

European Network on New Sensing Technologies for Air Pollution Control and Environmental Sustainability - *EuNetAir*

COST Action TD1105

WGs and MC Meeting at LINKOPING, 3 - 5 June 2015

Action Start date: 01/07/2012 - Action End date: 30/06/2016

Year 3 : 1 July 2014 - 30 June 2015 (*Ongoing Action*)

Present IAQ sensor technologies and future trends



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Expert

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 **cost**
EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY



Today's IAQ probes

- IAQ probes

- CO₂, VOC, T°, RH
- Controls



Today's probe



On going project
With ISO 16000-29 compliance for VOC

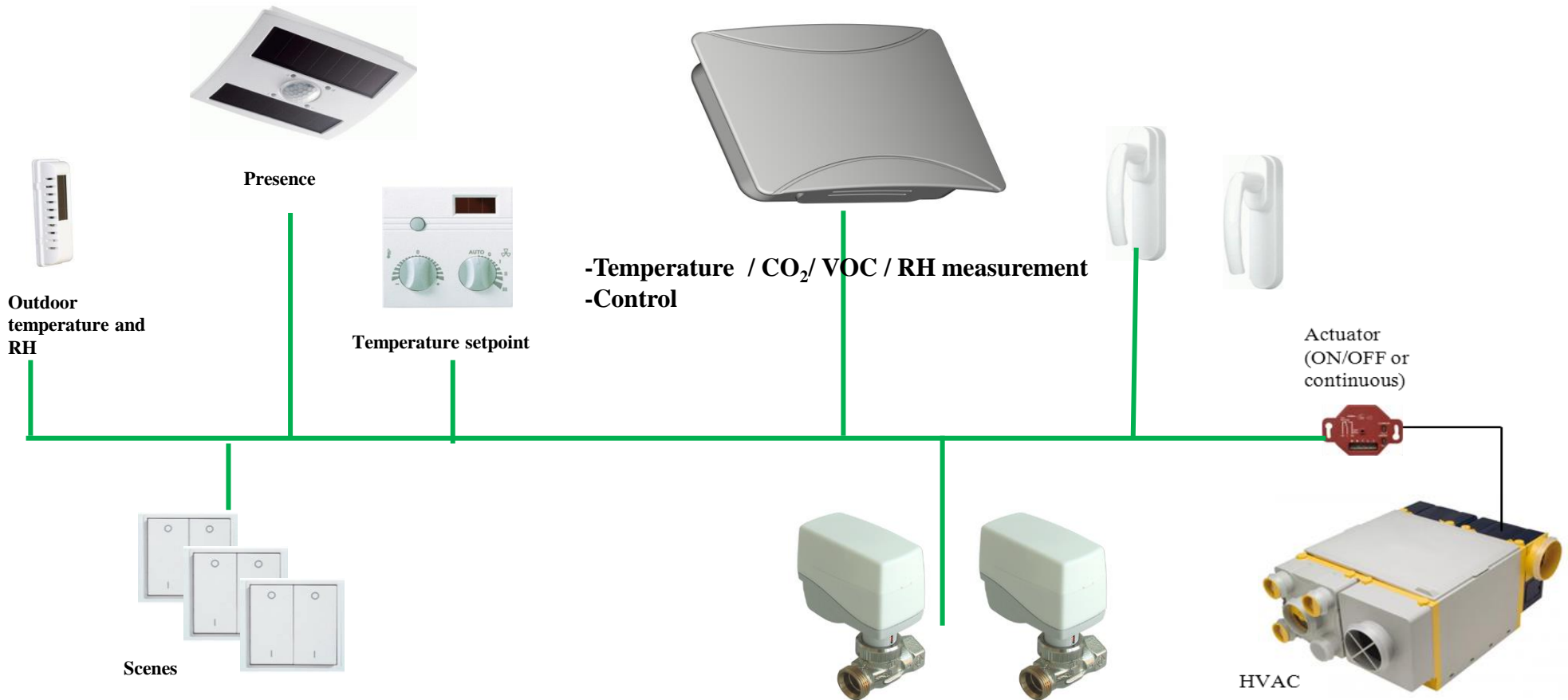
- Particles (PM₁, PM_{2.5}, PM₁₀)



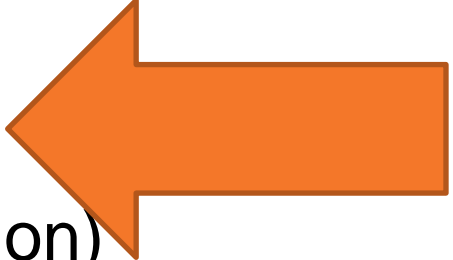

- Radon (alpha of first decay)



