IoT
Introduction, Smart Cities, EkoNET

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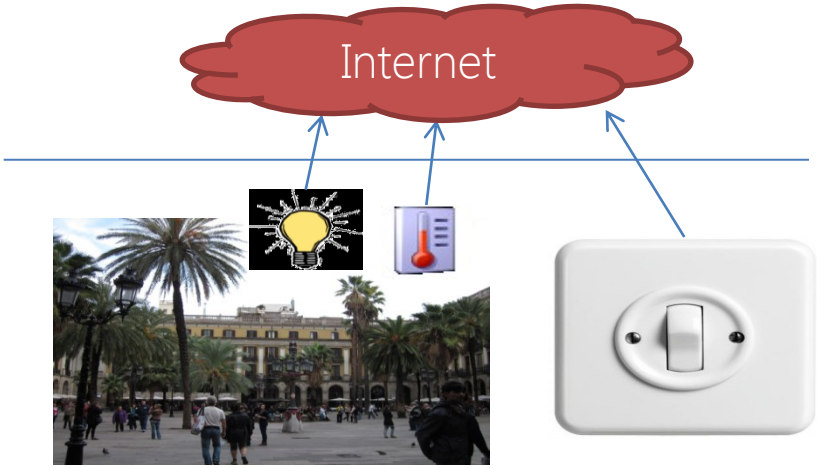
What is IoT

- Hot research topic
- Word used by many and in different contexts
- IoT research at intersection of several domains:
  - Internet Computing,
  - Communications,
  - RFID,
  - Sensor Networking,
- No commonly accepted definition of the term 'Internet of Things'

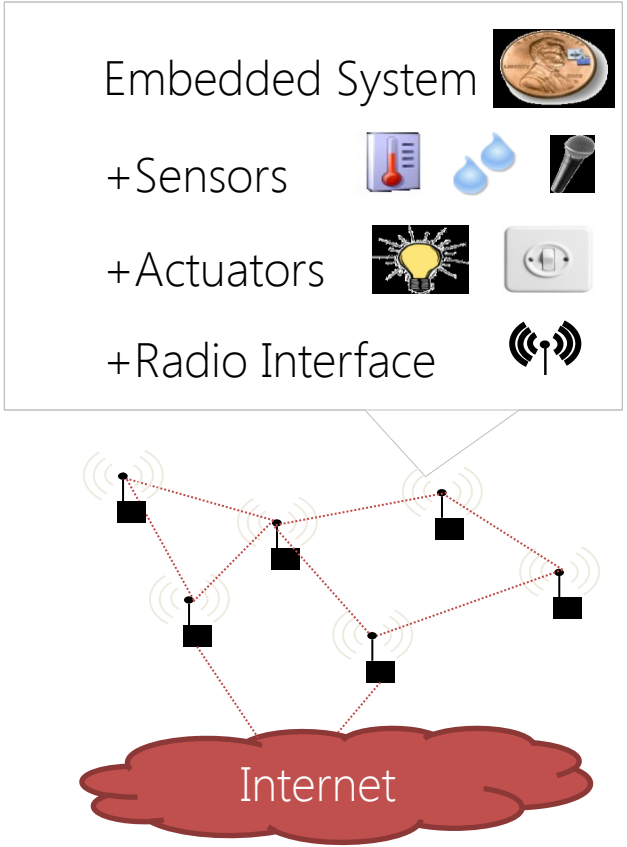
Internet of Things (IoT)

- Digital representation of real „things“ in the Internet
- State of real environments is available via sensors in real time
  - temperature, light, CO_2, movement, humidity, …
- Via actuators, it is possible to influence the real world through actions in the digital world:
  - switches, traffic lights, displays, …



Internet of Things (IoT)

- Embedded system
  - \+ sensors and/or actuators
  - \+ Radio interface
  - = Wireless sensor node
- Many wireless sensor nodes
  - = wireless sensor network
- Wireless sensor network
  - \+ Internet connectivity
  - = Internet of Things (IoT)



Connect everything

Physical objects

Living organisms

Persons

Concepts

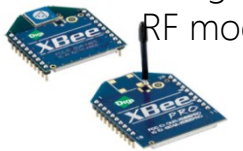
Services

Resources

Anything that is
interesting from the perspective of an application

Smart objects, devices, things,…

ZigBee / 3G, WiFi, Ethernet gateways



ZigBee RF modules

Environmental: Temperature, CO2 Presure, ambient light

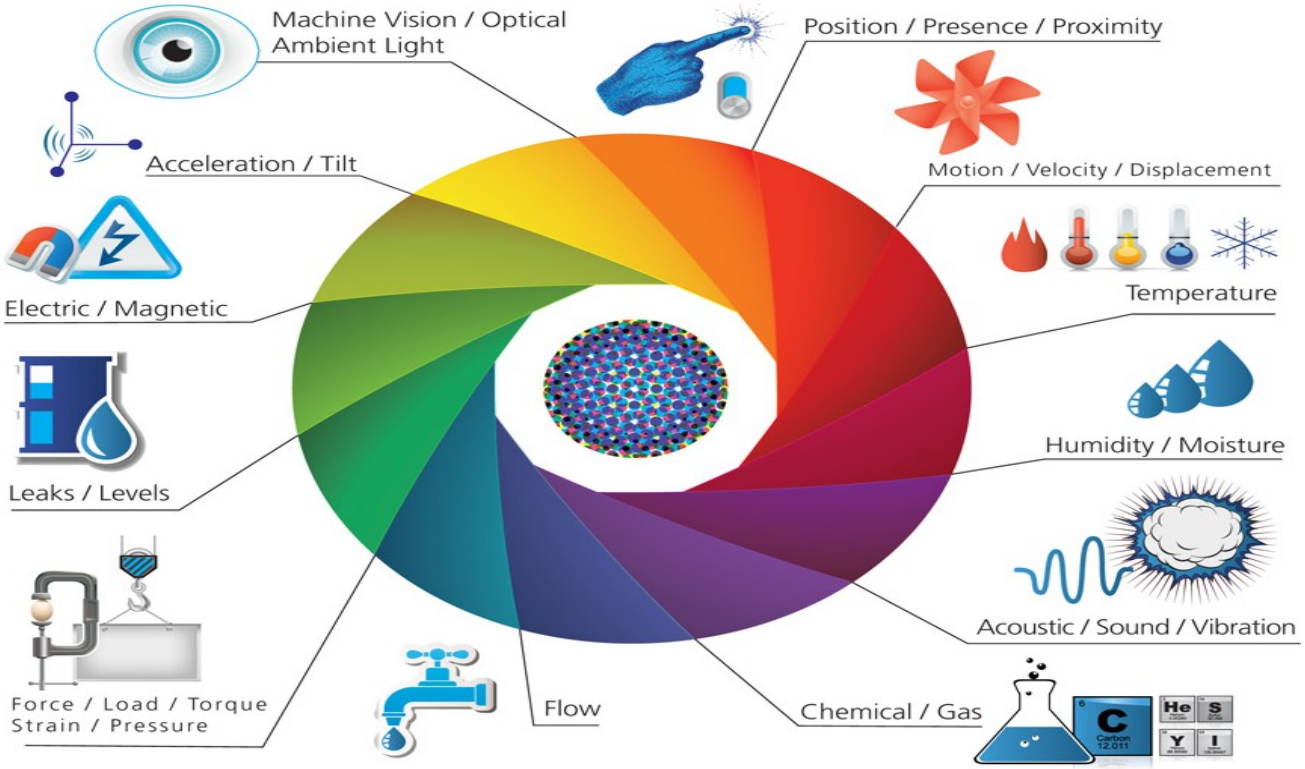
Presence detectors
Smoke & gas detectors
IP video cameras

