IV Asamblea Planetic 2017

LAS TICs Y LOS SISTEMAS INTELIGENTES

Introducción a los Sistemas Inteligentes: concepto y ecosistema europeo

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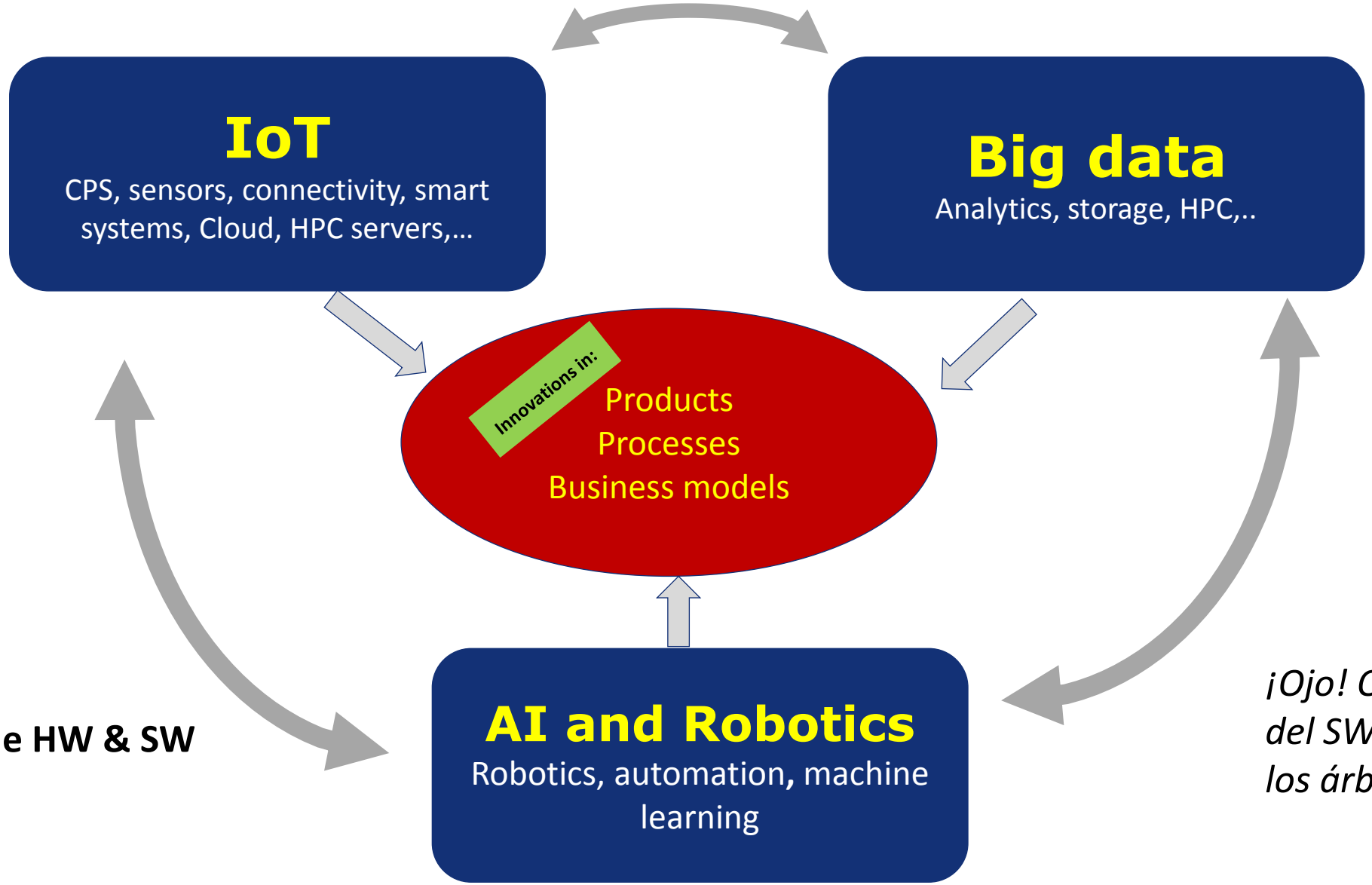
Pócima TIC

sXXI (IoT, I4.0…)

sXX

DEI: Digitising European Industry
Driving Technologies



Mezcla de HW & SW

¡Ojo! Que el bosque del SW no nos tape los árboles del HW

Piedra filosofal de las TIC

Transmutar:

magnitudes en **señales**…

… señales en **datos**…

… datos en **información**…

… información en **conocimiento**

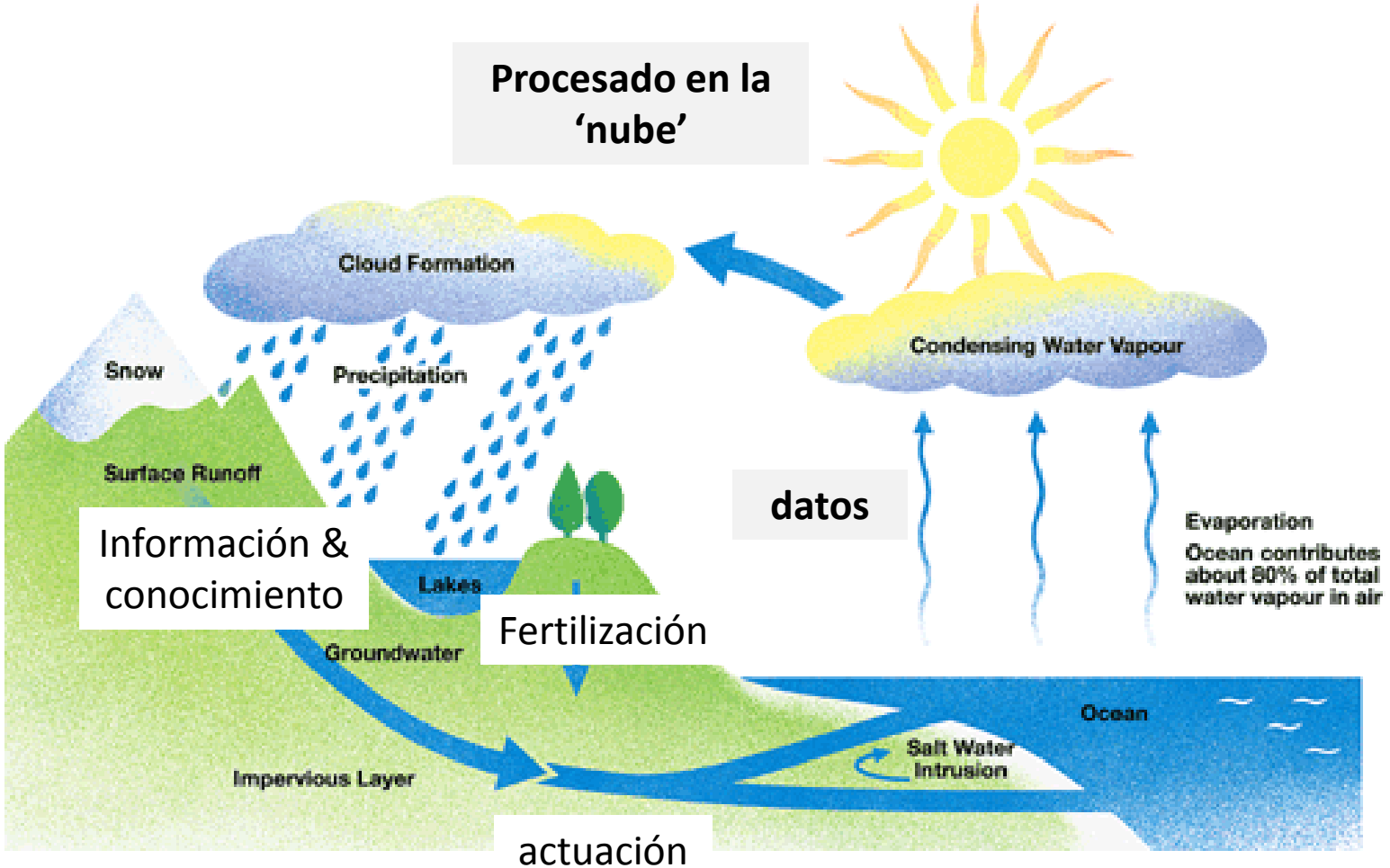
Y si es posible, conocimiento en **decisión**, y decision en **actuación** acertada

Sistemas inteligentes

Cada vez vamos a estar más rodeados de ellos. Nos hemos habituado al concepto de la Internet de las Cosas, pero tanto mejor que esas Cosas y su reunión sean a su vez inteligentes. Esa inteligencia se construye peldaño a peldaño:

