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SENSORCOMM 2017

PANEL

Sensor-based Applications and Services in Digital Society

MODERATOR:
Abdallah Makhoul, Femto-st, University of Bourgogne Franche-Comté, France

Sensor tasks

Temperature, Humidity, Vehicular Movement, Lightning Condition, Pressure, Soil Makeup, Noise Levels,

Presence or Absence of Certain Types of Objects, Mechanical Stress Levels on

Attached Objects, Current Characteristics (Speed, Direction, Size) of an Object, chemical, biological, ….

Sensor Network Applications

Sensing + CPU + Radio ⇒ Thousands of potential applications

Wireless Sensors Applications

Smart City

- Smart Parking, Structural health, Smart Roads, Traffic Congestion, …

Smart Environment

- Forest Fire Detection, Air Pollution, Snow Level Monitoring, Earthquake Early Detection, …

Smart Metering

- Tank level, Photovoltaic Installations, Water Flow, …

Security & Emergencies

- Perimeter Access Control, Liquid Presence, Radiation Level, Explosive and Hazardous Gases, …

Domotic & Home Automation

- Energy and Water Use, Remote Control Appliances, Intrusion Detection Systems, Art and Goods Preservation, …

eHealth

- Fall Detection, Medical Fridges, Sportsmen Care, Patients Surveillance, Ultraviolet Radiation

Panelists

Moderator

Abdallah Makhoul, University of Bourgogne Franche-Comté, France

Panelists

- Winfried Vonau, Kurt-Schwabe-Institut, Germany
  [Can chemo- and biosensors be integrated efficiently in long-lasting smart-home and home-care systems?]
- Ivan Krejci, College of Polytechnics Jihlava, Czech Republic
  [Electronic Systems for Electrochemical Measurements designed in College of Polytechnics Jihlava.]
- Nanpeng Yu, University of California, Riverside, USA
  [Smart sensor-based applications in power systems and smart grid]
- Thierry Laroche, frec|n|sys, France
  [frec|n|sys and its applications in wireless/batteryless sensor domain]

Open discussion

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frec|n|sys

Frequency Components and Systems

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Fax. : +33 (0) 3 81 25 53 51
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www.frecnsys.com

Scientific origins...(mine)

- Academic area
  - Electromagnetic wave propagation
    - Near-field (scanning near-field optical microscopy)
    - Non-linear optic (microscopy resolution increasing and information transfer)
    - nano-optic (plasmonic to adress information, biological sensors)
  - Acoustic wave propagation (piezoelectric crystal)
    - Filters in mobile telecommunications
    - High stability sources (time stability in GPS applications)
    - Sensors (Temperature and pressure)
- Industrial area
  - Filters in public and strategic telecommunications
  - Energy suppliers (adress a resistor or capacitor without battery, passive transformers RF-DC)
  - Batteryless et wireless sensors and antennas
  - Electromagnetic compatibility (impedance matching between sensor and antenna in remote applications, sensor network/antenna influence on an individual)

A business core for high-end markets

Passive and wireless sensors for harsh environments:Temperature, static and dynamic stress, acceleration, pressure, adsorption, gas

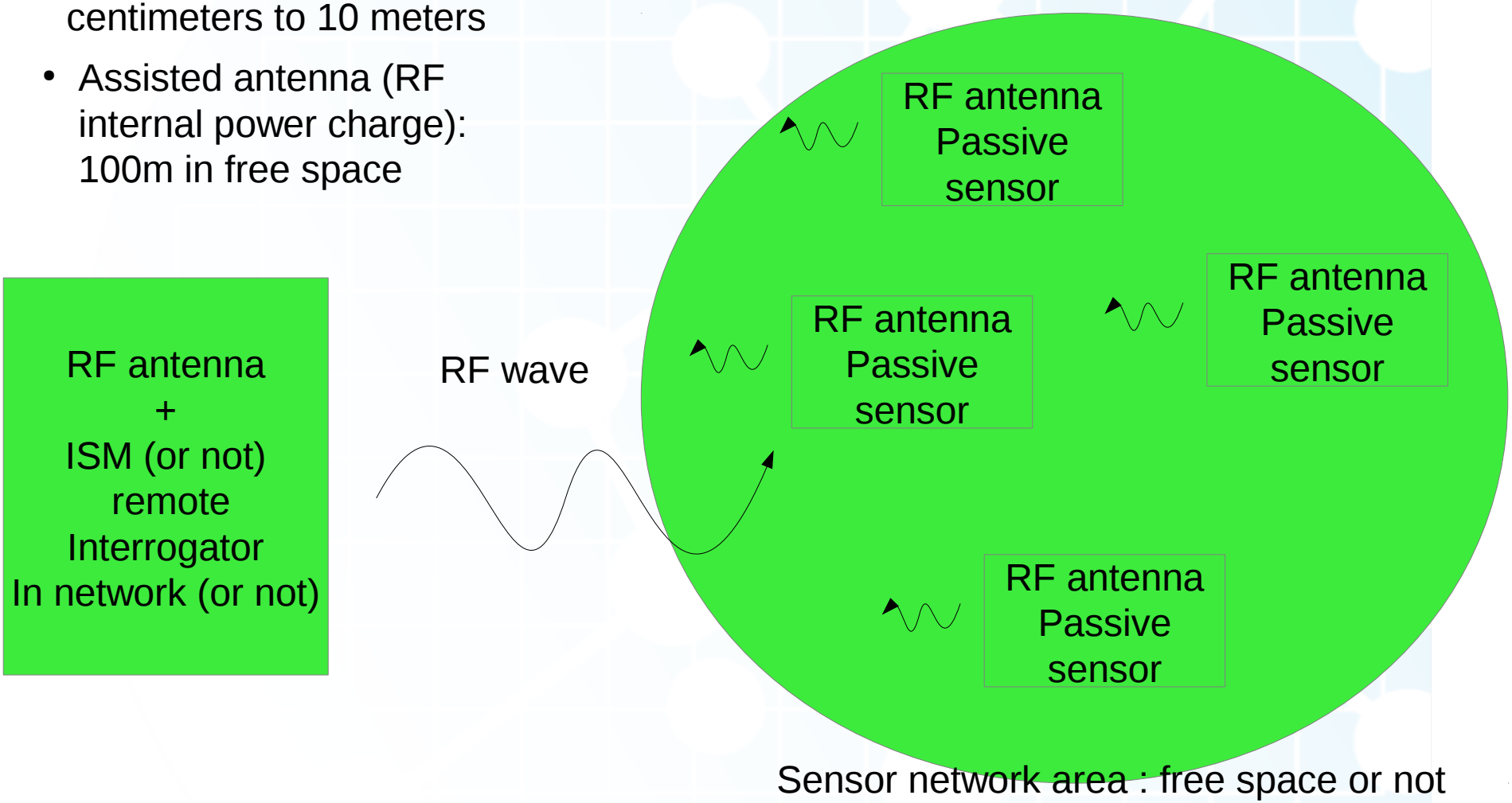
Pipeline, Alaska
Temperature < -50°C,
humidity, condensation,
extreme geographical localization