microcontrolers

RFID tracking

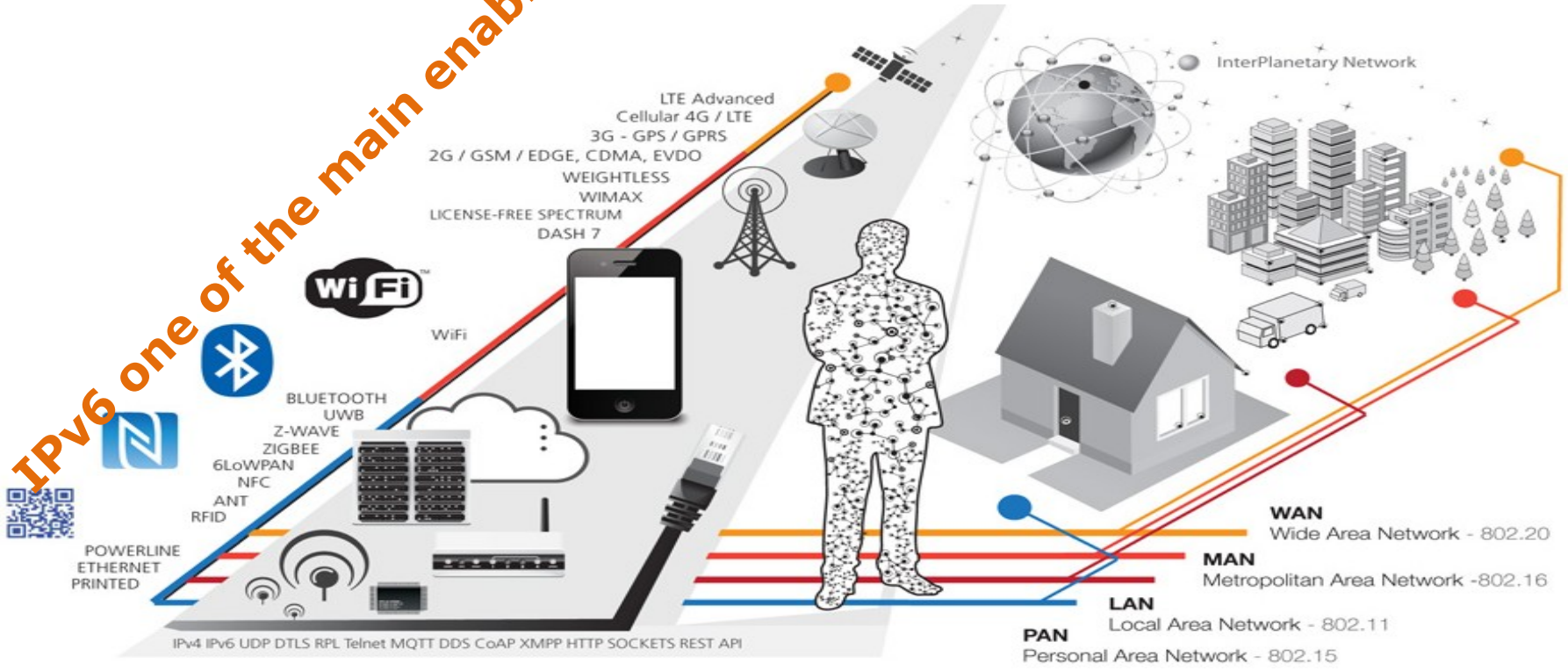
Personal care and assistance

Sensors&actuators



Source: http://postscapes.com/what-exactly-is-the-internet-of-things-infographic

Get connected