Integration into ecosystem

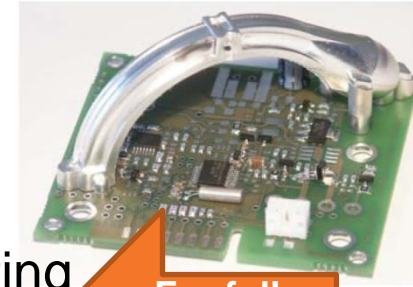


Temperature and humidity

- MEMS sensor 
 - No calibration (for mass production)
 - Size
 - Digital
- Thermistor
 - Low price
 - Calibration required (for moderate production)
- Platinum
 - High price
 - Replaceable without calibration (for industry)

CO2 sensors

- NDIR sensor
 - ABC algorithm for single channel required
 - Size generally large
 - Special LED as light source for energy harvesting
 - Double band or double source for no ABC
 - Life duration 10 years
- Solid state sensor
 - Heated solid electrolyte
 - Compact but warm
 - ABC algorithm
 - Linearization (Lin /Log)
 - Temperature compensation
 - Life duration 10 years
- Electrochemical sensor
 - Short life duration (3 years wit calibration each year)



For full
time
occupancy



Good enough
in most
application



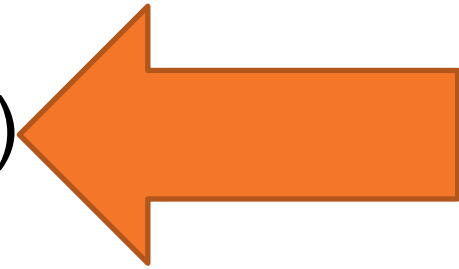
CO2 sensors trend

- NDIR sensor
 - Compact size
 - Double band
 - low energy (50 times lower)
 - IR LED source
 - Double source
- Solid state sensor
 - MEMS with novel nanostructured semiconductor material
 - Collaborative program with academics to be funded
 - To address smartphone market too

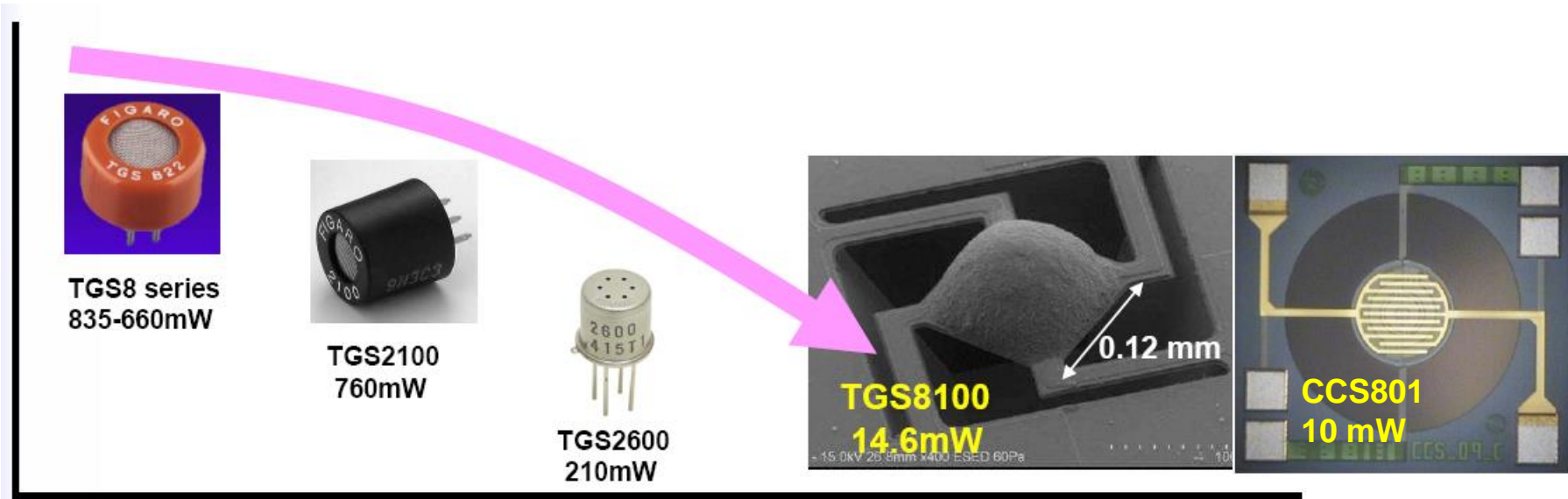


VOC sensors

- Metal Oxide Semiconductor (MOX)
 - Low cost
 - Sub ppb sensitivity (with selectivity)
 - Life span 10 years
 - Selective by dopant + data processing
- PID (Photo Ionization Detector)
 - Expensive
 - Sub ppm sensitivity
 - Not selective
 - Short Life span