Turbines
Temperature > 500°C,
Rotation speed (26000 rpm),
magnetic fields and metallic environment

Most important issues in passive and assisted mode

- Passive RF distance of interrogation : from a few centimeters to 10 meters
- Assisted antenna (RF internal power charge): 100m in free space

Sensor and antenna sizes depend on frequency



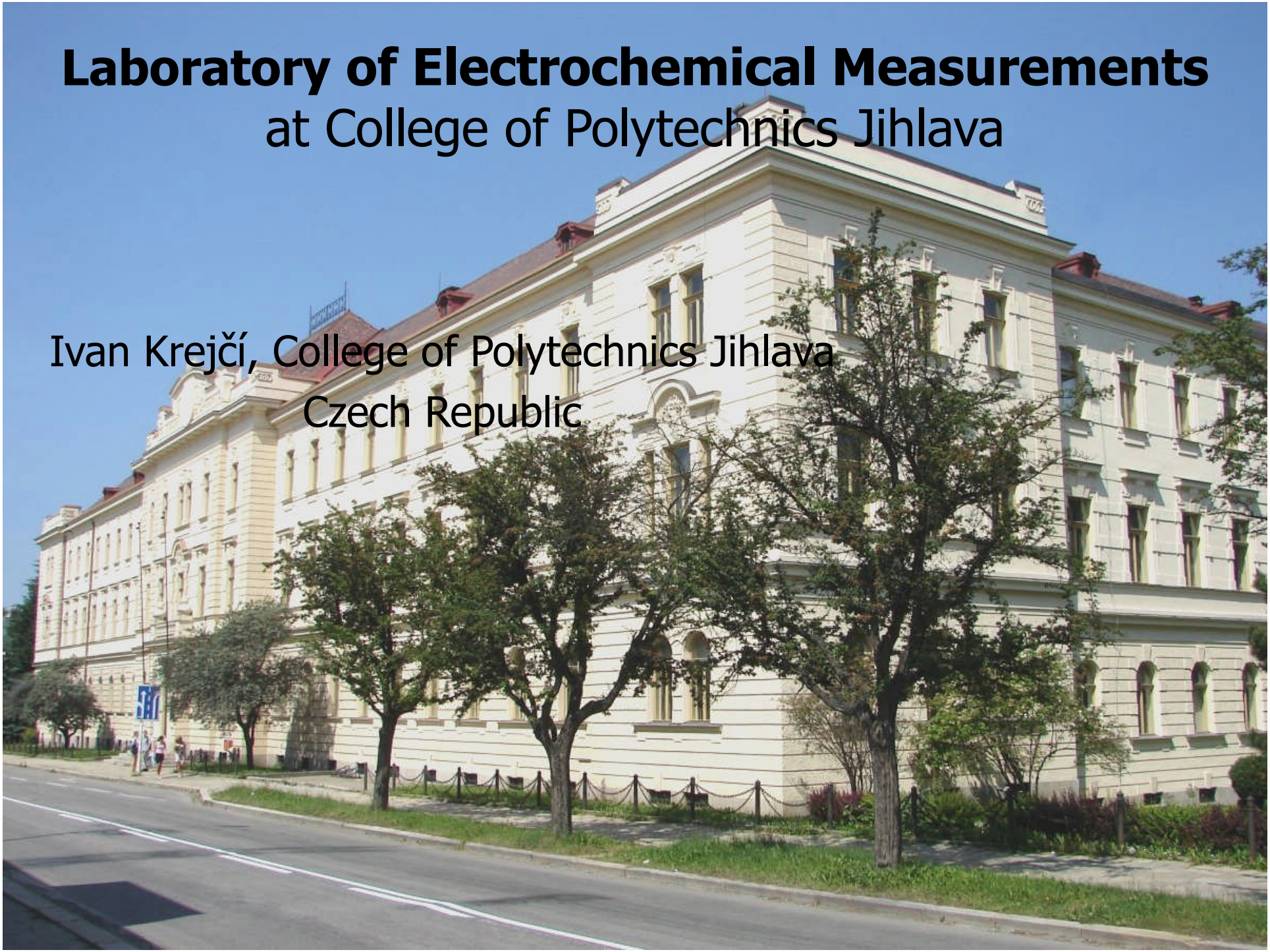
Most important issues in passive and assisted mode

Standard active wireless sensor response does not depend on the frequency of communication with the interrogator

It's not the case for passive wireless sensors !

- How to control and to predict the response of passive sensors:
  - Frequency response
  - Sensitivity to mesured parameters
- How to know the impact of the antenna on passive sensors :
  - The frequency response changes
  - The surrounding medium has an impact on the antenna itself
- How to predict the influence of sensor networks on an individual :
  - Interactions with surrounding medium influence (metallic medium or active electromagnetic...)
  - Cross-talk between all individual sensors on only one.

Laboratory of Electrochemical Measurements
at College of Polytechnics Jihlava



Ivan Krejčí, College of Polytechnics Jihlava
Czech Republic

Department of Technical Studies

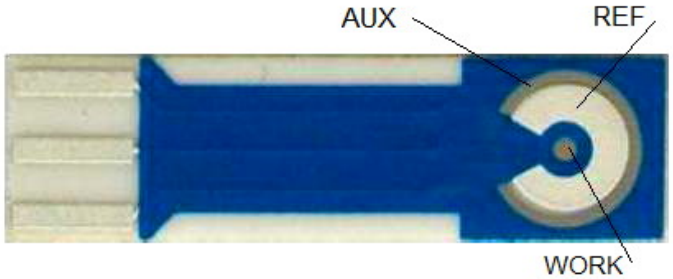
Introduction

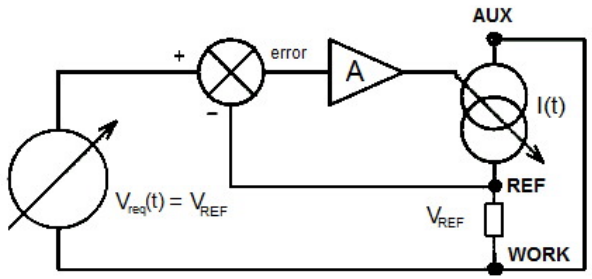
- The College has several departments and one of them is the Department of Technical studies, which involves following fields of study: Computing Systems (oriented to the electrical engineering), Applied Technique for the Practice (the mechanical engineering) and Applied Informatics.
- The measurement technique and sensors are subjects which are taught at the first two branches.
- The department cooperates with another university laboratories in Czech Republic (Brno University of Technology, University of South Bohemia in České Budějovice) and abroad (Hochfachschule Technikum, Vienna, A, TU Regensburg , D), and with regional firms.
- One of such firms is BVT Technology, the manufacturer of electrochemical sensors and biosensors.
- The laboratory of electrochemical measurements was established several years ago, as the result of this cooperation.
- The main task of the laboratory is the building of electronic systems for electrochemical sensors' signal processing.