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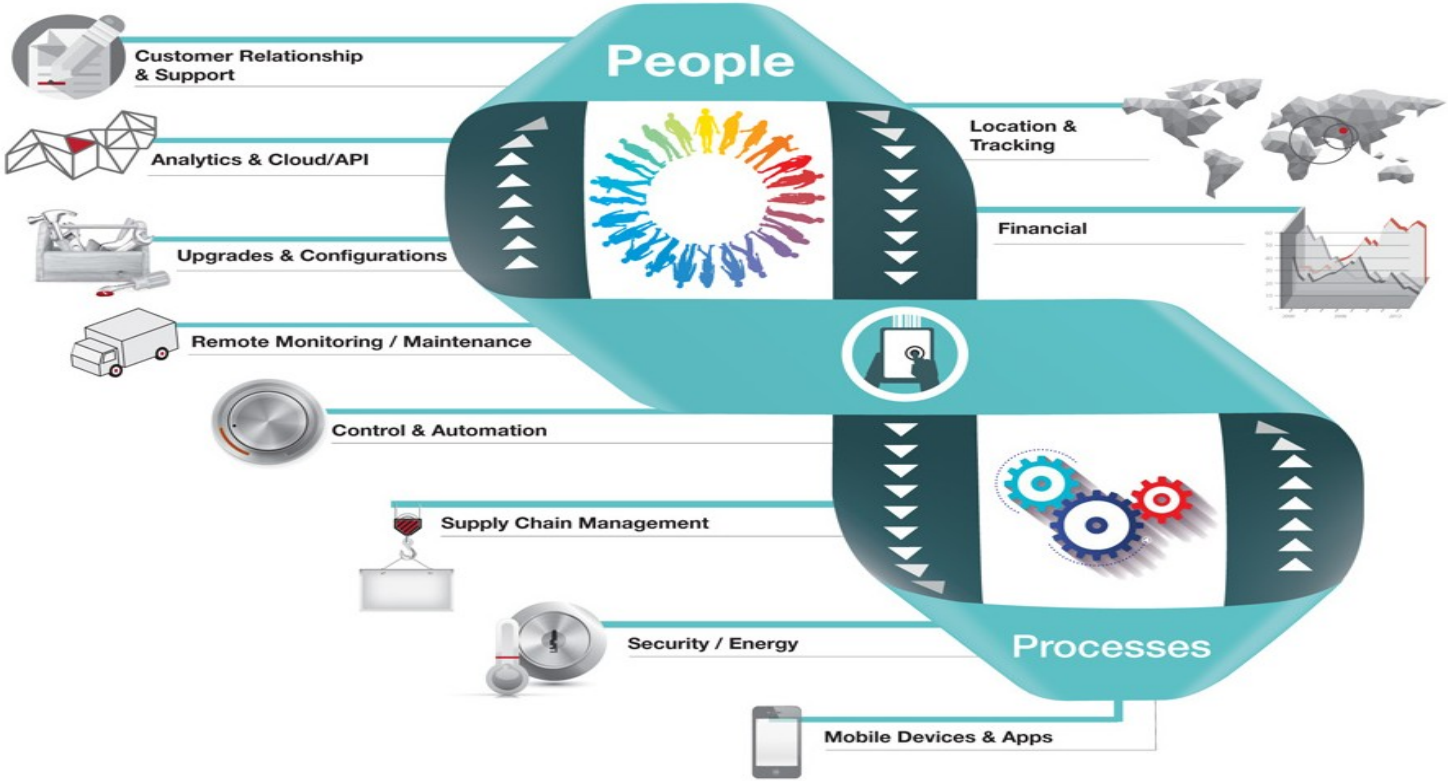
People and processes



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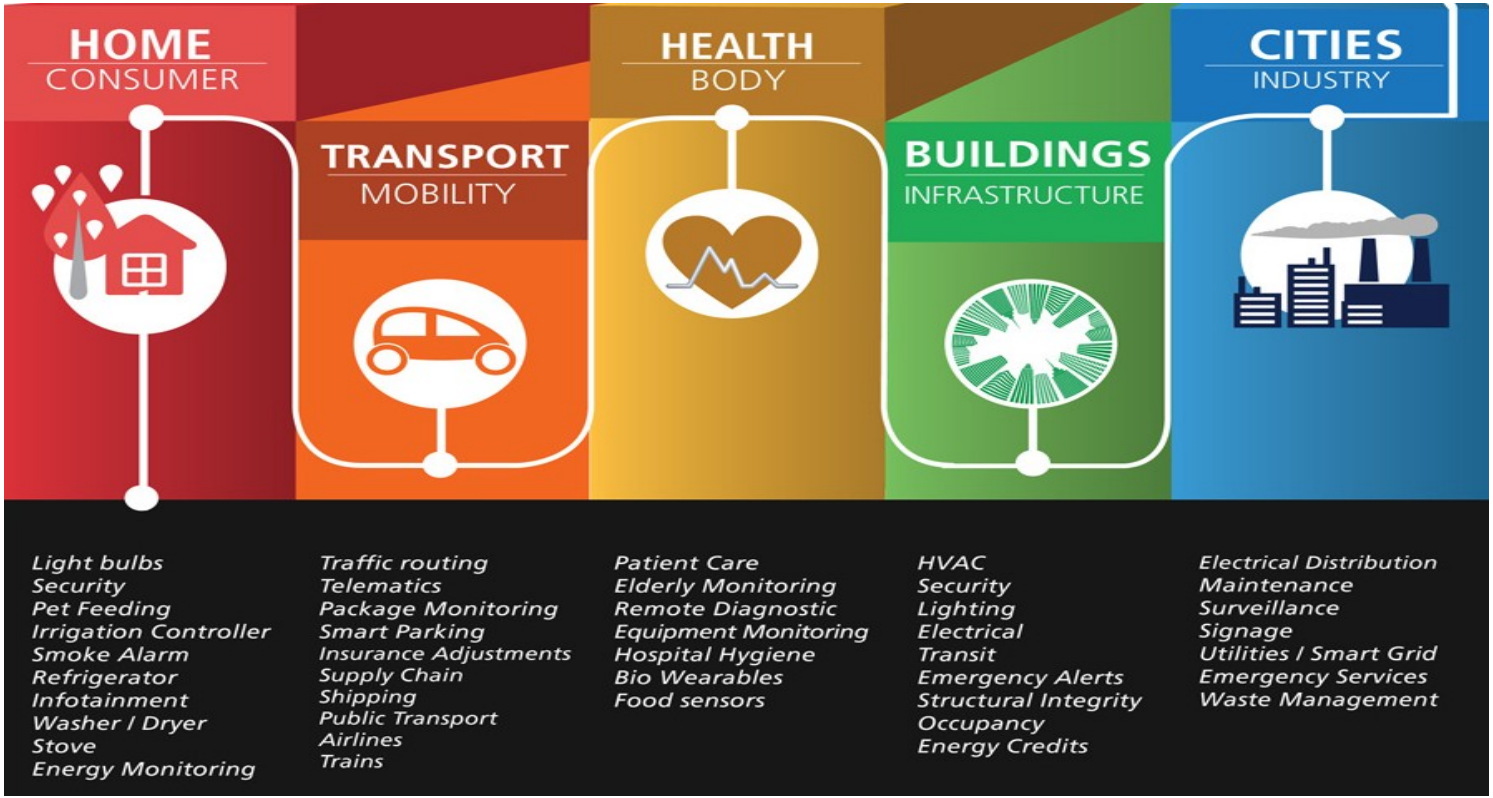
Diverse applications