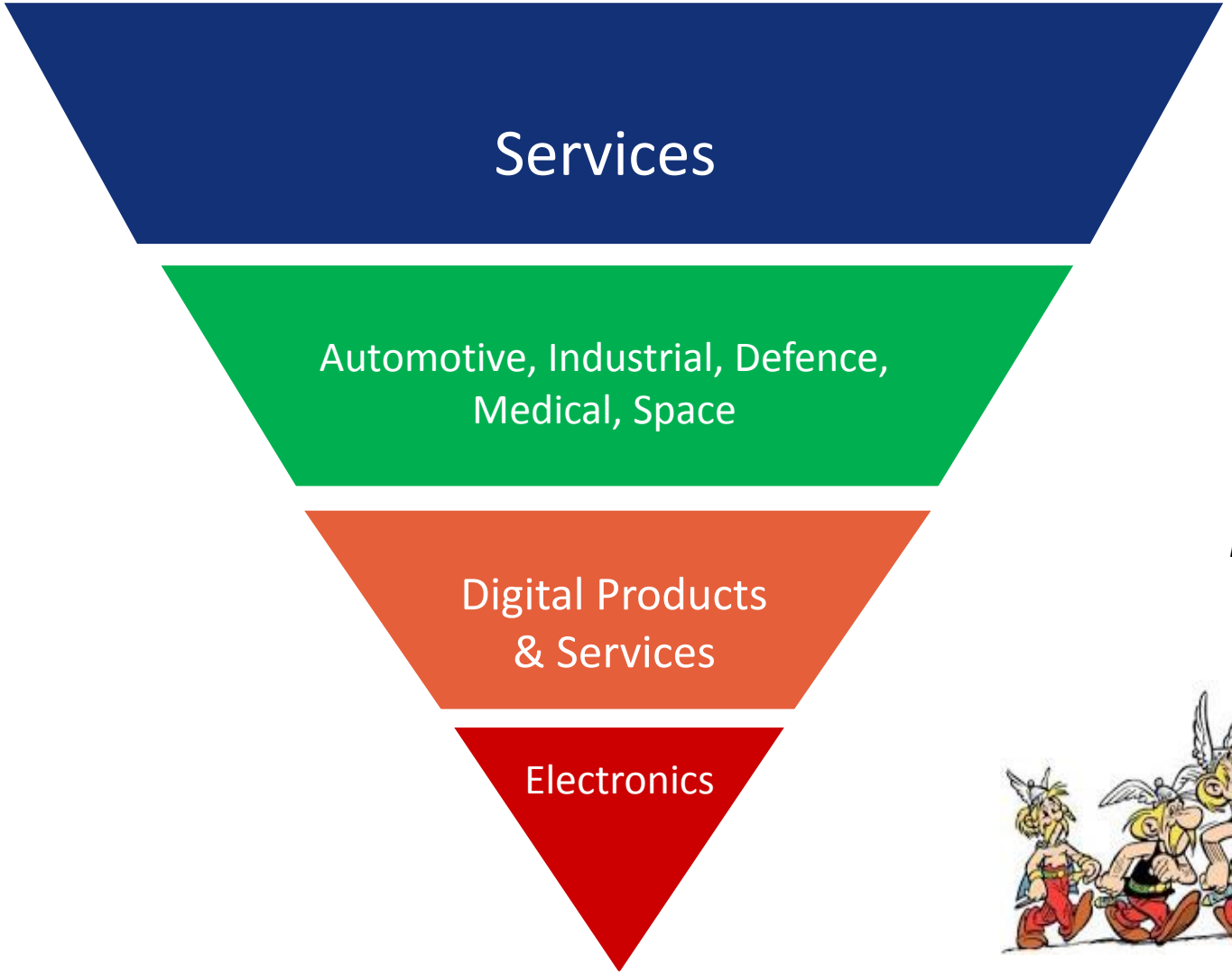
desde el sensor que convierte lo físico en digital, pasando por la comunicación de la señal y su procesado, hasta la gestión en la nube y el aprovechamiento de la información y conocimiento generado... Sin olvidar su viaje de vuelta de lo digital a lo físico para cerrar el círculo de la actuación

Ciclo de la información



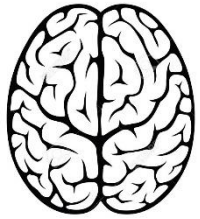
Pirámide TIC (Electronics, the nuts and bolts of Digital transformation)

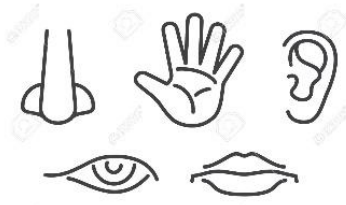
€



El HW, el primer peldaño de las TIC

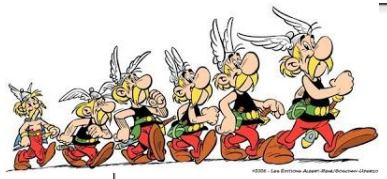
Hardware: Electronic Components and Systems





Micro-nanoelectrónica

Micro-nanotecnología



Nanoelectronics | **Smart System Integration** | **"IoTification" (Smart Anything Everywhere)**

Integration chain

More Moore — **Beyond CMOS** — **More than Moore** — **Heterogeneous integration** — **Autonomous systems & Cyber-Physical Systems**