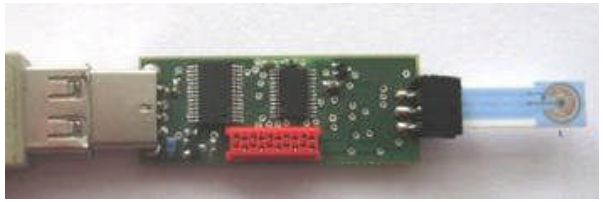
Realized projects

1. **Potentiostat for three electrode measurements**

- The system measures properties of a molecular capacitor at a polarized electrode.
- The sensor has three electrodes, the reference, working and auxiliary once.
- The reference electrode defines intensity and homogeneity of the electrical field in the working electrode neighborhood.
- The auxiliary electrode sets the electrical current through the system, so that the voltage at the reference electrode is kept on a required level.
- The current circuit is closed by the polarized working electrode. The current flowing via this electrode is measured.







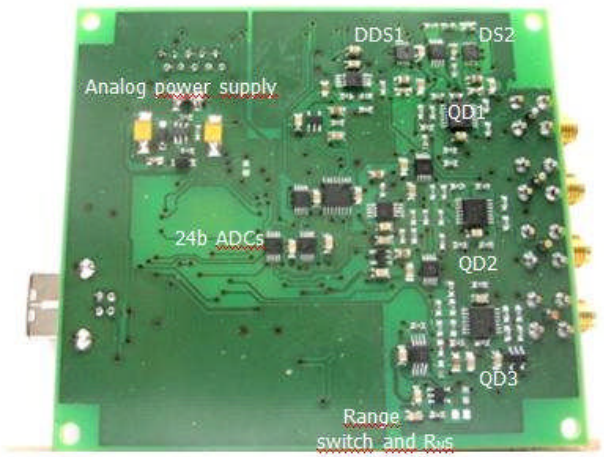
- Two basic methods of measurement :

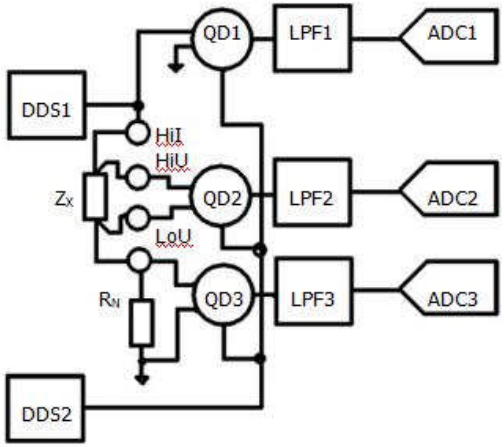
  V_{REF} = const – the amperometry,

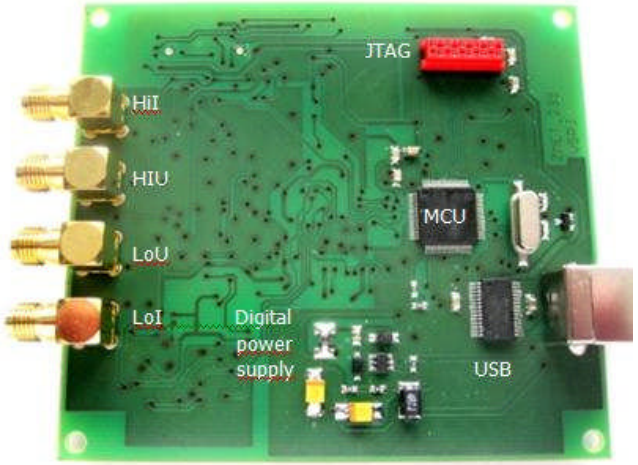
  V_{REF} is cyclically time variable – the cyclic voltametry.

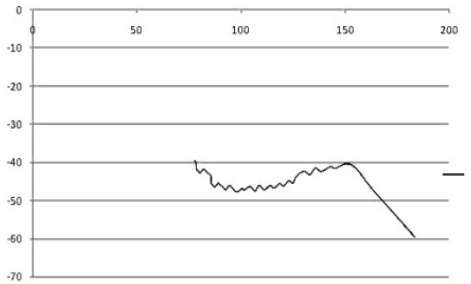
2. Impedance spectrometer for food quality control

- Intended for impedance measurement in objects on boundaries between solid and liquid phases.
- The instrument measured impedances from 10 Ω to 1 MΩ within the frequency range from 100 Hz to 1 MHz.
- The system offers selection between Ohm's and three voltmeters method.









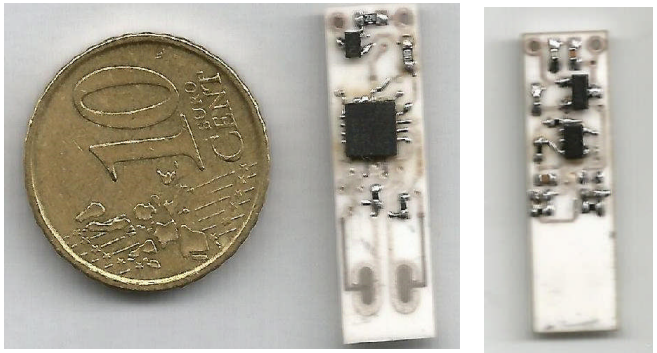
3. Relative humidity meter taking advantage of electrochemical sensors.

- See this conference material.

And the future?

4. Analog and digital front end at the sensor

- All electronic circuits of the potentiostat on the sensor body.
- Only two supplying wires required.
- Supply current modulation makes possible to send measured data.
- The equipment FW is built now.



Sensor-based Applications and Services in Digital Society

A Digital Society is a modern, progressive society that is formed as a result of the adoption and integration of Information and Communication Technologies at **home**, work, education and recreation.

- people avail various government services, pay their bills and taxes, access important information and register companies through an online gateway that works 24/7
- people prefer reliable and secure electronic transactions to cash
- all residents are issued national identity cards based on smart-card technology that enables biometric authentication with a capability for multiple-applications such as personal identification, financial transactions, medical records and employment status in a single card
- Information Technology Enabled Services (ITES) will create more job opportunities through technology parks, IT incubators, and call centres
- all governmental units will be electronically connected with each other and will provide better public services
- people will be highly IT literate and will use e-Government services to better their lives
- a digital society will boast of highly advanced telecommunications and wireless connectivity systems and solutions

https://answers.yahoo.com/question/index?qid=20111010192618AAxbnYr

Sensor-based Applications and Services in Digital Society

Sensor???