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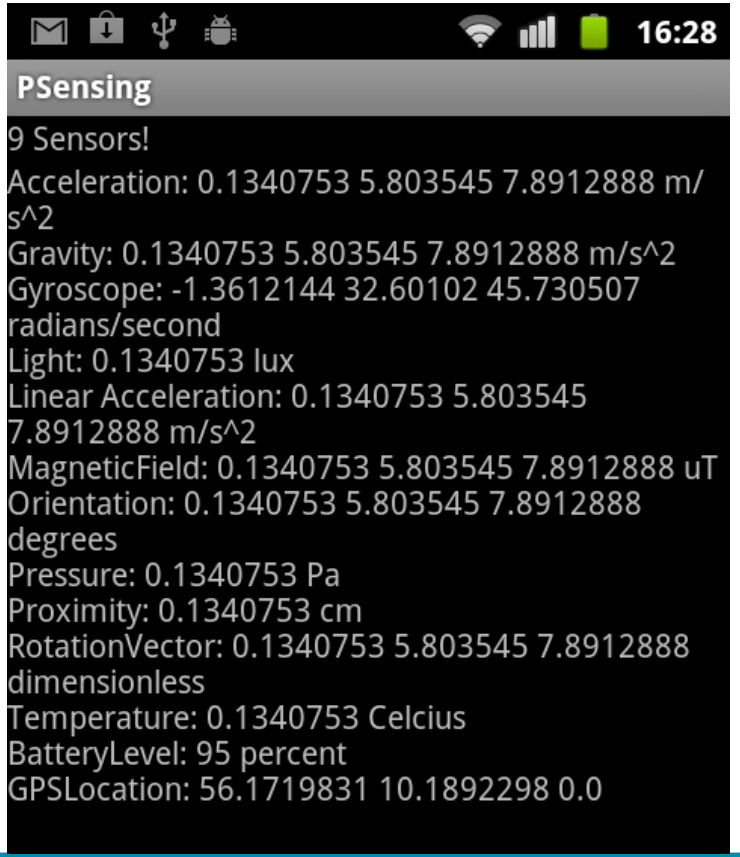
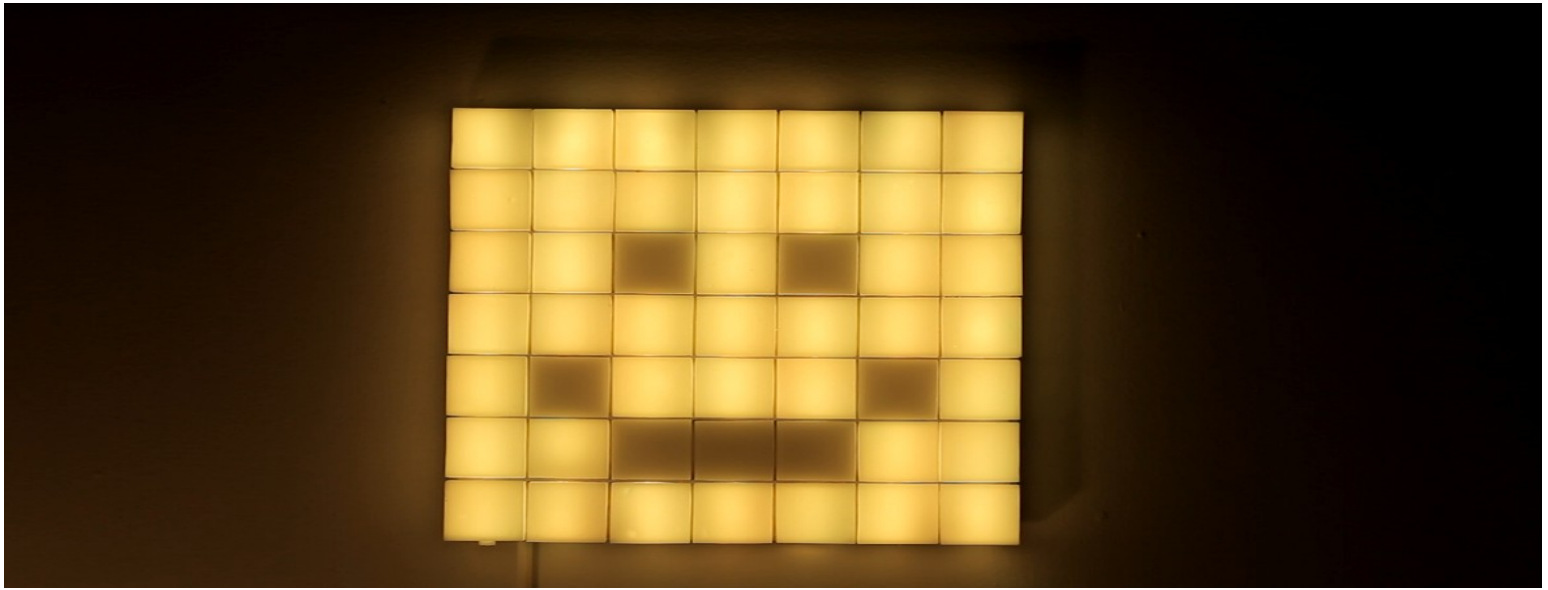
Smart phone sensors

- Acceleration
- Gyroscope
- Light
- Magnetic field
- Orientation
- Pressure
- Proximity
- Rotation
- Temperature
- Battery level
- GPS location
- Camera
- Microphone



