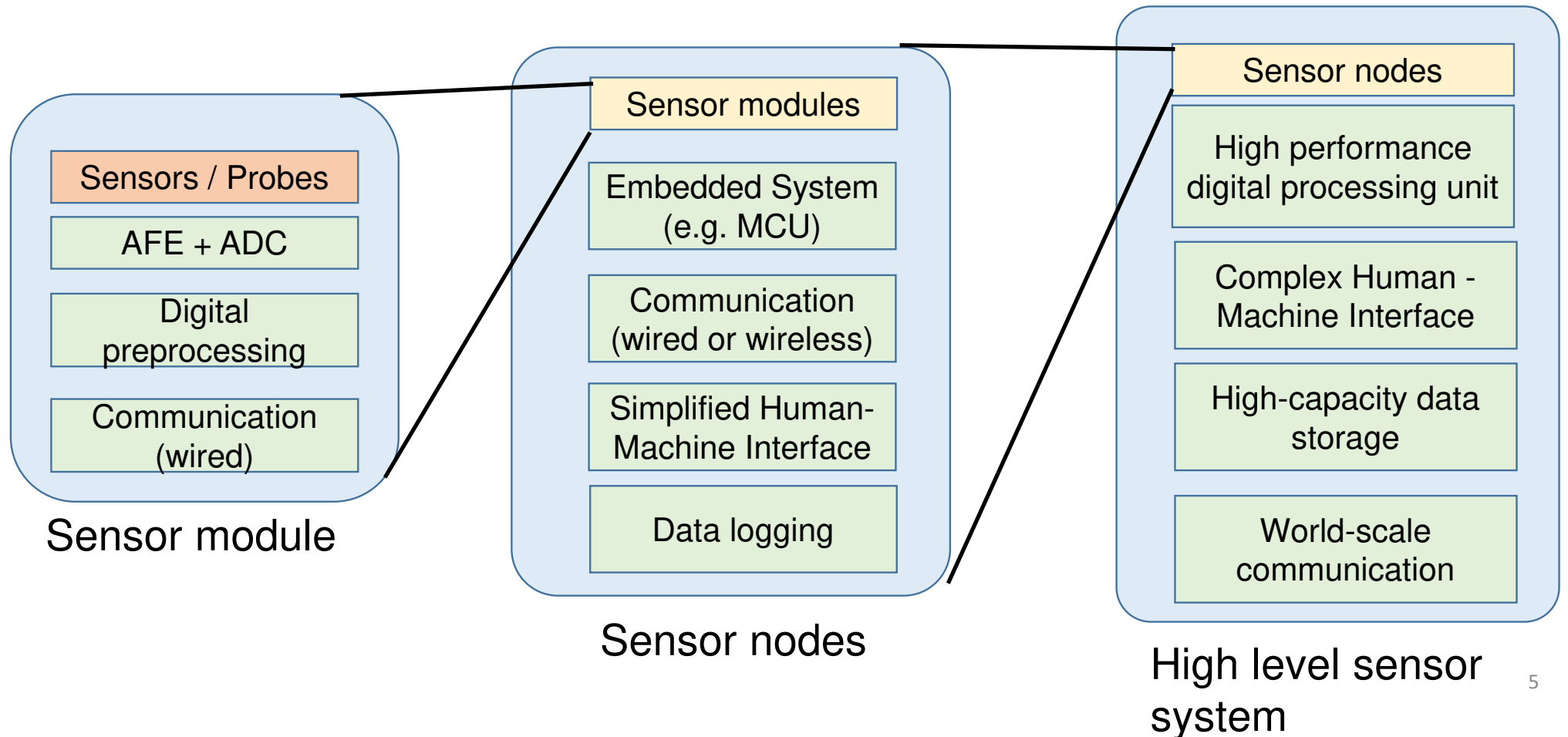


# System partitioning



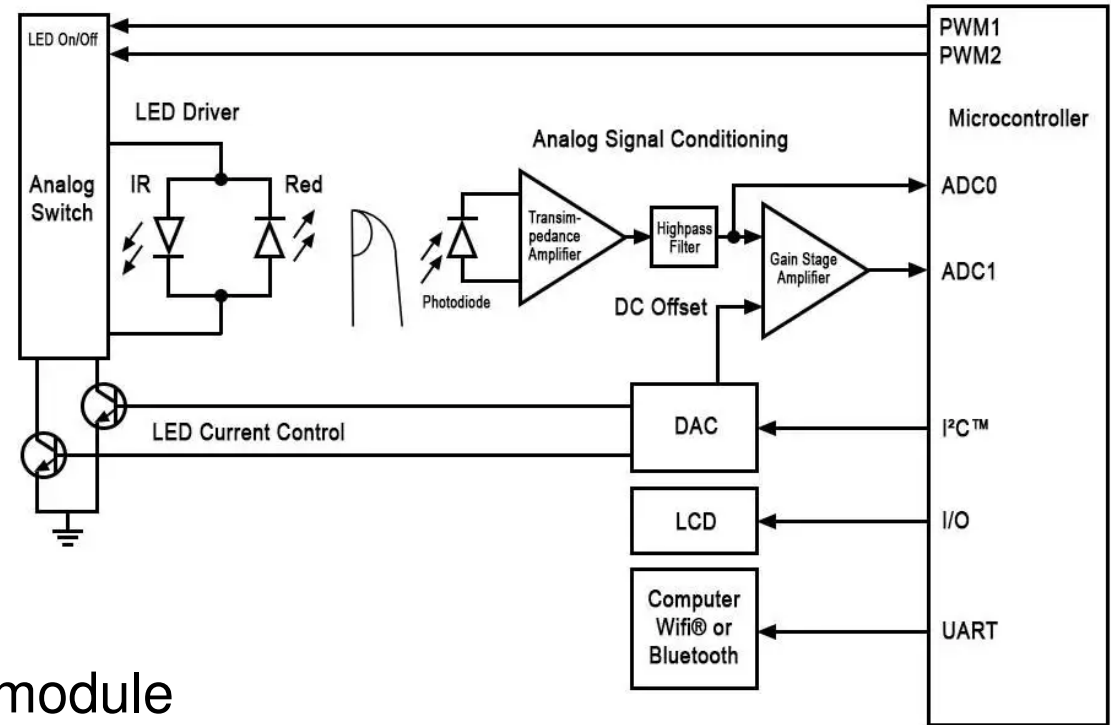
- ❑ A complex sensor system can be formed by a large number of different partially independent components. In some cases the sensor system can be distributed in a large volume and include tens or hundreds of sensors.
- ❑ In other cases the system can be relatively simple and small in size.
- ❑ For this reason, in the system level design phase, it is important to organize the sensor system in a hierarchical way, deciding at which level the above depicted operations must be performed