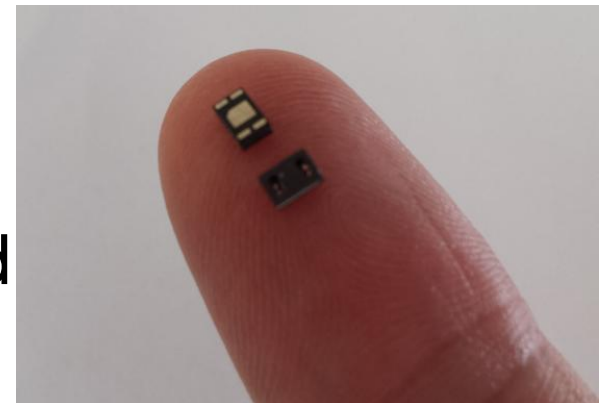


MOX sensors trend



- MEMS

- Lower cost
- Low consumption
- Life span > 10 years when pulsed



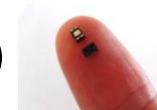
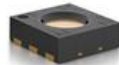
MEMS MOX VOC sensors actors

- Figaro (Japan)
 - Leader
 - Hanged platform
 - 15mW consumption MEMS
 - Platinum heater (long term stability)
- SGX (Europe)
 - The main European manufacturer
 - Micro hot plate
 - 80mW consumption MEMS
 - Poly silicon heater (PT in road map)




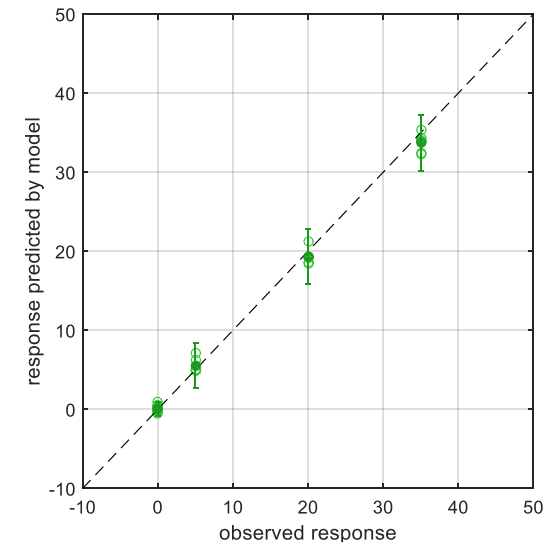
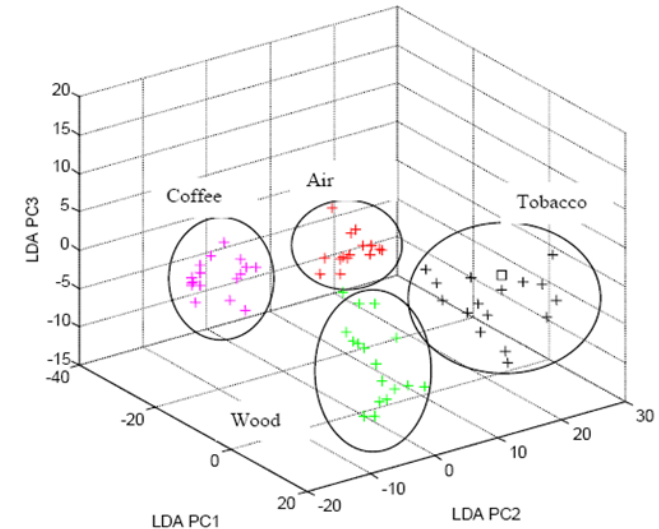
- New players

- Bosh Sensortec
- Sensirion
- Cambridge CMOS Sensors (10 mW tungsten heater)
- ams AG (34mW)