Specific Technologies

Si
Ge, III-V, Comp. SC
Nanotubes,
Graphene
NEMs
3D-integration, TSV
Spintronics
Single e⁻ Transistors
RF
Bio-on-Si
MEMs
Power electronics
µ-Fluidics
Thin electronics
Photonic ICs
Bio-electronics, MNBS
µ-Mechanics
Microrobots
Smart
Complex
Systems
RF-com

Internet
Big Data
Cloud
Services

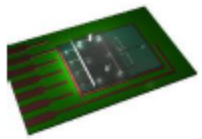
COOPERATION


3-D transistors


CMOS 22 nm


3-D stacking


Sub-THz Telecom (iPHOS)


Lab-on-Chip (PYTHIA)




Endosopic capsule
Neural probes
(VECTOR, NEUROPROBES)

Economic
Moore's law
ending
Diversification

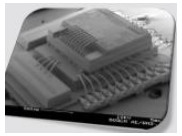
Integrated Smart Systems
Enabling & Pervasive

Autonomous
Connectable

The Smart and Hard(ware) road to Next Generation Objects

nm → µm → mm → cm

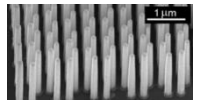
Nanoelectronics

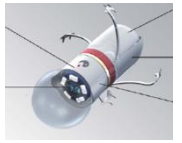


"Conventional":
CMOS, MOSFET
Si-Ge, III-V compound SC
Nanowires, CNT, Graphene

"Non-Conventional":
Spintronics
Single e- trans
3-D monolithic @ transistor scale)

Smart System Integration





µ-Fluidics

µ-Bio-sensors

µ-Mechanics - MEMS

Everything On-CMOS:
Photonics, RF…

µ- batteries : µ-harvesters

µ- Antenna

The "T" of IoT

Next Generation Objects

Autonomous smart object

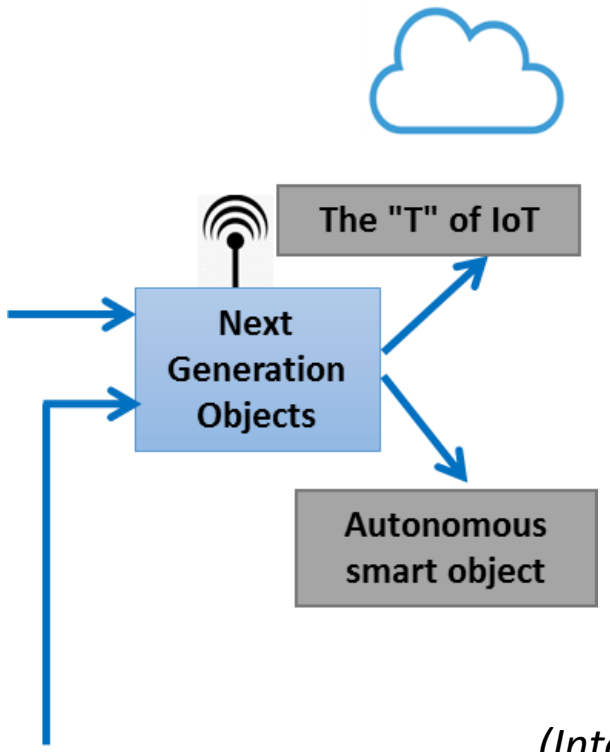
Plastic and wearable electronics - TOLAE

"Hybrid": Si chips mounted on flexible substrates

"Monolithic": thin film transistors, thin film / large area sensors /labels

The Smart and Hard(ware) road to Next Generation Objects

IoT
(Internet of
Things)

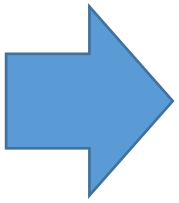


'IoIT'
(Internet of
Intelligent Things)

'IoT'
(Intelligence of
Things)

