Internet of Things

Internet of things

The Internet ➡️ **The Internet of things**

- Set of connected computer devices
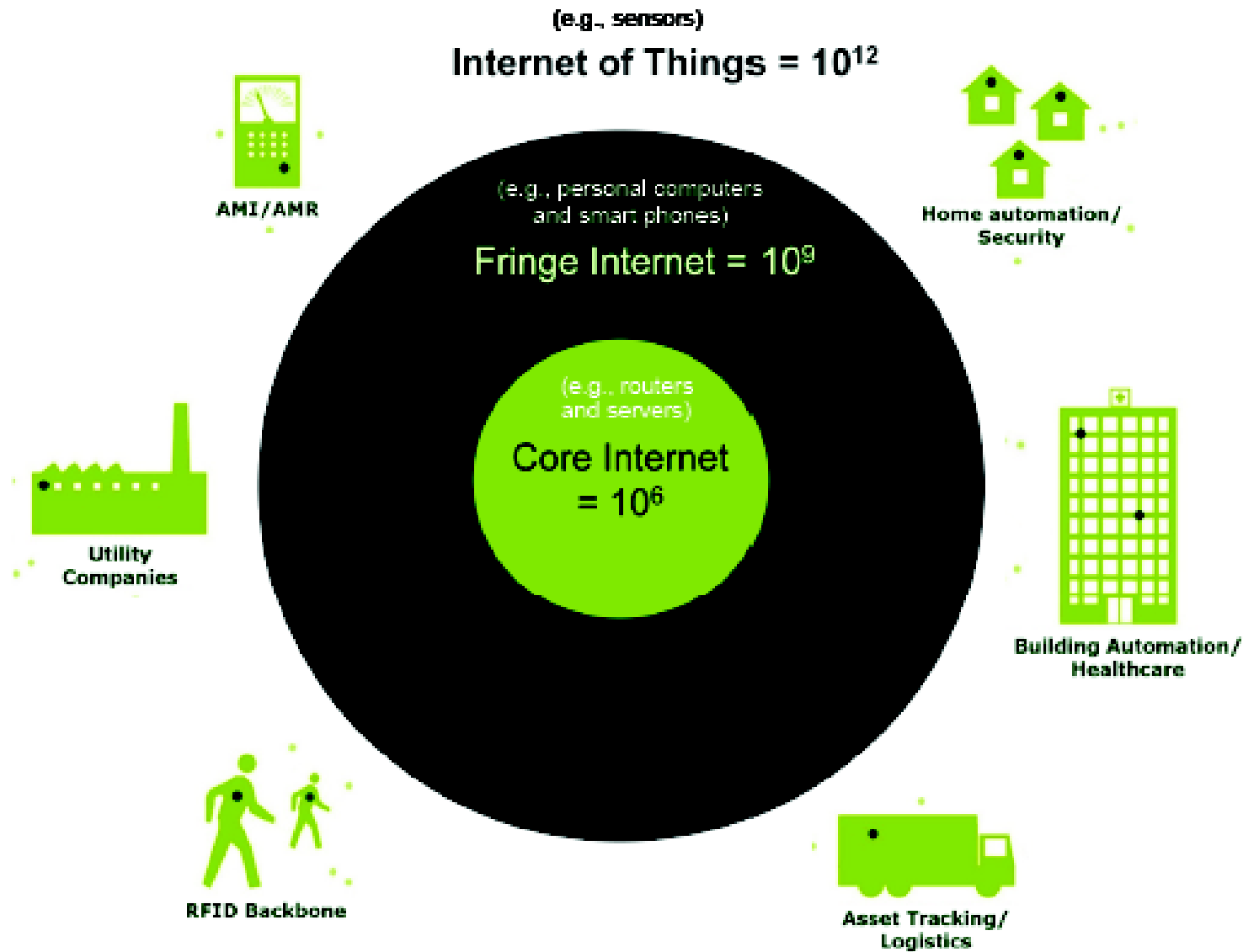
- Set of connected surrounding things of human living space
  - ✓ Home appliances
  - ✓ Machines
  - ✓ Transportation
  - ✓ Business storage
  - ✓ Goods
- No standard architecture (till 2013)
- No standard definition

Research

- How to make these things communicate with each other like the Internet ?