# Sensor systems: a possible hierarchy



# Example 1: Pulse oximeter

## A simple, complete sensor system



Sensor probe, AFE, ADC = Sensor module

Digital Processing

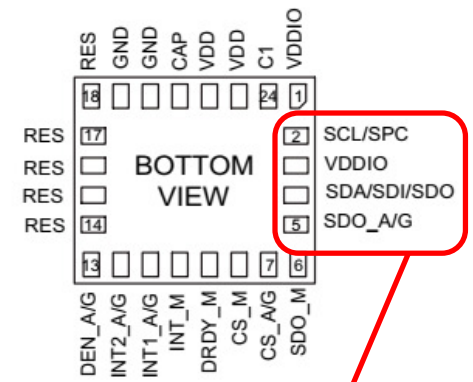
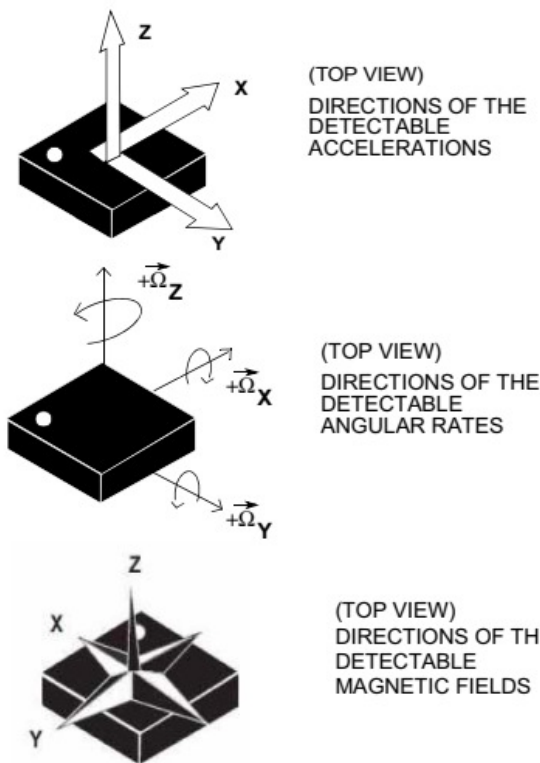
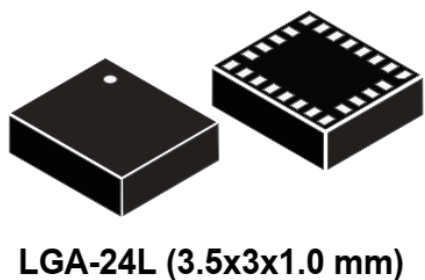
Human Interface (simplified)

Communication

} Performs the functions of sensor node

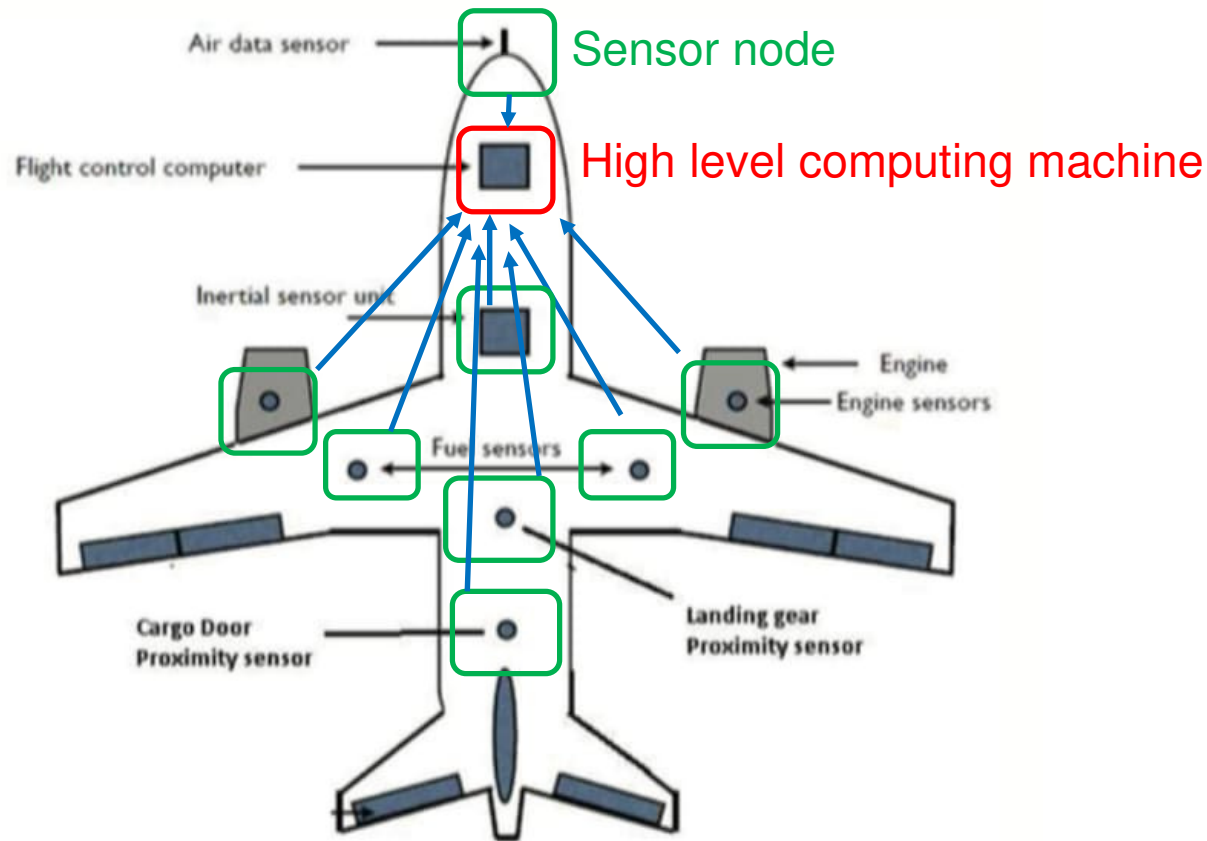
# Example 2: Integrated 9 axis inertial sensor (sensor module or smart sensor)