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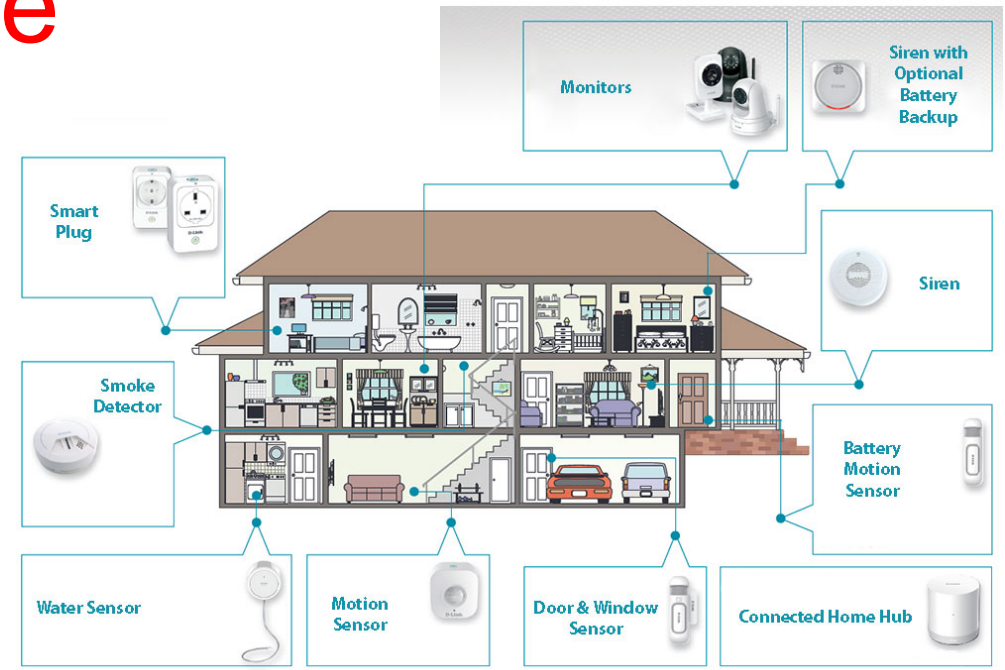
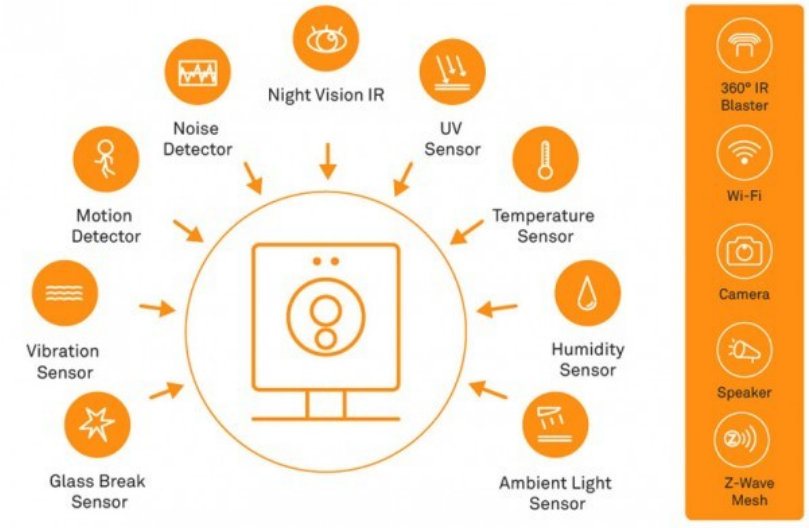
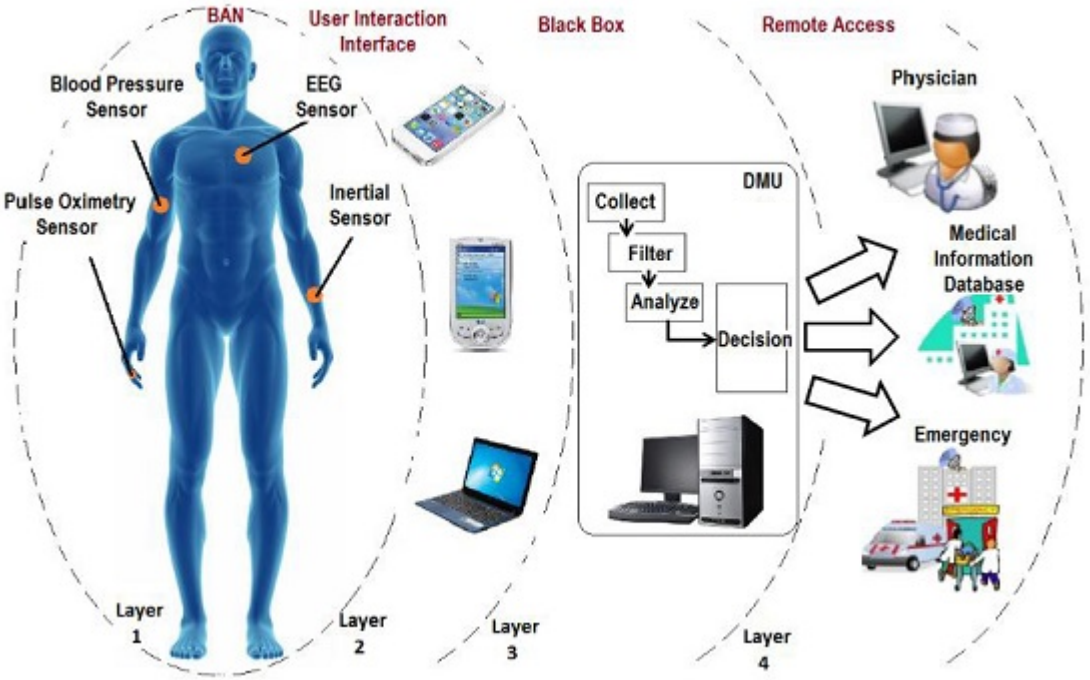
Smart Home