The Intenet of things (IoT)

(e.g., sensors)
Internet of Things = 10^{12}

(e.g., personal computers and smart phones)
Fringe Internet = 10^9

(e.g., routers and servers)
Core Internet = 10^6

AMI/AMR

Home automation/ Security

Utility Companies

Building Automation/ Healthcare

RFID Backbone

Asset Tracking/ Logistics

Source: Sensinode

IoT- sample definitions

- Definition 1: by some researchers [survey]
  - ✓ A new model that contains all of wireless communication technologies
    - ✓ Sensor networks
    - ✓ Mobile networks
    - ✓ Actuators
  - ✓ IoT= a set of things
    - ✓ having each a unique address (example: IP address)
    - ✓ Communicate using RFID

IoT- definition**s**

- Definition 2:
  - ✓ a dynamic global network infrastructure with self configuring
  - ✓ "things"
    - ✓ have identities
    - ✓ use intelligent interfaces
    - ✓ are active participants in business, information and social processes
    - ✓ communicate among themselves and with the environment (sensing data about the environment)
    - ✓ reacting autonomously to the "real/physical world" events: trigger automated actions

IoT- definitions

- Definition 3:

  ✓ The network formed by things/objects

  ✓ Things

    ✓ have identities,

    ✓ virtual personalities

    ✓ Use intelligent interfaces to connect and communicate with the users, social and environmental contexts.
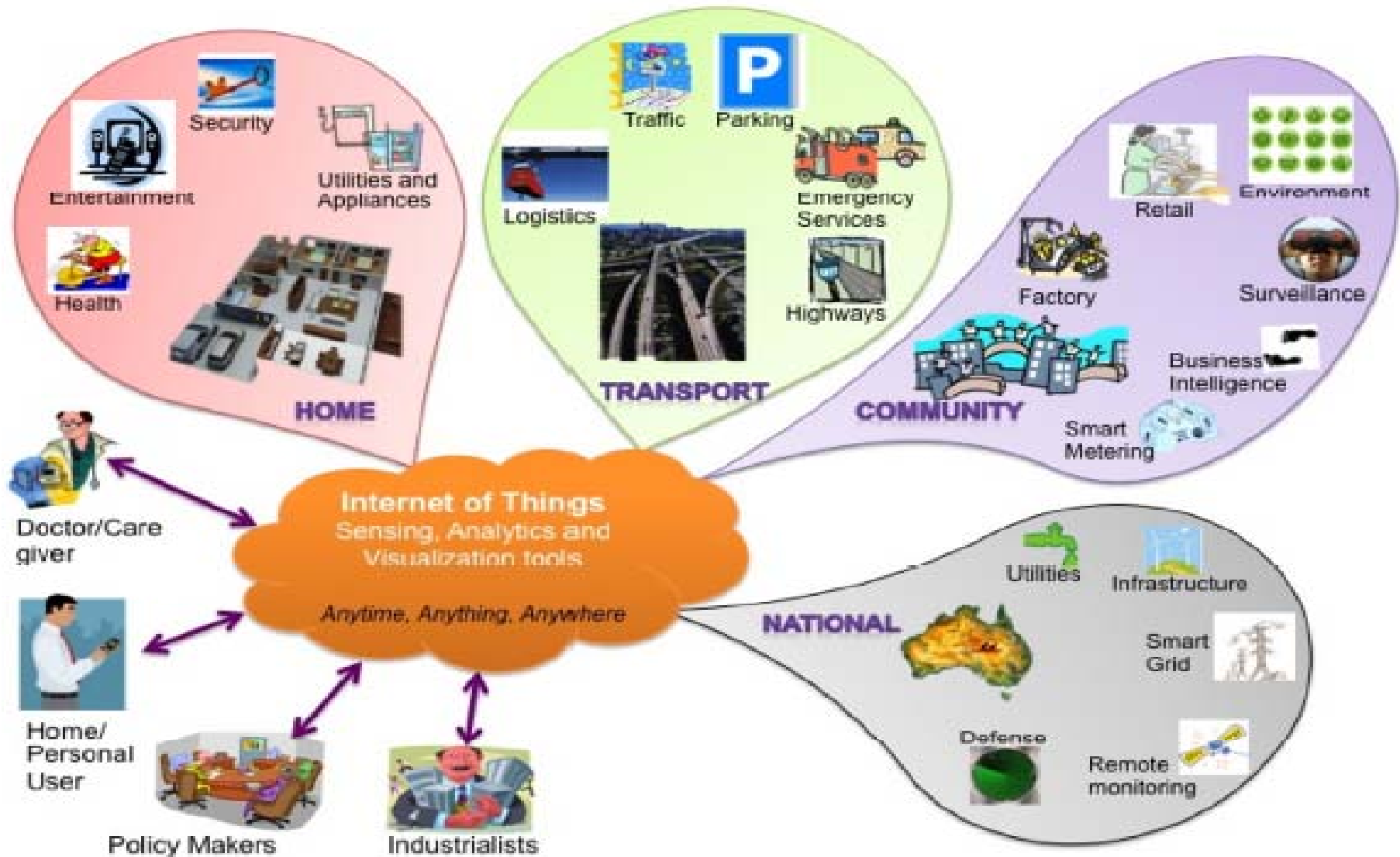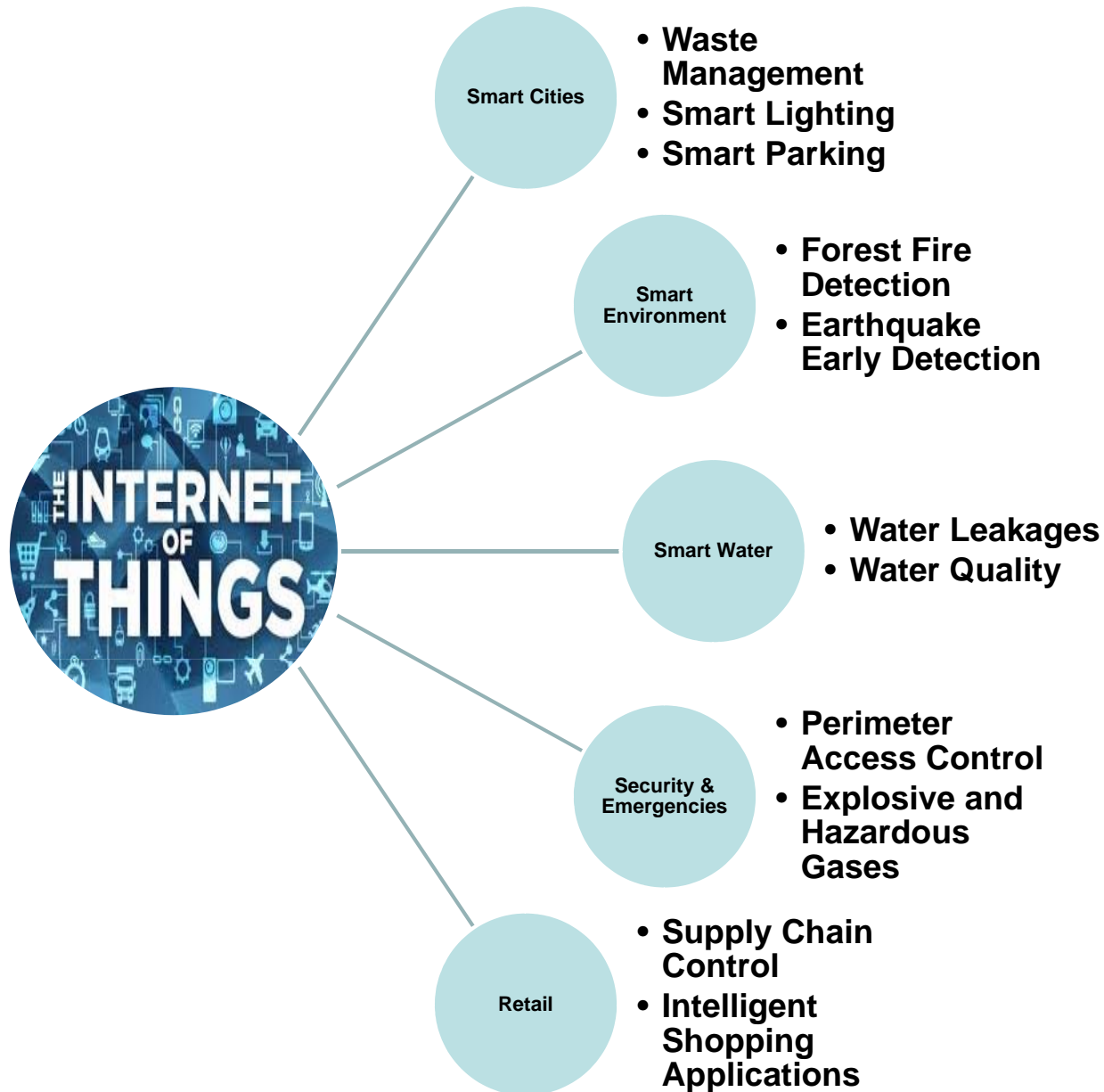
IoT applications