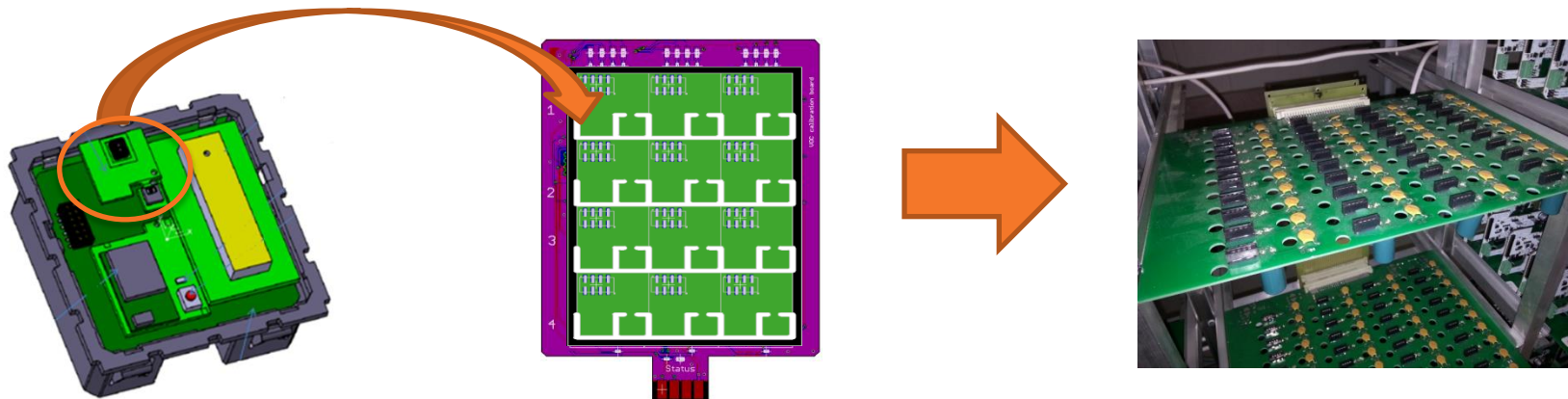
VOC selectivity with MOX sensors

- Proven algorithm for identification
- New algorithm for quantification
- Works better with MEMS
- Collaborative programs 
 - VOC IDs (ended in 2014)
 - SensIndoor (underway)
- Sensitivity levels in the sub ppb range
- Low cost system under development



MOX sensor Calibration for MP

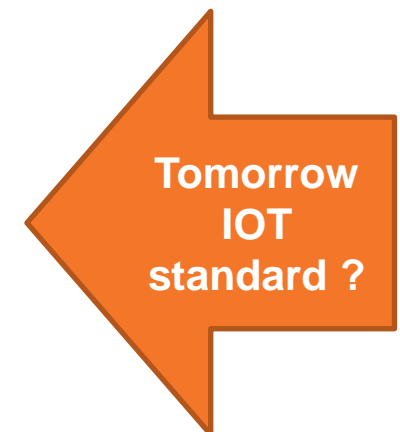
- Pre heating by isotherm, then pulsed
- Balancing in air zero
- Individual Sensitivity recording into sensor module
- NanoSense is developing a calibration capacity of 20K per run for MEMs



Building automation interfaces

Standards	
0-10V	Majority of today's ventilation
Modbus	Cheapest, still popular
KNX	European TP standard
LON	North American TP standard
BACNET	MS TP popular in US HVAC
EnOcean	Standard of Energy harvesting
Zwave	US market (battery powered)
Allseen	Extended BLE with mesh
ZigBee	To merge with Thread
6LoWPAN	Applicative layer = Thread