Diferentes dimensiones del concepto Smart

Smart Sensors



Ciudades Inteligentes

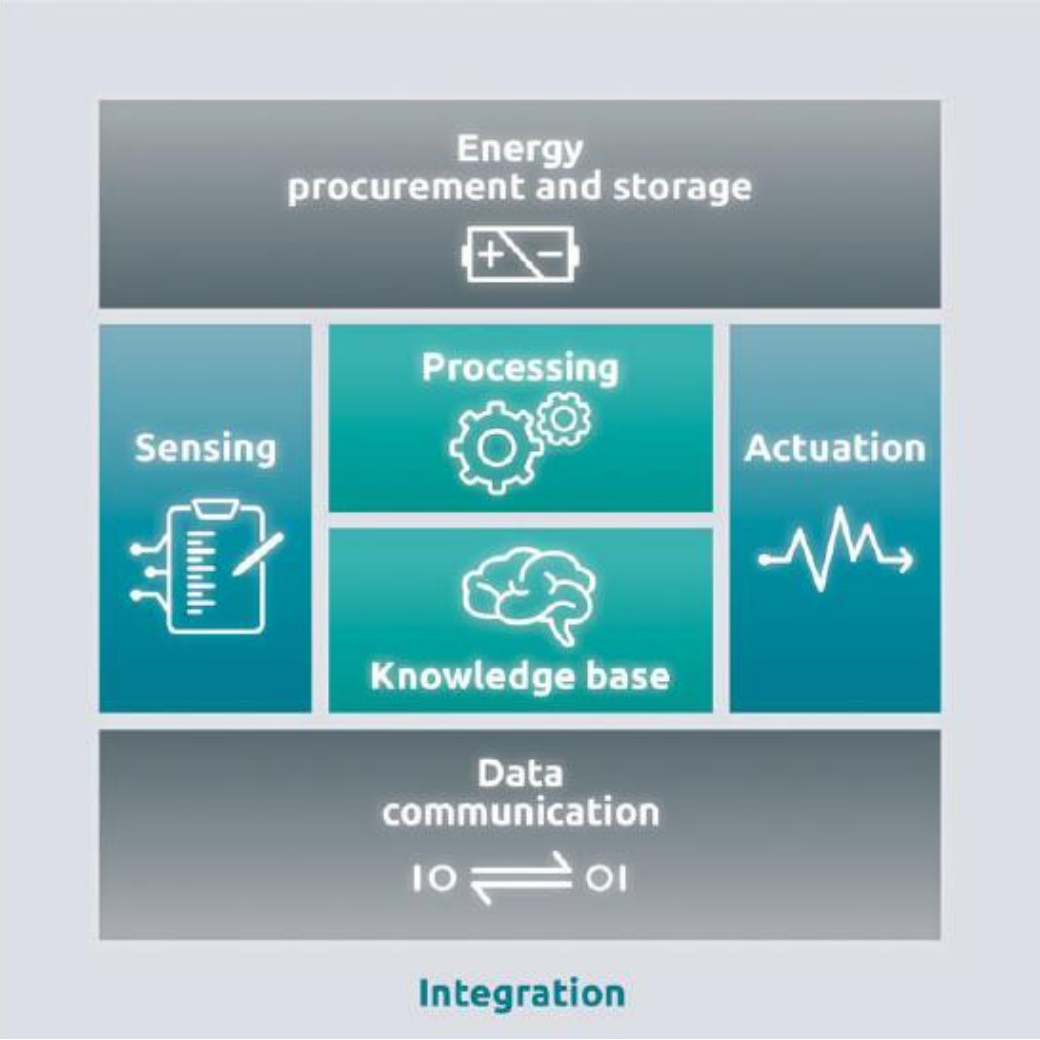
Agenda Digital para España

Smart Scenarios

Sistema Inteligente (definición EPoSS)

EPoSS
European Technology Platform on Smart Systems Integration

Smart systems combine **cognitive functions** with **sensing**, **actuation**, data **communication** and energy **management** in an integrated way