Fig. 1. Internet of Things schematic showing the end users and application areas based on data.
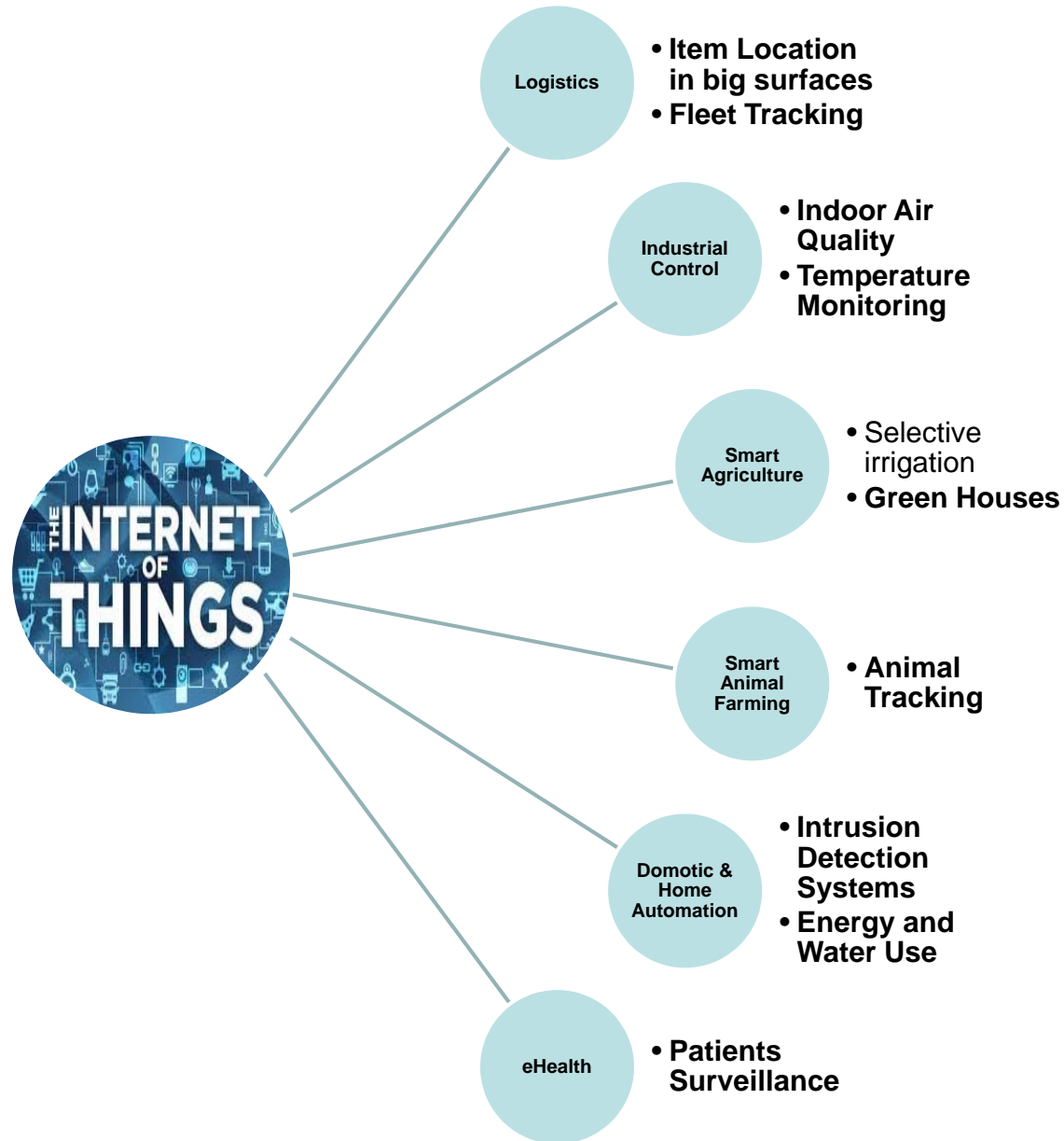
IoT sample applications