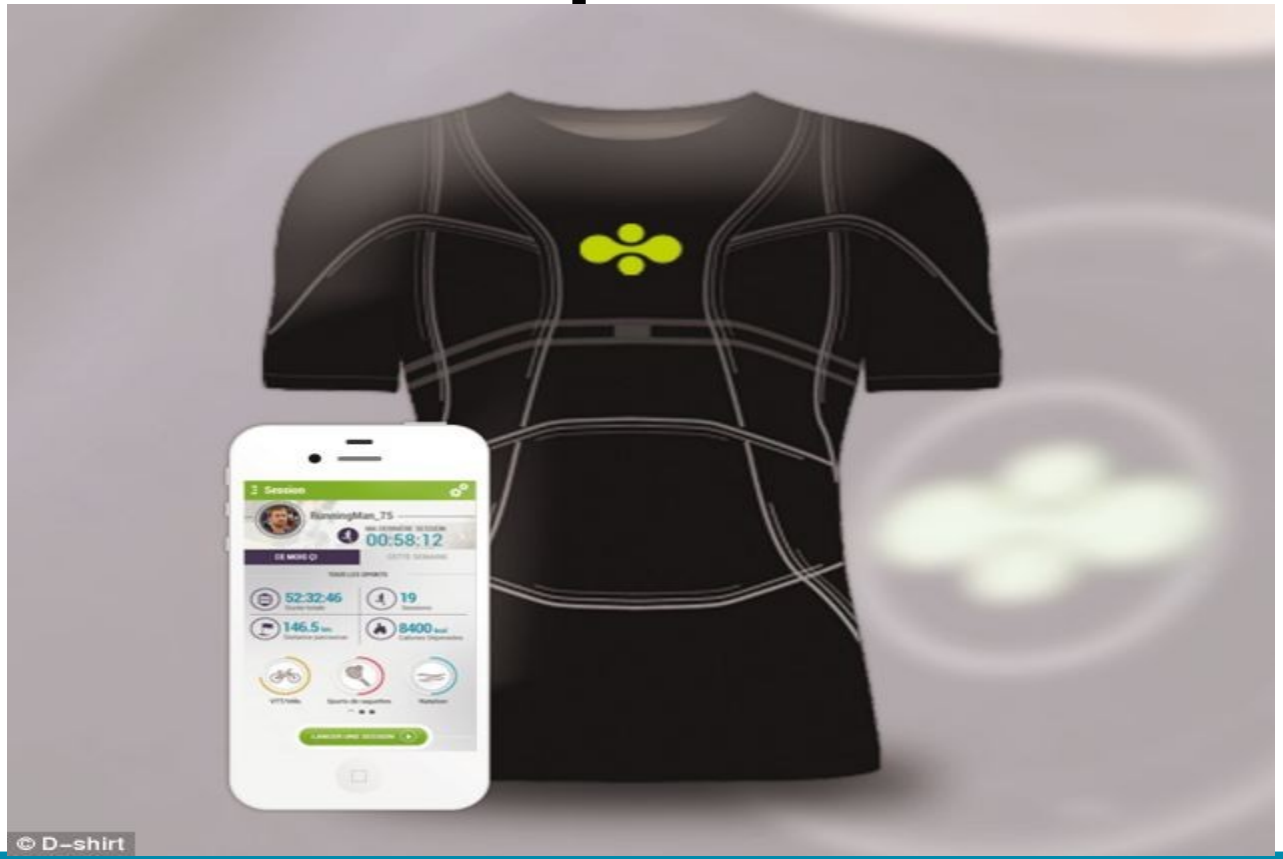
Smart LED lamp

- Happy or not



Intelligent classroom

Sport



Smart Shirt

- 'D-Shirt' by French company Cityzen Sciences
  - Made from a special fabric woven with sensors
    - heart rate, GPS location, route, speed and altitude
  - information sent to a small detachable transmitter on the back of the shirt
    - This in turn sends transmissions to a smartphone via Bluetooth
  - Transmissions can only be made up to 10 metres away from the phone
  - The phone can store and analyse data from the fabric
    - showing the person's route and how fast they are going
    - summary at the end of each session
      - route, time, speed, heart rate and number of calories burned
  - friend or personal trainer can monitor
    - from a distance
    - during a workout

Smart Shirt


11:20
1h30
COURSE
EDIT.
VOIX
VERROUILLER
STOP
01h 12m 26s
Durée
6,3 km
Distance parcourue
20 %
Fréq. cardiaque
452 kcal
Calories dépensées
64 bpm
Fréq. card. inst.
6,3 km/h
Vitesse
20 %
Fatigue
500 m
Dénivelé
© D-shirt


Session
RunningMan_75
MA DERNIÈRE SESSION
00:58:12
CE MOIS ÇI
CETTE SEMAINE
TOUS LES SPORTS
52:32:46
Durée totale
19
Sessions
146.5 km
Distance parcourue
8400 kcal
Calories Dépensées
VTT/Vélo
Sports de raquettes
Natation
© D-shirt

SMART CITY

Smart City Vision

- 50% of the world population lives in a city
- 2010-2050: Urban population will almost double
- Cities occupy 2% of the world's geography
- 1.2 billion cars on the road by 2015 (1 car / 6 people)

An accelerating growth

7,500

People per hour

70%

in cities by 2050

3%

of the earth's surface

80%

of CO_2 emission

75%

of energy consumption

Negative outcomes

Pollution, inadequate infrastructure, noise, social…

SMART Cities

Smart cities can be identified along six main axes or dimensions:

- a smart **economy**
- smart **mobility**
- a smart **environment**
- smart **people**
- smart **living**
- smart **governance**

Characteristics and factors of a smart city

SMART ECONOMY (Competitiveness)

- Innovative spirit
- Entrepreneurship
- Economic image & trademarks
- Productivity
- Flexibility of labour market
- International embeddedness
- *Ability to transform*

SMART PEOPLE (Social and Human Capital)

- Level of qualification
- Affinity to life long learning
- Social and ethnic plurality
- Flexibility
- Creativity
- Cosmopolitanism/Open-mindedness
- Participation in public life

SMART GOVERNANCE (Participation)

- Participation in decision-making
- Public and social services
- Transparent governance
- *Political strategies & perspectives*

SMART MOBILITY (Transport and ICT)

- Local accessibility
- (Inter-)national accessibility
- Availability of ICT-infrastructure
- Sustainable, innovative and safe transport systems

SMART ENVIRONMENT (Natural resources)

- Attractivity of natural conditions
- Pollution
- Environmental protection
- Sustainable resource management

SMART LIVING (Quality of life)

- Cultural facilities
- Health conditions
- Individual safety
- Housing quality
- Education facilities
- Touristic attractivity
- Social cohesion

IoT in the cities

- Smart technologies can create more efficient systems, such as:
  - transport and power supply,
  - and better-informed citizens.
- With the "Internet of Things", which refers to the networked connection between everyday objects, now including:
  - smart phones and tablets,
  - social media,
  - super-fast broadband
  - real-time instrumentation

Challenges for IoT

- Overcoming technology-domain specific boundaries

- Addressing the key challenges

  - Determine what technologies need to interoperate or integrate and at what level