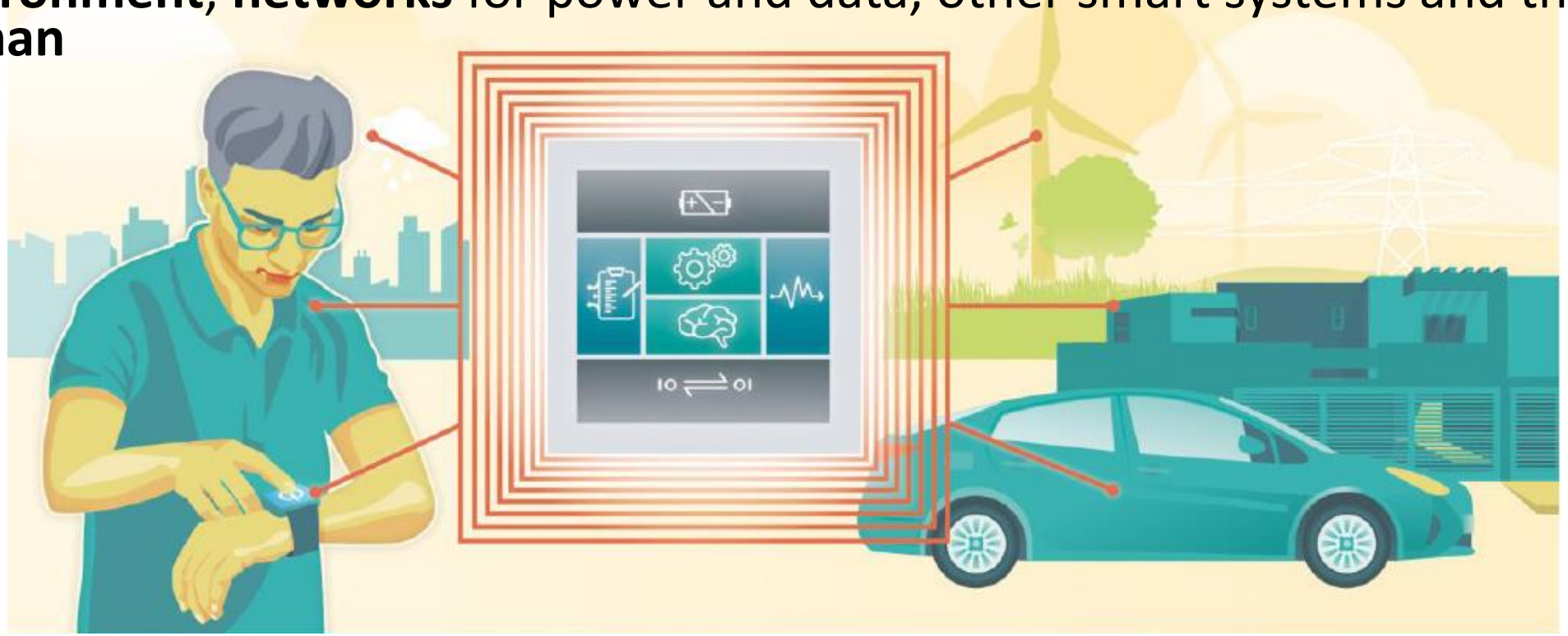


Smart systems provide **safe** and **reliable autonomous** operation under all relevant circumstances

Sistemas Inteligentes

EPoSS
European Technology Platform
on Smart Systems Integration

- Smart Systems are **integrated** with the (natural, built and social) **environment**, **networks** for power and data, other smart systems and the **human**



- Smart Systems provide (an use) cognitive support to (and from) their surroundings

Generaciones de Sistemas Inteligentes

EPoSS
European Technology Platform on Smart Systems Integration

System **functionalities** determine advancements in **smartness**.

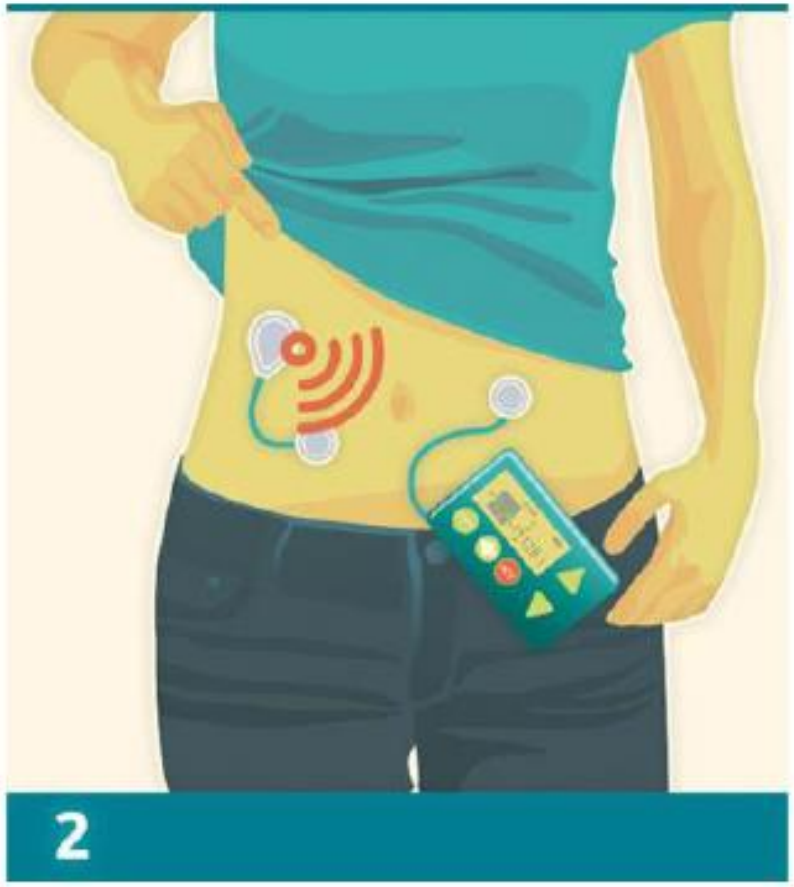
This can be expressed in terms of:

FIRST GENERATION

Smart systems that integrate **sensing and/or actuation**, as well as **signal processing**, to enable actions (e.g. the gyro mouse)

Generaciones de Sistemas Inteligentes

EPoSS
European Technology Platform on Smart Systems Integration



SECOND GENERATION

Smart systems built on **multi-functional perception**, and which are **predictive** and **adaptive** (e-g. continuous glucose monitoring)