- Cooperation between trafic lights and sensors [5]
    - ✓ To provide a normal distribution of cars in the roads
    - ✓ Adapt the time for each sign to be on or off
- Smart Bottles
    - ✓ Bottles equipped with pressure and temperature sensors and RFID tag
    - ➔ Identify sites on assembly lines that subject the glass to damaging pressure or collisions ➔ Reduce Glass Breakage
- Garbage cans equipped with sensors
    - ✓ When a threshold of weight/ volume is reached ➔ contact the garbage cars.

IoT sample sensor applications

Smart Cities
- **Waste Management**
- **Smart Lighting**
- **Smart Parking**

Smart Environment
- **Forest Fire Detection**
- **Earthquake Early Detection**

Smart Water
- **Water Leakages**
- **Water Quality**

Security & Emergencies
- **Perimeter Access Control**
- **Explosive and Hazardous Gases**

Retail
- **Supply Chain Control**
- **Intelligent Shopping Applications**

IoT sample sensor applications

Logistics
- Item Location in big surfaces
- Fleet Tracking

Industrial Control
- Indoor Air Quality
- Temperature Monitoring

Smart Agriculture
- Selective irrigation
- Green Houses

Smart Animal Farming
- Animal Tracking

Domotic & Home Automation
- Intrusion Detection Systems
- Energy and Water Use

eHealth