  - Create a community with common vision for the IoT

  - Secure and reliable access to sensor and actuator information

Smart City Vision


Street Light Management


Public Safety


Smart travel


Management Control


Education


Fleet Management


VoD


Video Conferencing


HealthCare


KIOSK


Access Control


Parking Control


CCTV Monitoring


Waste Management


Facilities Control

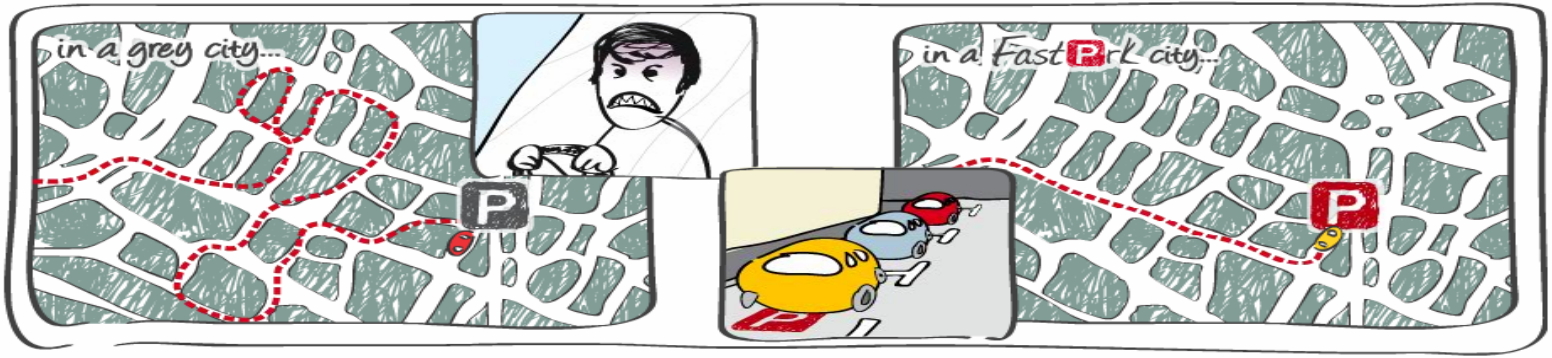

Power Control


Light Control

Non-exhaustive list of M2M applications & services

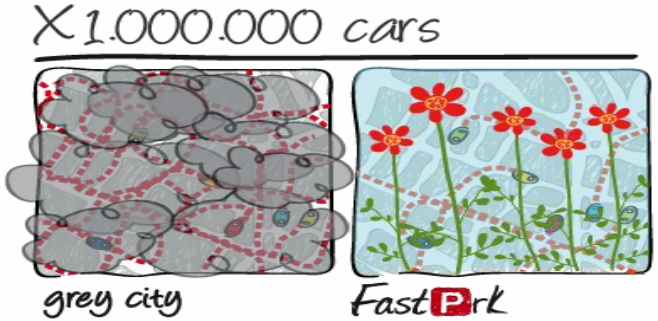
- Car Telematic
- Fleet Management
- Parking & Traffic Management in urban areas
- Positioning Systems
- Smart Metering
- POS-Terminal
- Security
- Remote Monitoring of Green Energy power plants
- Remote Management of Assets & Products
- Environmental monitoring & ICT support to a sustainable economic growth
- eHealth

Smart City Vision - Urban Parking Quests



Real cities...

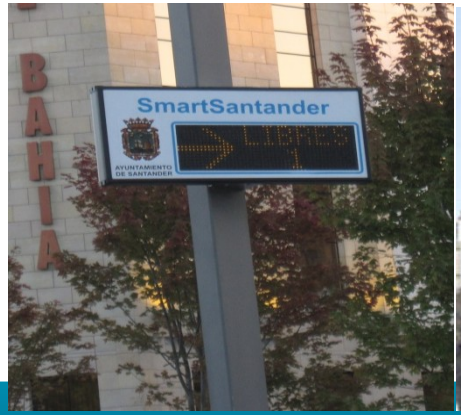
Barcelona 2010:
- daily quest for parking spots
- 1,000,000 (million) cars
- average 16 minutes