Generaciones de Sistemas Inteligentes

EPoSS
European Technology Platform on Smart Systems Integration

THIRD GENERATION

Smart systems that perfom **human-like perception and actions** and which generate energy (e.g. fully automated driving)

Resumen: el Hardware de las TICs

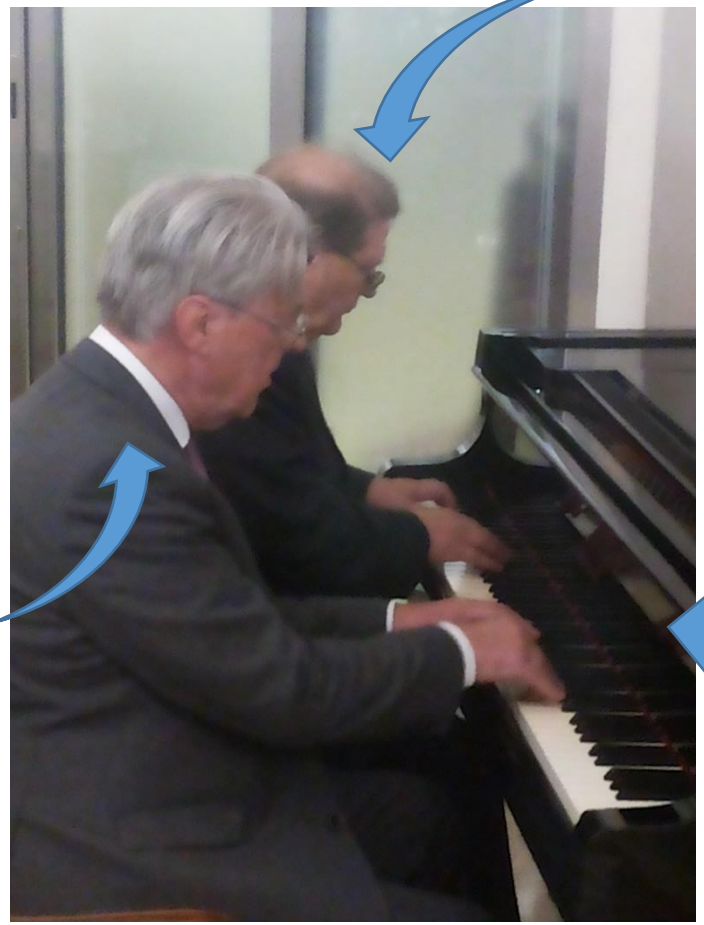
- Nanoelectronics
- Large Area Electronics
- Electronic Smart Systems