- Patients Surveillance

IoT features

- Univocally identifiable and addressable objects

- Artificial Intelligence

- Architecture

- Geo-Localization

- Size Considerations

IoT- technologies
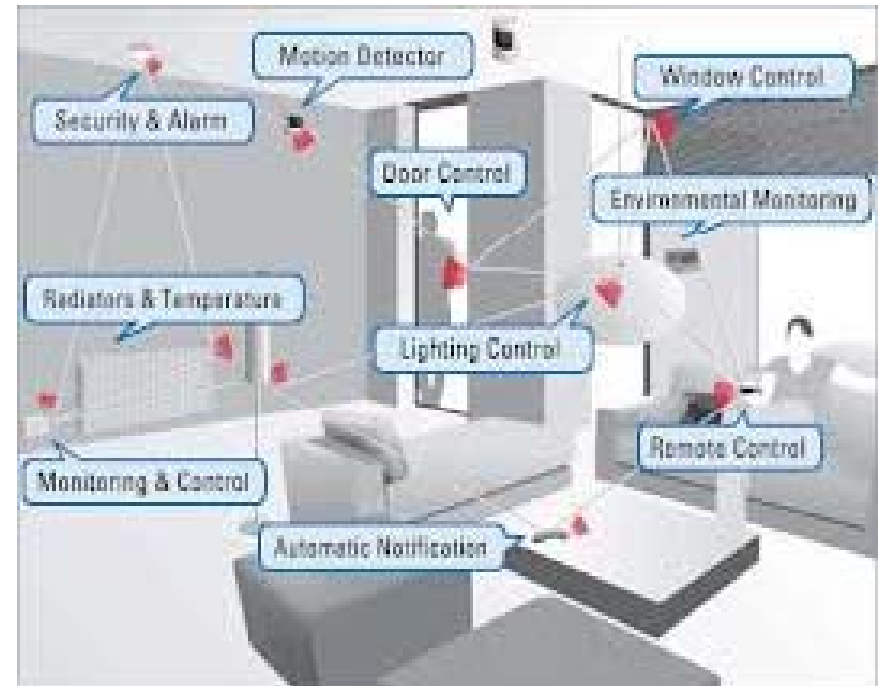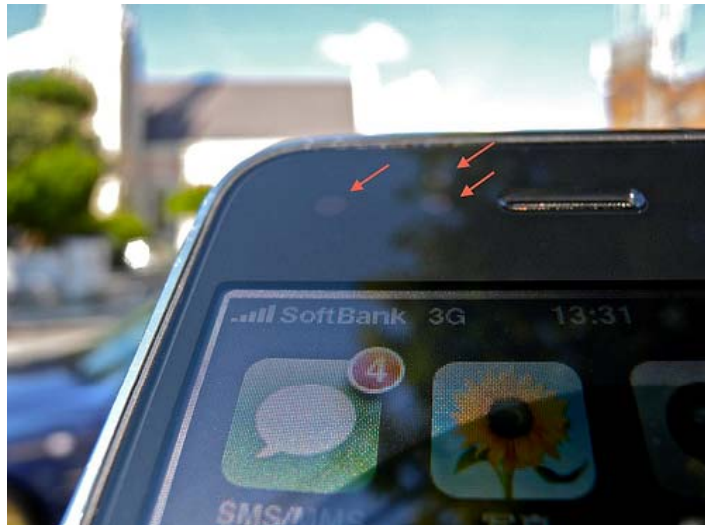
- RFID: tags and readers

- WiFi IEEE 802.11

- Barcode and QR Code

- Sensors and smartphones

- ZigBee IEEE 802.15.4

IoT architectures

- 3 layers architecture (beginning of IoT)

- 5 layers architecture (replace the 3 layer one)

- Specific purpose architectures

IoT architectures : 3 layers architecture

Application
- Middle tier between technologies and how they can be used to respond to human needs

network
- Core of Iot: transmits information gathered by the perception layer
- Hardware + software + management ceners

perception
- Used to identify each thing by gathering information
- Contains RFID tags, sensors, cameras…

IoT architectures : 5 layers architecture

Business
- Define application charge and management

Application
- Identifies types of applications to be used in IoT (intelligence, authentication, safety…)

Processing
- Storing & analysing of gathering information of things (database, cloud, ubiquitous computing, intelligen processsing…