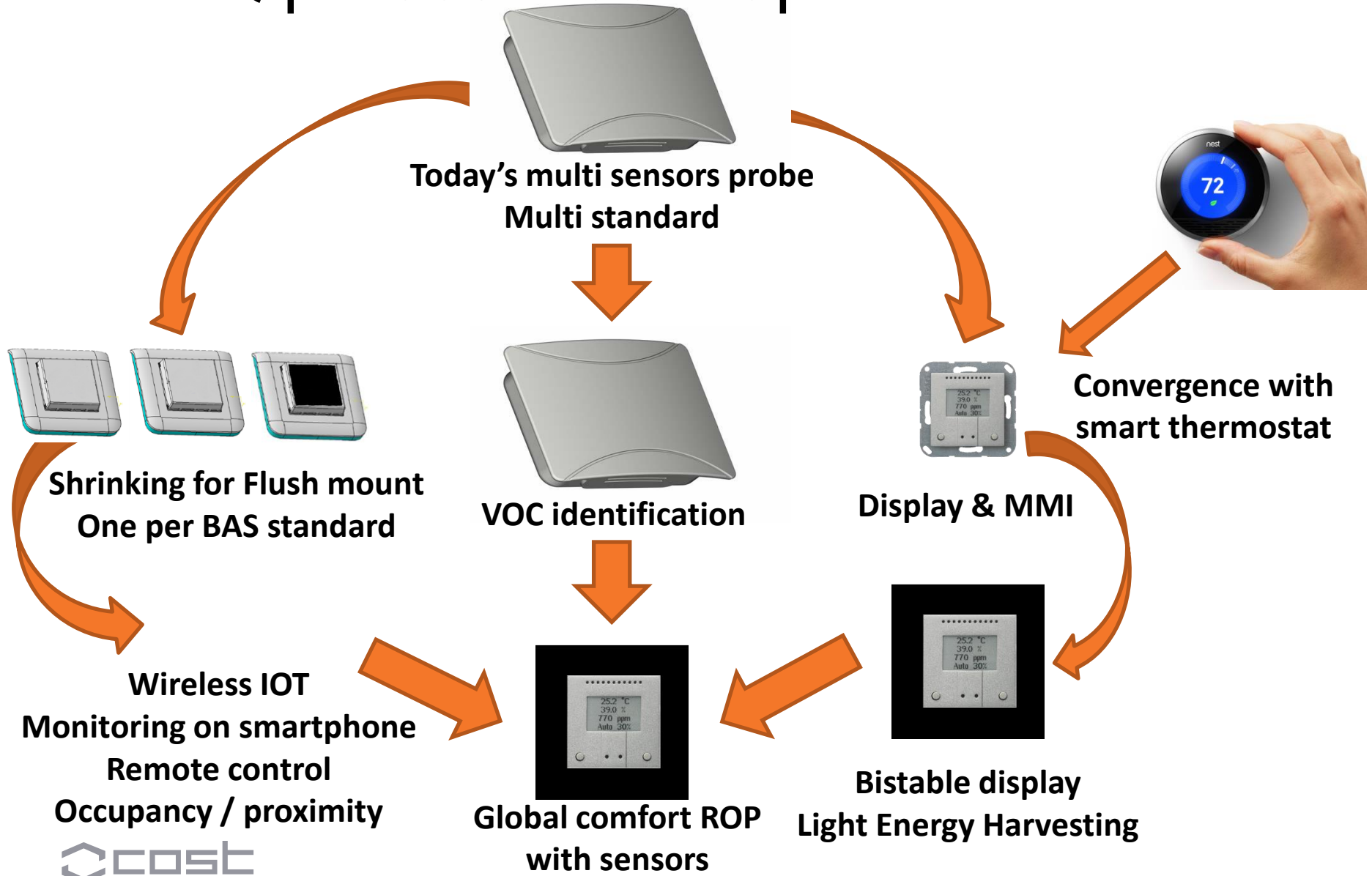
The BLE is not a building automation standard but it can be considered as the best direct smartphone interface with localization feature (occupancy, in range beacon..)

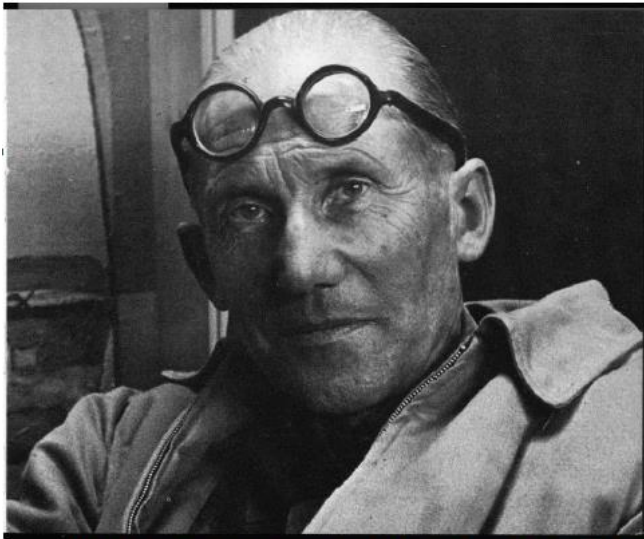


IAQ Sensor systems trends

- Compact flush mount (easy integration, cost reduction)
- Wireless (smartphone and IOT compatible)
- Setting and data display via smartphone
- Batteryless (NanoSense will release a CO₂, VOC, T°, RH probe totally indoor light powered soon)
- Dedicated MMI for smart thermostat merging (C-ROP)
- VOC Identification (improve on demand ventilation)
- Real time monitoring of regulatory gas + high quality buildings standard compliance (BREEM, LEED..)
- Easy integration into building automation and IOT (DIY)

IAQ probes road map





"A house is a machine for living in"
Le Corbusier

Thank you for your attention

NanoSense

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