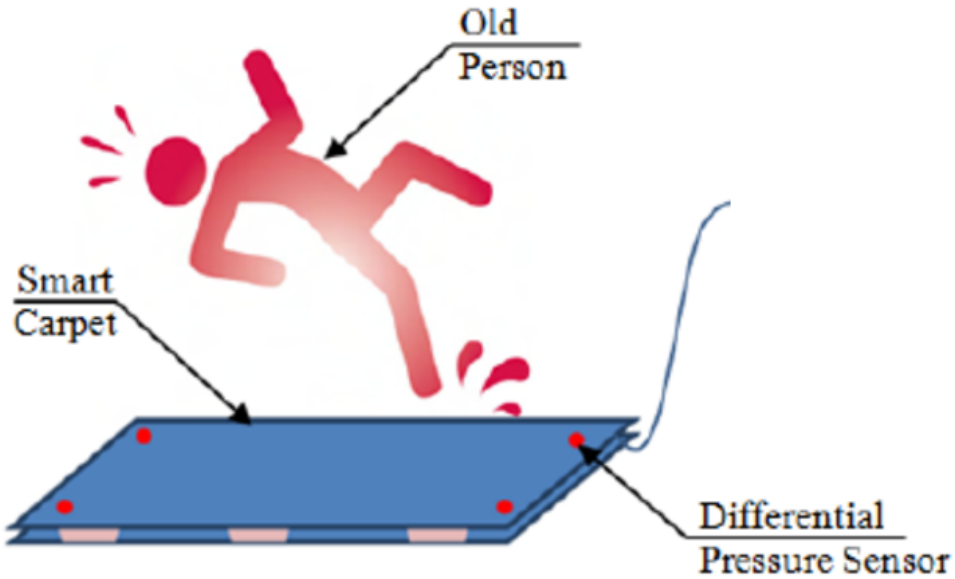


figures from the internet

Home Care

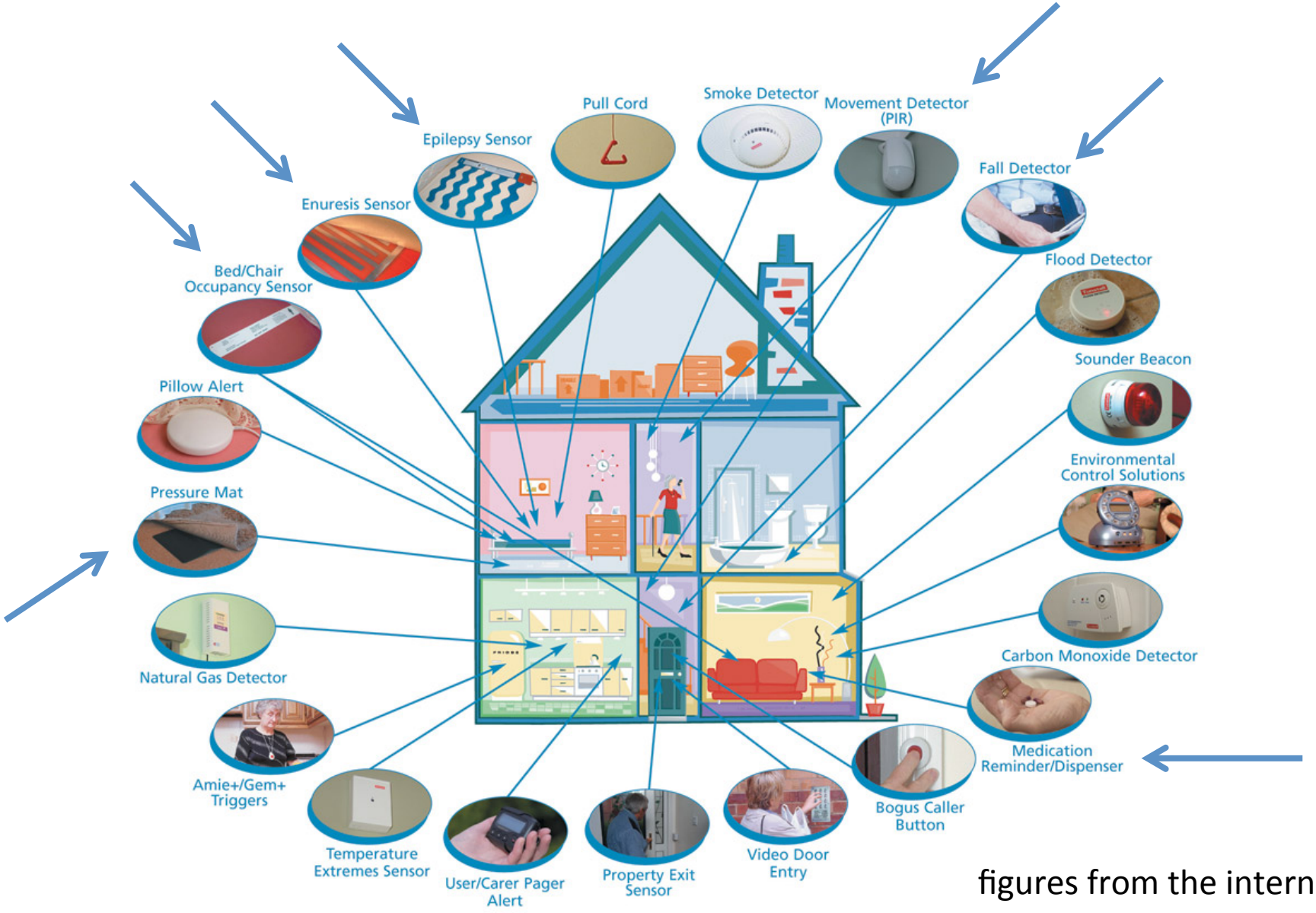


Threat Detection



figures from the internet

Smart Home + Home Care + …



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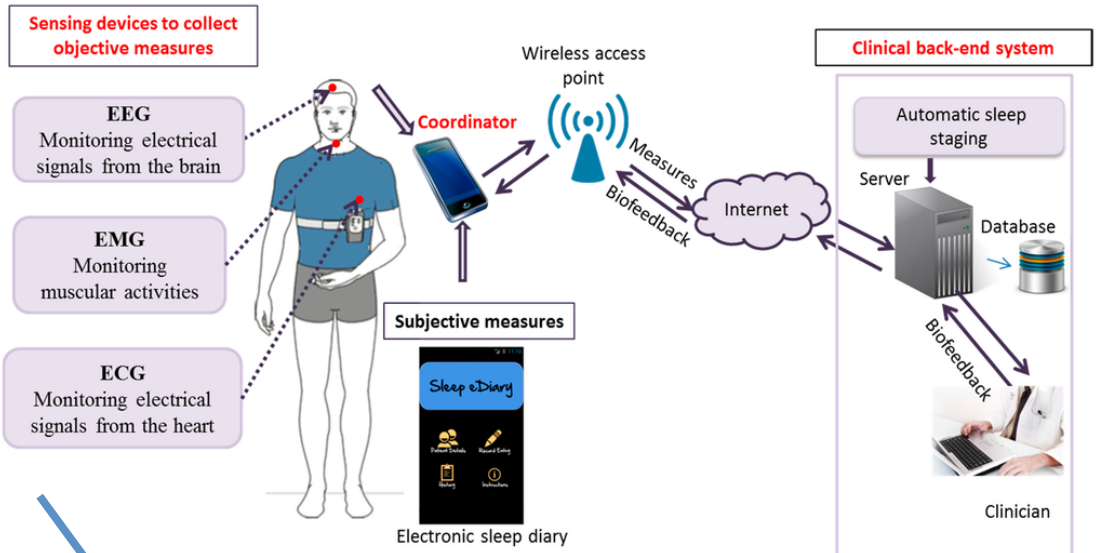
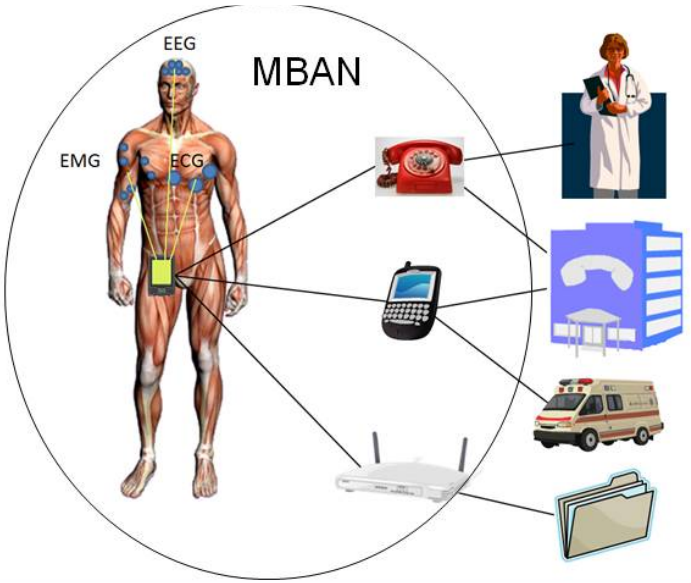


physical sensors

chemical sensors

- **Bio-Medical**
  - EEG Electroencephalography
  - ECG Electrocardiogram
  - EMG Electromyography (muscular)
  - Blood pressure
  - Blood SpO2
  - Blood pH
  - Glucose sensor
  - Respiration
  - Temperature
  - Fall detection
- **Sports performance**
  - Distance
  - Speed
  - Posture (Body Position)
  - Sports training aid



Physical Sensors

long-term stable

- temperature
- pressure
- motion
- ...