Transport
- Transports information between perception and processing layers (wifi, bluetooth+ IPV6 for thins)
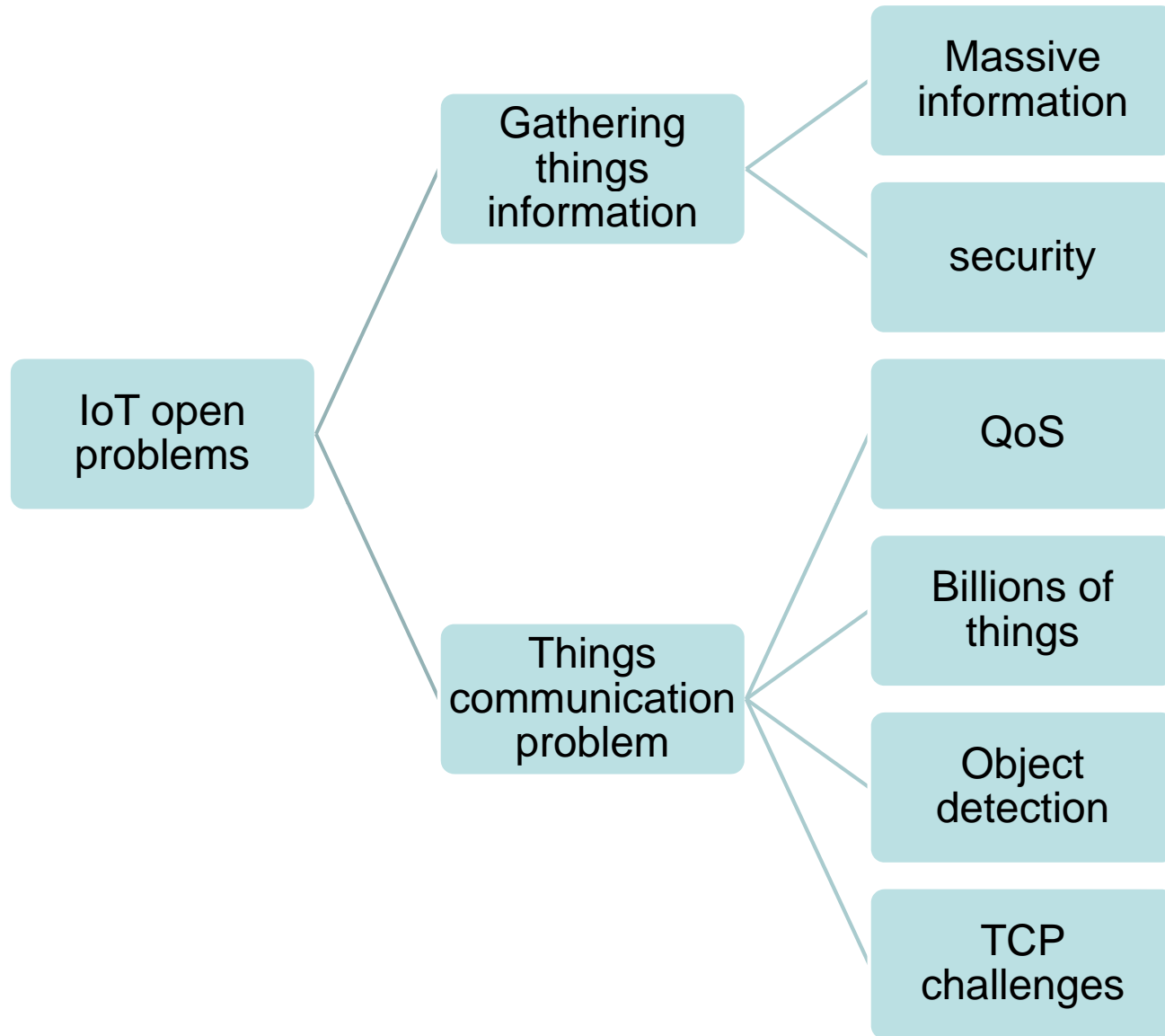- Hardware + software + management ceners

perception
- Gathers information of things (RFID, sensors..)
- Define the physical meanin of each thing (temperature, location

IoT core problem

- Setup a universal architecture for systems with different targets applications and features

IoT open problems

IoT open problems:

- Massive information problem

  - ✓ Information of billions of things

  - ➔ communication problem

    - ➔ Transmission of data to control centers (web applications) in real time

    - ➔ Storing and backup

    - ➔ Processing things information to determine the control action for each thing

IoT open problems:

- Security

  - ✓ Communication using wireless connections

    - ✓ information sniffing

  - ✓ Physical attacks: things are alone most of the time

  - ✓ Low self defense

    - ✓ Most IoT devices can't accept securit packages (low performances, energy saving)

  - ✓ Privacy of things personal information

    - ✓ Who can collect, store and access personal information

IoT open problems: Communication problems

- Billions of things:
  - ✓ Type of hardware for communication
  - ✓ Ideal adressing
  - ✓ Informaion access :RFID or other systems (image processing)
- TCP
  - ✓ Congestion contrôl, data buffering, connection setup…
- Qos:
  - ✓ Objects with different features
  - ✓ A non localised area => QoS problems
- Real time object detection:
  - ✓ How we can define each thin and aquire its information in real time (RFID, computer vision…