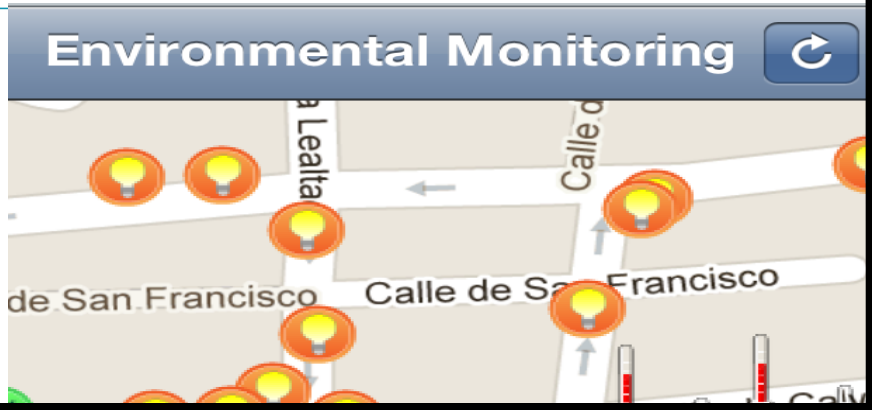


Smart Parking

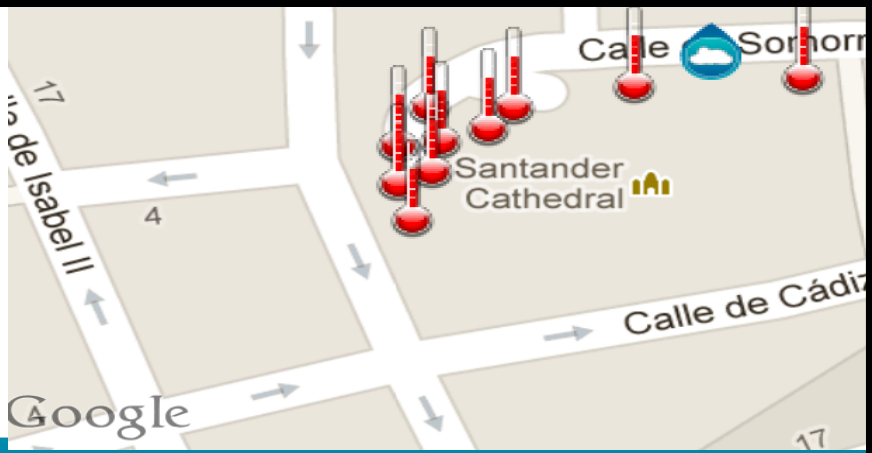
First step…

….then it is easier to find parking place…





Environmental Monitoring and Smart Parking

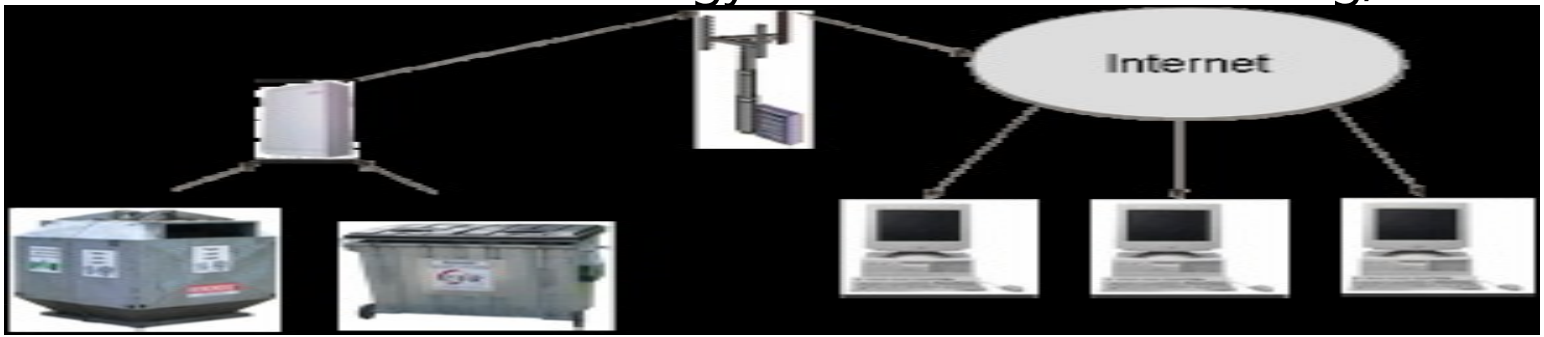


Participatory Smart Sensing

http://psens.smartsantander.eu/map.php

Urban Container Monitoring

- Recycling containers (Voiron, France):
  - reduces cost (no more random collection), reduced dissatisfaction (no more spillovers), protects investment (real time theft alert)
  - France Telecom technology: ultrasound level sensing, shock



Smart Bin

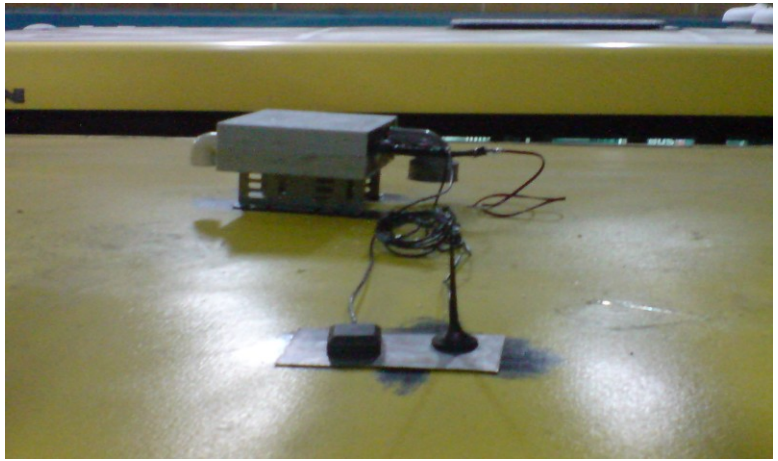

OUTSMART Waste Management System
Start Database Debug
OUTSMART
60 %
Garbage Can Information
ID 1
Street Carrer Pedrosa A 64
Fill Level 60
Defect False
Longitude 41.354605049472
Latitude 2.1280178359984
Future
tructures
XiPi
www.xipi.eu


ZIELPUNKT

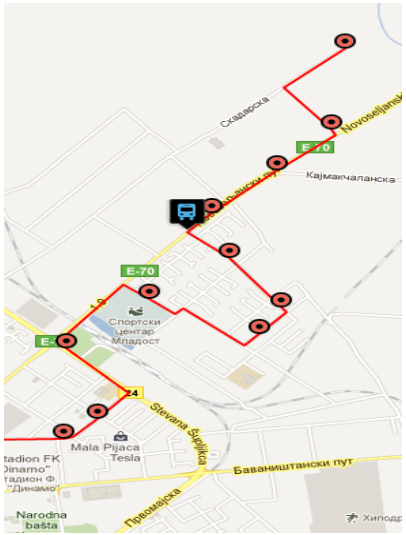
EKONET

Real world experience – FP7 SENSEI

- ekoBus deployment in Belgrade and Pancevo
- Fleet management solution
- ekoBus service collects measurements



ekoBus



ekoBus

Public transport fleet management:

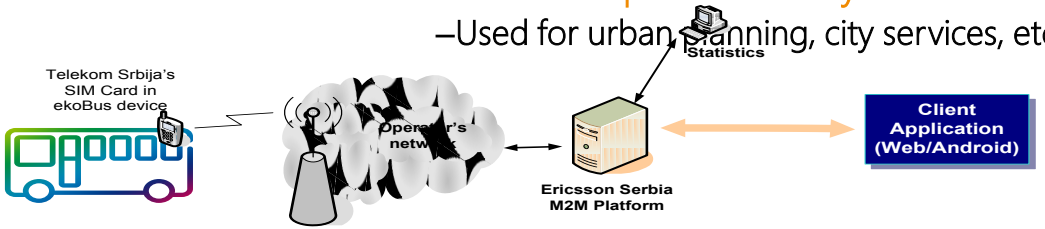
- Public Transportation Company
  - –Start/stop times, schedule compliance, route compliance,…
- Citizens
  - –Mobile phones based delivery of information about bus arrival times

Mobile environment monitoring system for citizens and authorities:

- –Monitoring of air quality and environment conditions using buses as mobile stations

Platform for acquisition of city wide data

- –Used for urban planning, city services, etc.



EkoNET - Problem Statement

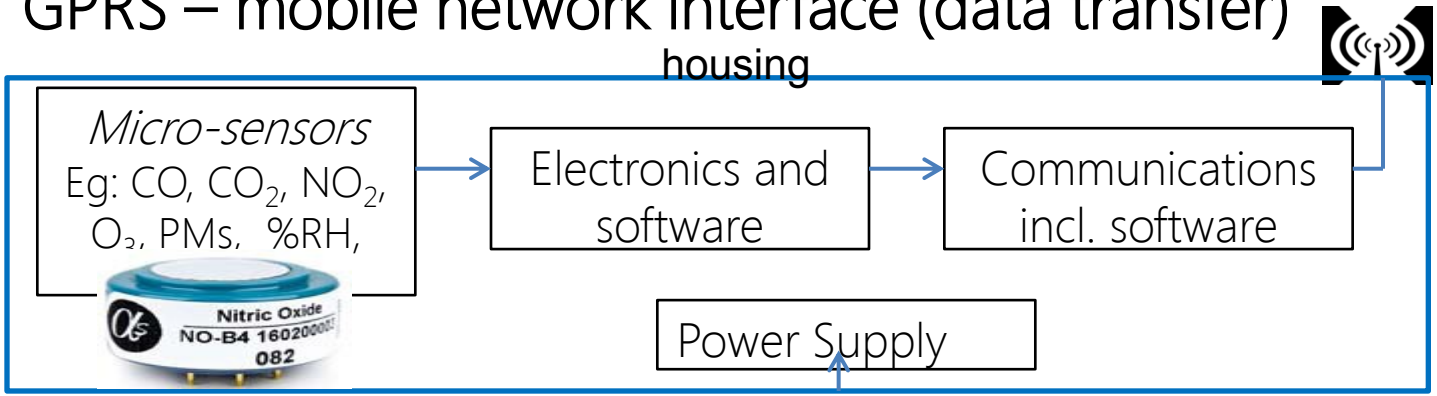
Air quality monitoring is extremely important as air pollution has a direct impact on human health.