3-axis accelerometer  
 3-axis gyroscope  
 3-axis magnetometer



SPI -I2C communication lines

# Example 3, a complex case: sensor system in an airplane

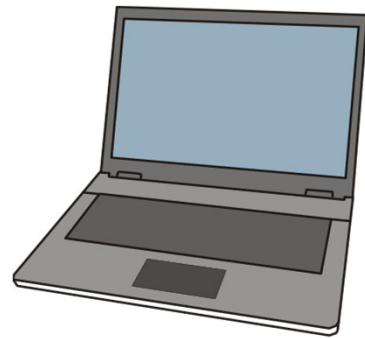


Includes different sensor modules (air speed, air temperature, angle of attack) and implements complex communication protocols.

To reduce wiring, there is a tendency towards wireless communication between sensor nodes

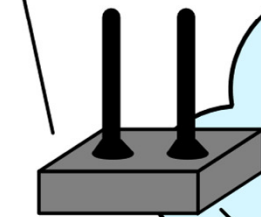


## Example 4: Wireless Sensor Network

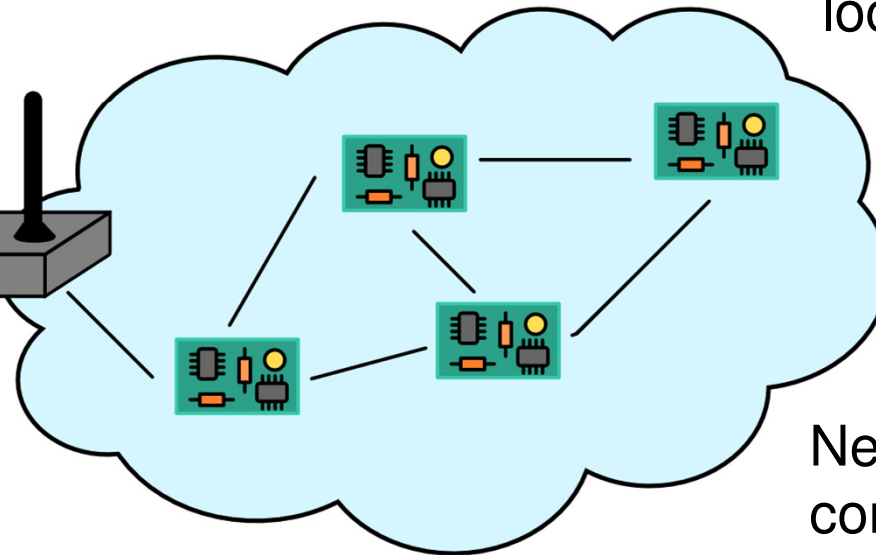


High level computing machine: PC, smartphone, embedded computer

Sensor Nodes  
Can be equipped with different sensor types or simply replicate the same sensor set in different locations (distributed sensing)



Sink

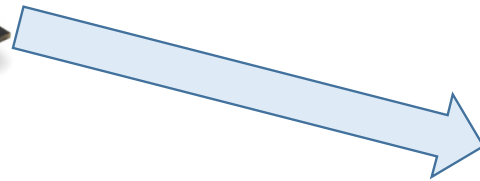


Network: Multi-hop communication protocol

## Example of a sensor node for WSN



Sensor module  
(air quality)



Libellium wasp-mote

Multi-protocol wireless communication

<https://www.libellium.com/iot-products/waspmote/>