(Bio-) Chemical Sensors ???

- Degeneration of functional materials (e.g. selective membranes)
- often calibration necessary
- life time strongly limitated

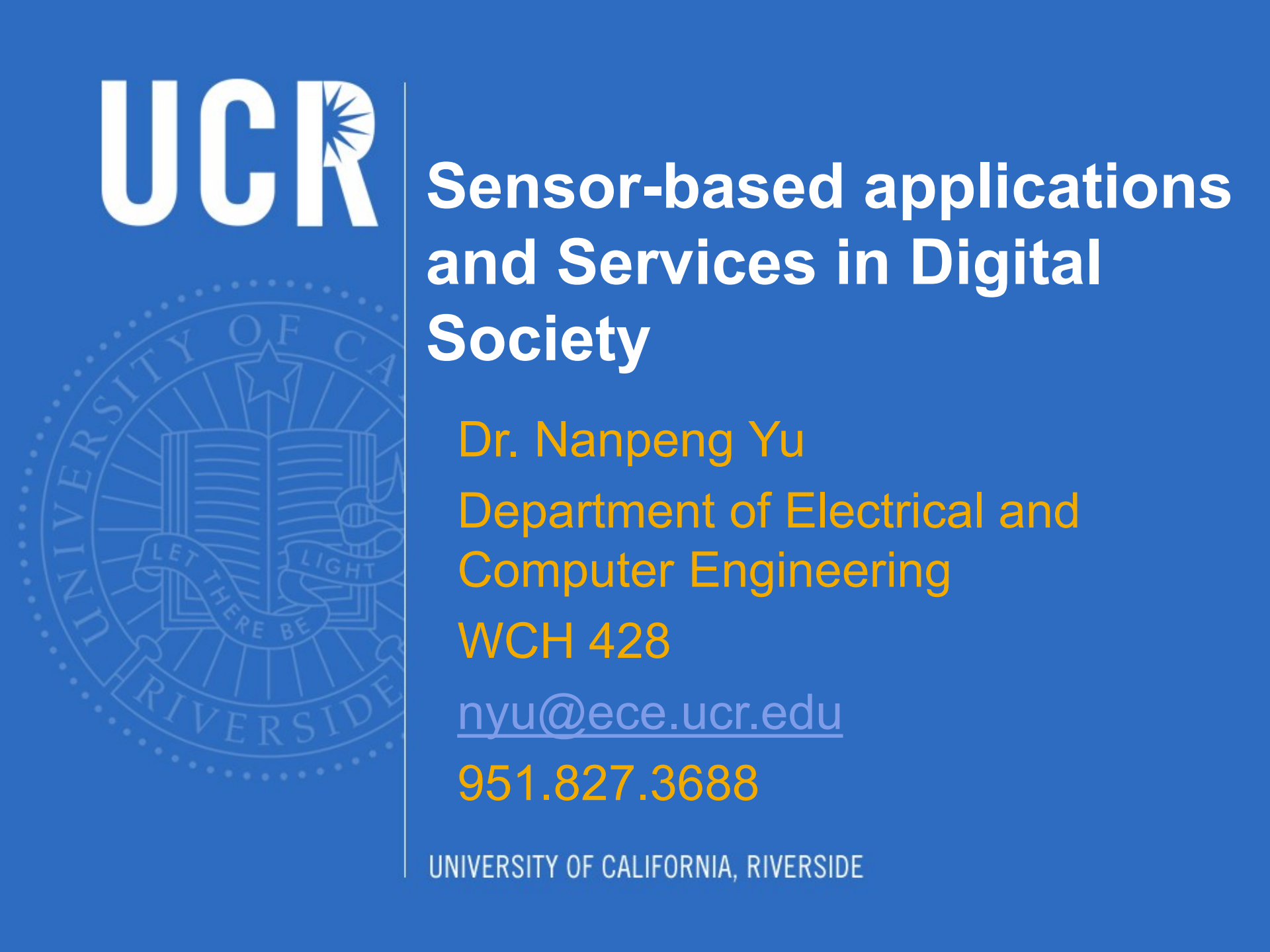
- pH value
- dissolved oxygen
- glucose
- lactose

Question

Can chemo- and biosensors be integrated efficiently in long-lasting smart-home and home-care systems? (Consumer area)

Single-, two- or four point calibration
Check of plausibility of measurement values
...

Measuring instruments with calibration function
Fresh calibration solutions
Frequent subsequent purchase
....



Sensor-based applications and Services in Digital Society

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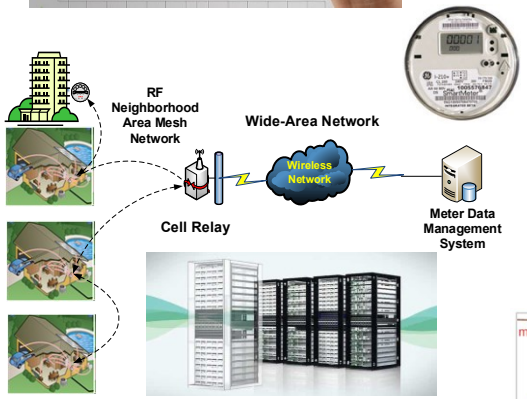
Smart Meter Based Applications in Smart Grid