- Rising need to measure and monitor environment parameters such as temperature, humidity, air quality etc.
- Currently expensive stationary monitoring station are used
- A real-time data is currently not available
- People are detached from the air quality monitoring process, but acutely aware of impact air quality has on their health

EkoNET - Overview

The ekoNET devices contain the following components:

- Measurement devices to monitor the environmental parameters (gas and atmospheric condition sensors)
- GPS module (location)
- GPRS – mobile network interface (data transfer)



EkoNET - Overview

Together with the following modules ekoNET devices represent the whole environment monitoring system:

- data server (data storage and processing)
- web and mobile application (data visualization)

The ekoNET service is designed to provide a complete end-to-end solution for the environmental monitoring following the design concepts used within the Internet of Things domain (IoT).

EkoNET - Overview

It offers:

- A real-time air pollution monitoring in urban and rural areas that utilize low cost sensors
- Using wireless systems for transmission of measured data and vizualisation of data in a real-time
- For the air quality estimation, electrochemical gas sensors are utilized which measure: CO, CO_2, NO, NO_2 and O_3, as well as particle monitor PM2.5 and PM10
- Other environment parameters are measured using sensors, such as:
  - noise,
  - temperature, humidity
  - air pressure

EkoNET - Environment Monitoring Solution

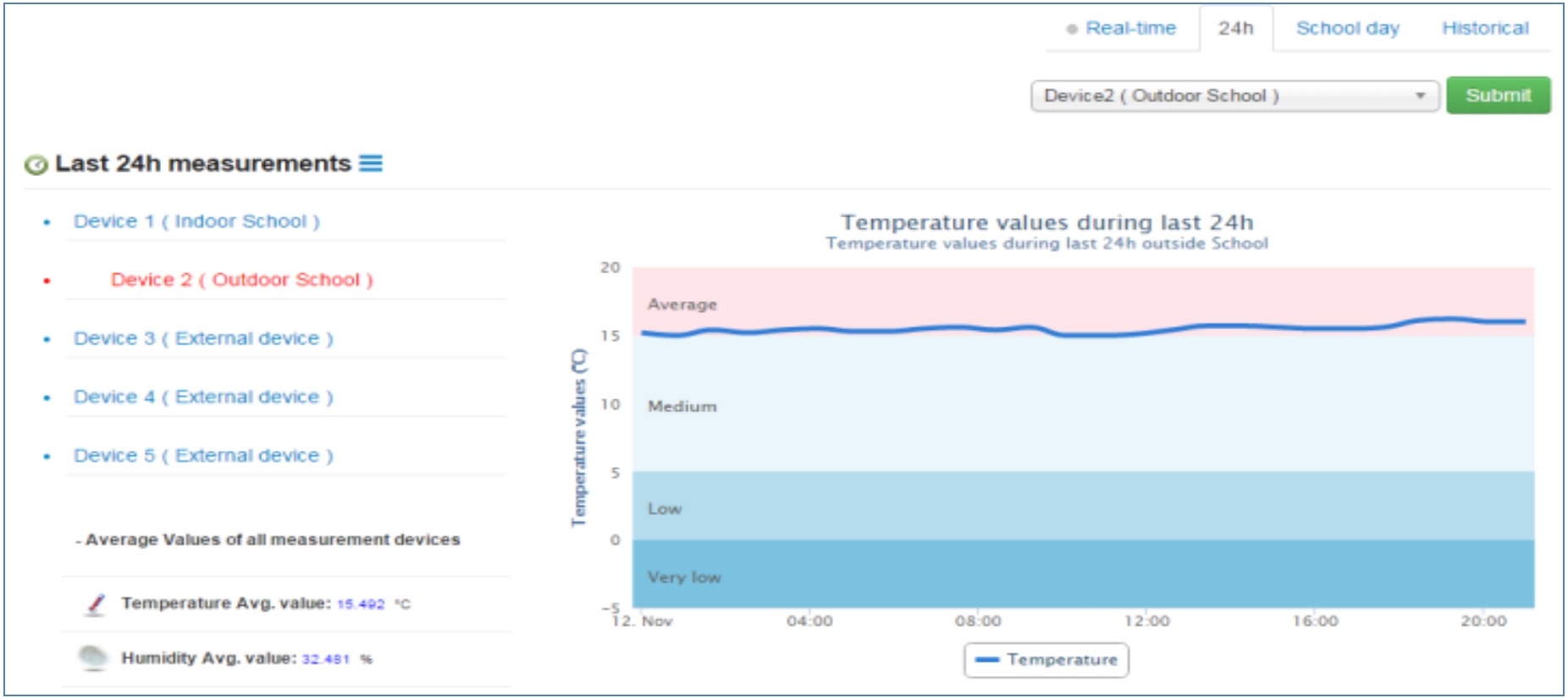
ekoNET device with low-cost electrochemical gas sensors

Deployed ekoNET device

EkoNET - Results

The data can be visualized in a real-time using the appropriate web or mobile applications

EkoNET - Results



EkoNET - Customers

- Small to medium municipalities and enterprises
- Large cites
- The oil and gas industry
- Personal monitors (future models, possibly in collaboration with partners)

EkoNET - Markets

- The EB700 has been deployed 4 years ago on buses in the city of Pancevo, Serbia
- Two devices are deployed in Oslo (Norway) as a part of a small pilot.
- It is deployed in 5 elementary schools in the city of Belgrade (Serbia) as part of Citi-sense project (www.citi-sense.eu).
- Monitoring device will be made for city of Novi Sad and deployed in a few schools and crossroads
- It is planned to deploy several devices in the open-pit coal mine
- Now we are developing portable version of device with individual sensors

Kostolac