Spatio-temporal Forecasting

Electric Load / DERs – Short-Term / Long-Term

Anomaly Detection

Electricity Theft, Integration of EV



System Monitoring

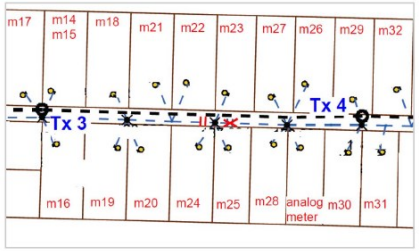
State Estimation & Visualization

Equipment Monitoring

Predictive Maintenance
Online Diagnosis

Customer Behavior Analysis

Customer segmentation, nonintrusive load monitoring, demand response

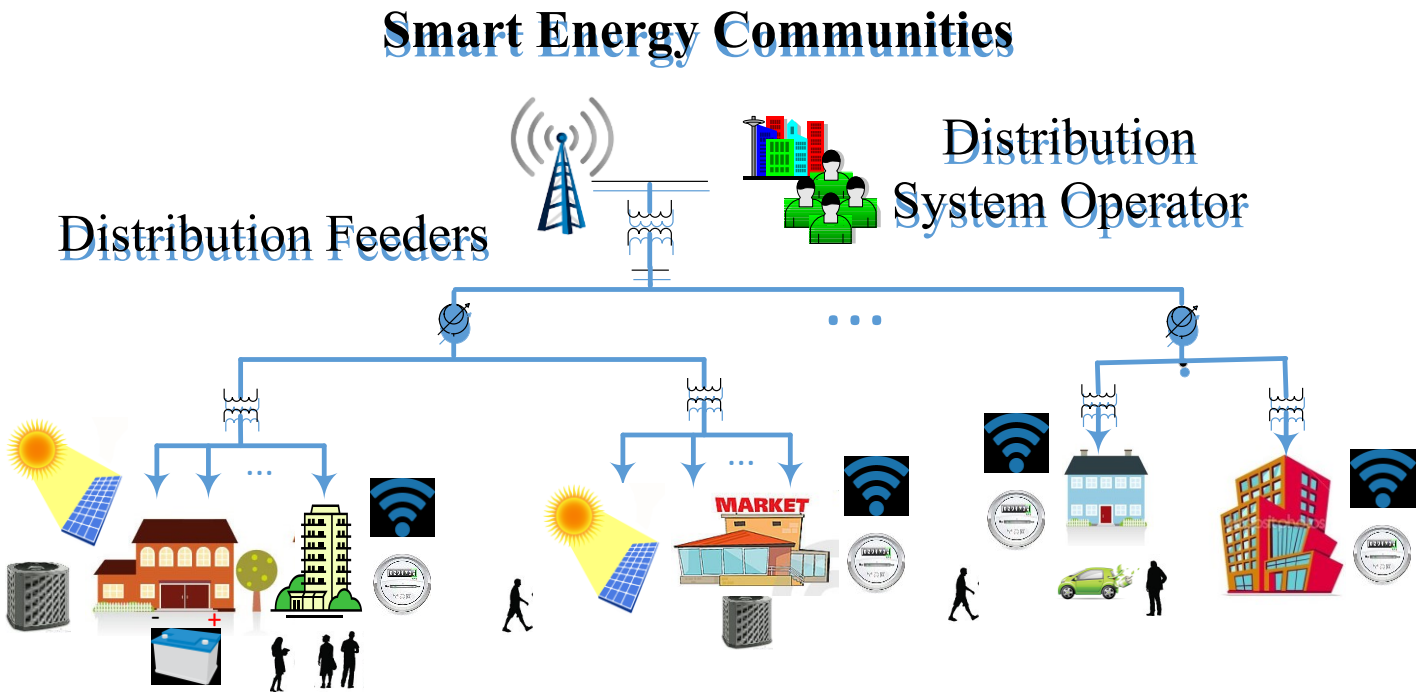


Network Topology and Parameter Identification

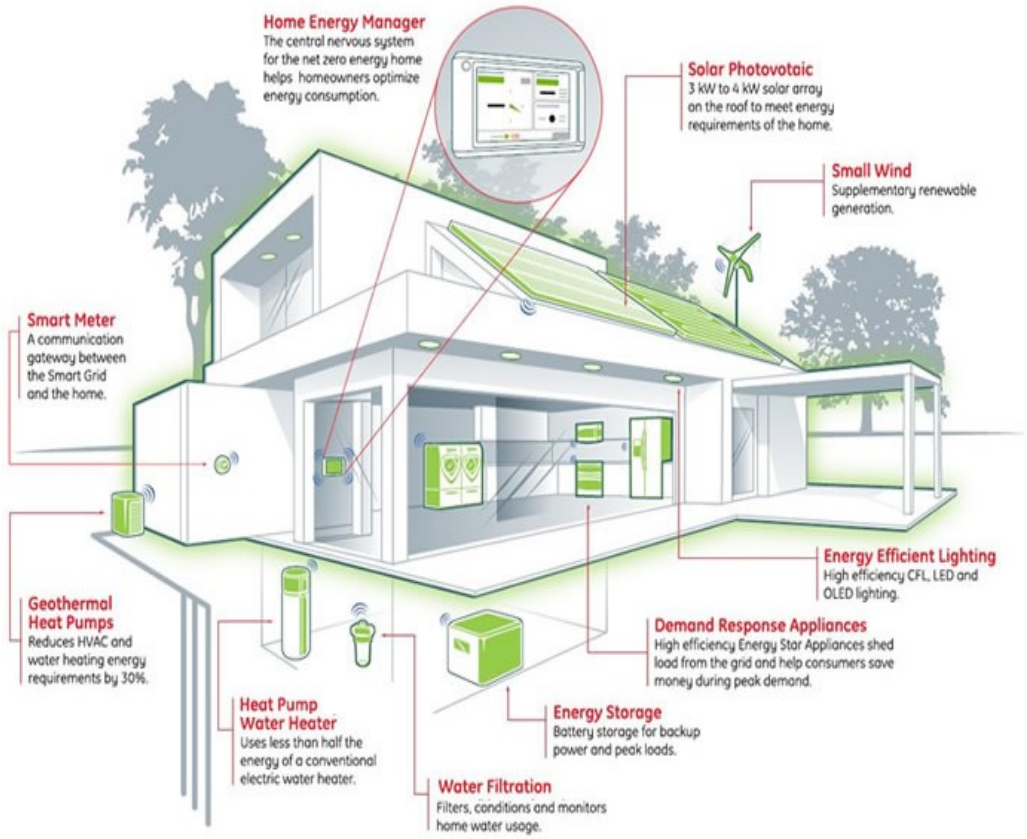
Transformer-to-customer, Phase connectivity, Impedance estimation

Introduction to Smart Energy Communities

- Definition: *Seamless connection* of smart buildings, smart grid, and human network facilitated by rapid deployment of ubiquitous sensor networks, two-way communication networks, and intelligent devices in smart buildings and electric grids.



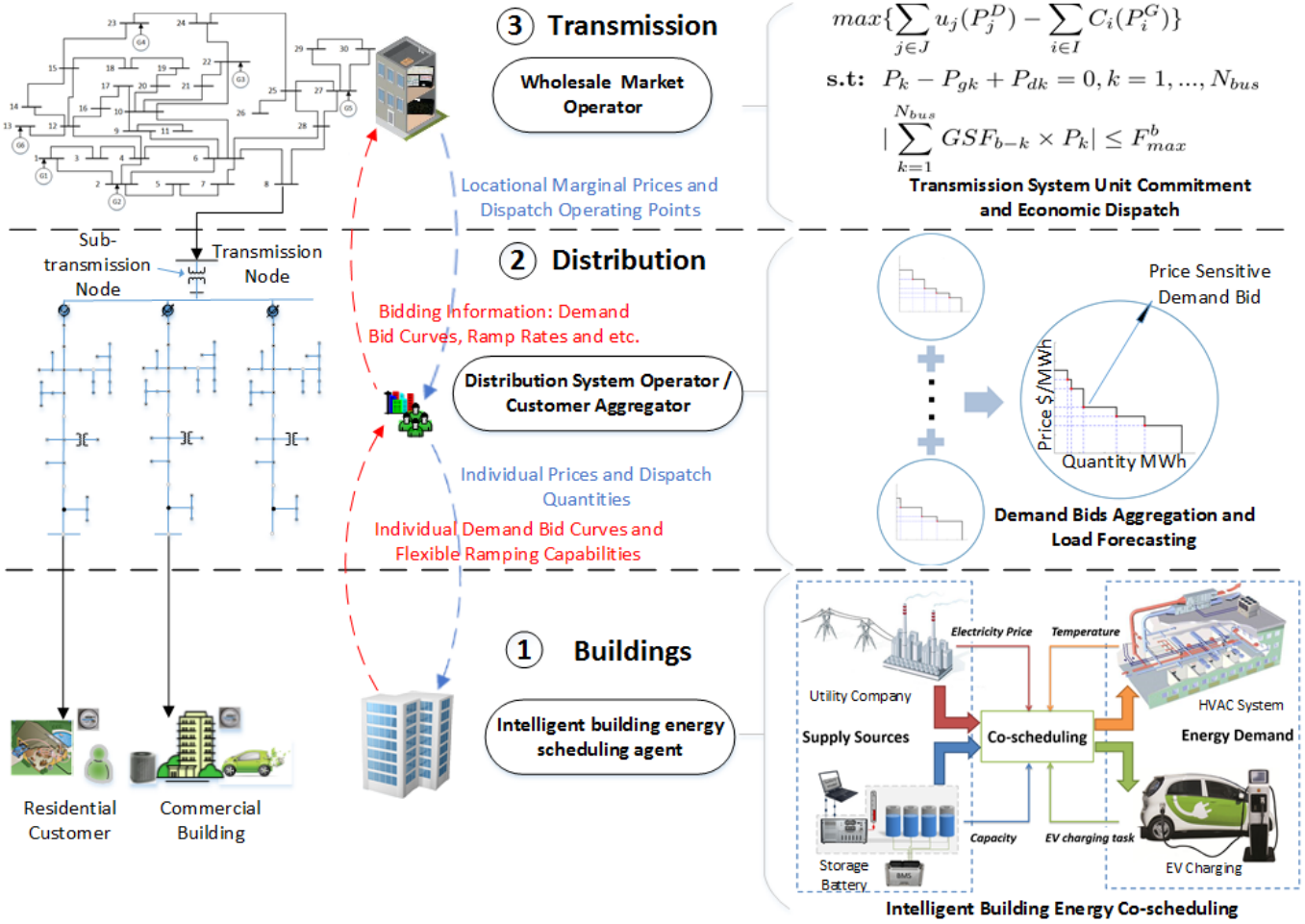
Smart Buildings
Demand Following → Supply Following



- Buildings account for 40% of energy consumption and 70% of electricity consumption
- Building energy efficiency mandate (e.g. California)
- Increasing adoption of smart meters, distributed generation, energy storage
- Higher participation rate in demand response programs.

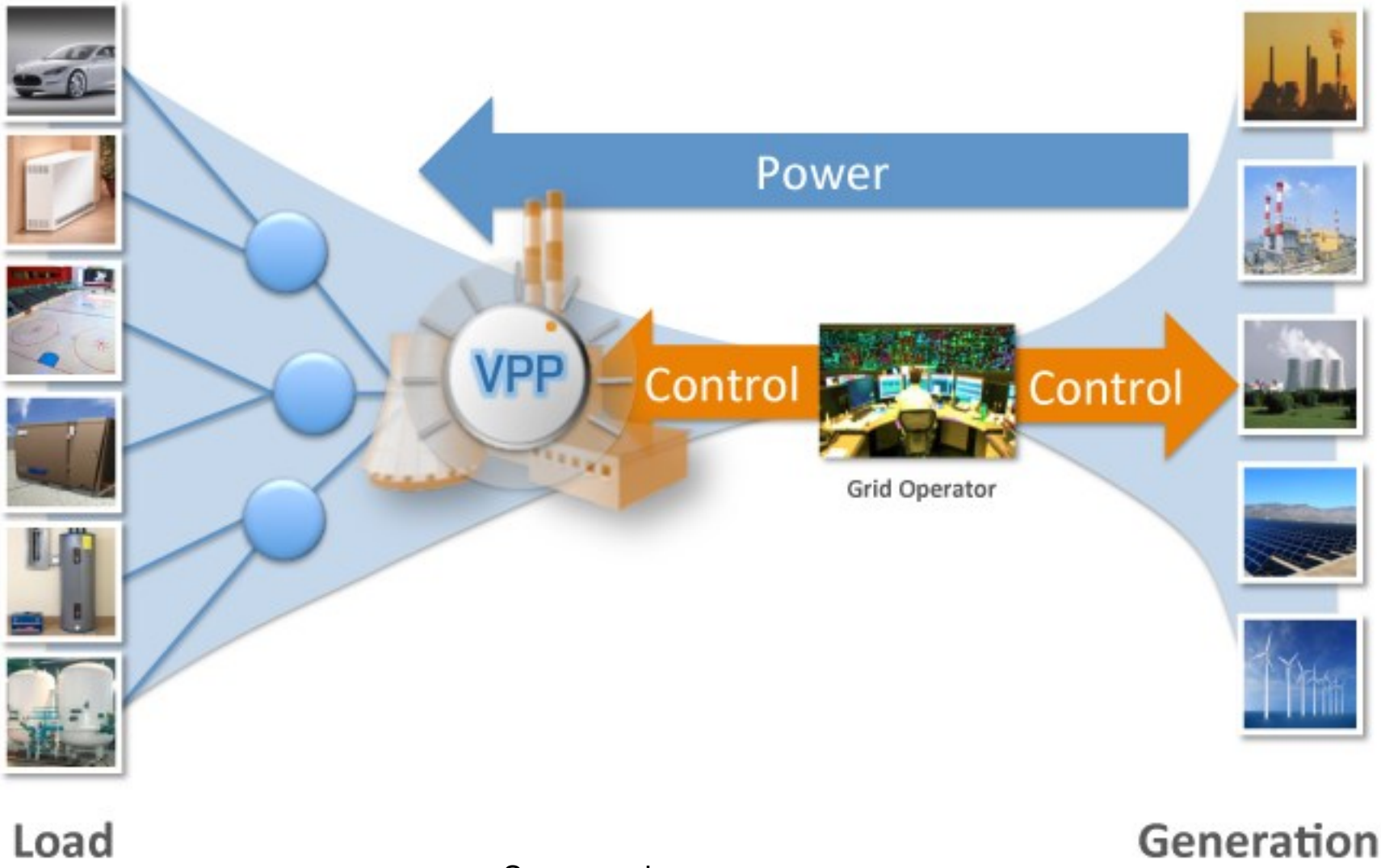
Source: K-Energy (http://www.cypruspv.com/en/services/smart-buildings)

Building to Grid Integration via Smart Sensor Network[1]



1. Tianshu Wei, Qi Zhu and Nanpeng Yu, "Proactive Demand Participation of Smart Buildings in Smart Grid", to appear in *IEEE Transactions on Computers*, 2015.

Create Virtual Power Plant by Aggregating Loads



Source: vcharge-energy.com