- Cyber Physical Systems

‘Concentración’: Smart Systems y CPS

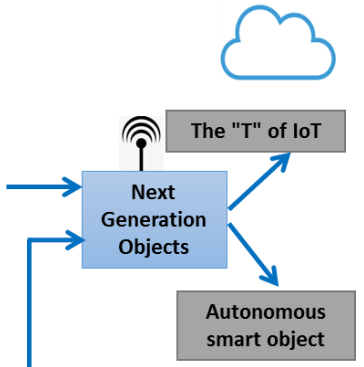
SS

Mr. EPoSS



Mr. ARTEMIS

CPS

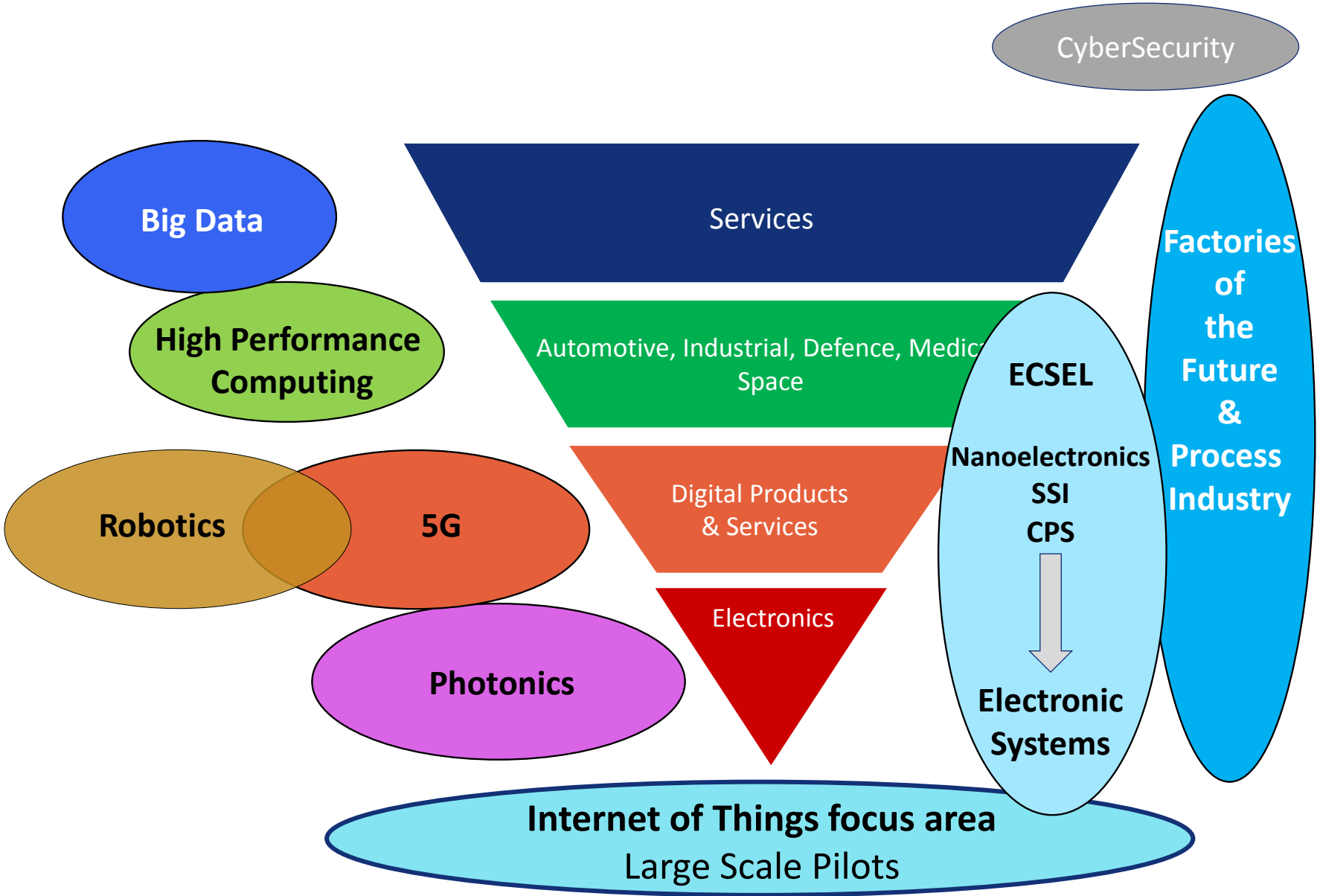


NEXT GENERATION OBJECTS?

Ecosistema europeo

Public Private Partnerships at the centre

More than 23 B€ of investment!



Ecosistema europeo

- *EPoSS*
- H2020 / (SAE)
- ECSEL (ENIAC, EPoSS, ARTEMIS)
- EUREKA / EURIPIDES

EPoSS
European Technology Platform
on Smart Systems Integration

€

SAE

SmartAnythingEverywhe

€

EURIPIDES²

European Smart Electronic Systems

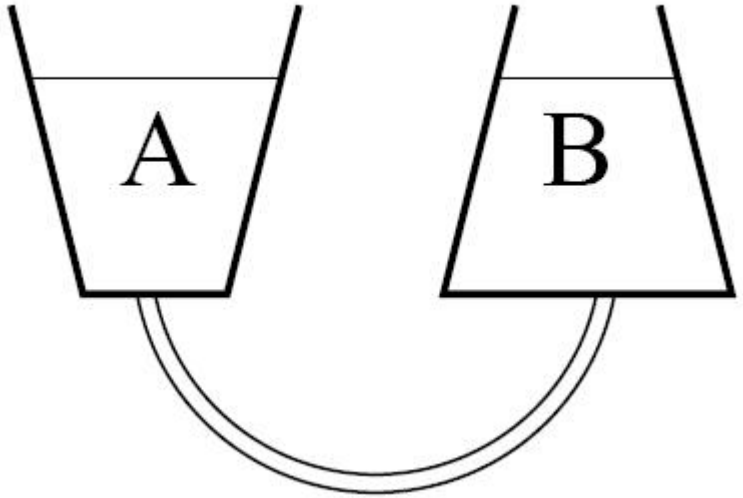
€

Ecosistema europeo

- H2020 /(SAE)
- ECSEL (ENIAC, EPoSS, ARTEMIS)
- EUREKA/EURIPIDES

EC vs no-EC (H2020, ECSEL vs Eureka)
TRL complementarity (H2020 vs ECSEL / Eureka)
- consorcio / presupuesto / intensidades de financiación

Ojo a los vasos comunicantes



Unconventional nanoelectronics
Electronic Intelligent Systems
Large area electronics

Ecosistema europeo

- H2020 /(SAE) - https://smartanythingeverywhere.eu/

EuroCPS
Cyber-Physical Systems

Digital Innovation Initiatives based on European Networks of Competence Centres in EU H2020.

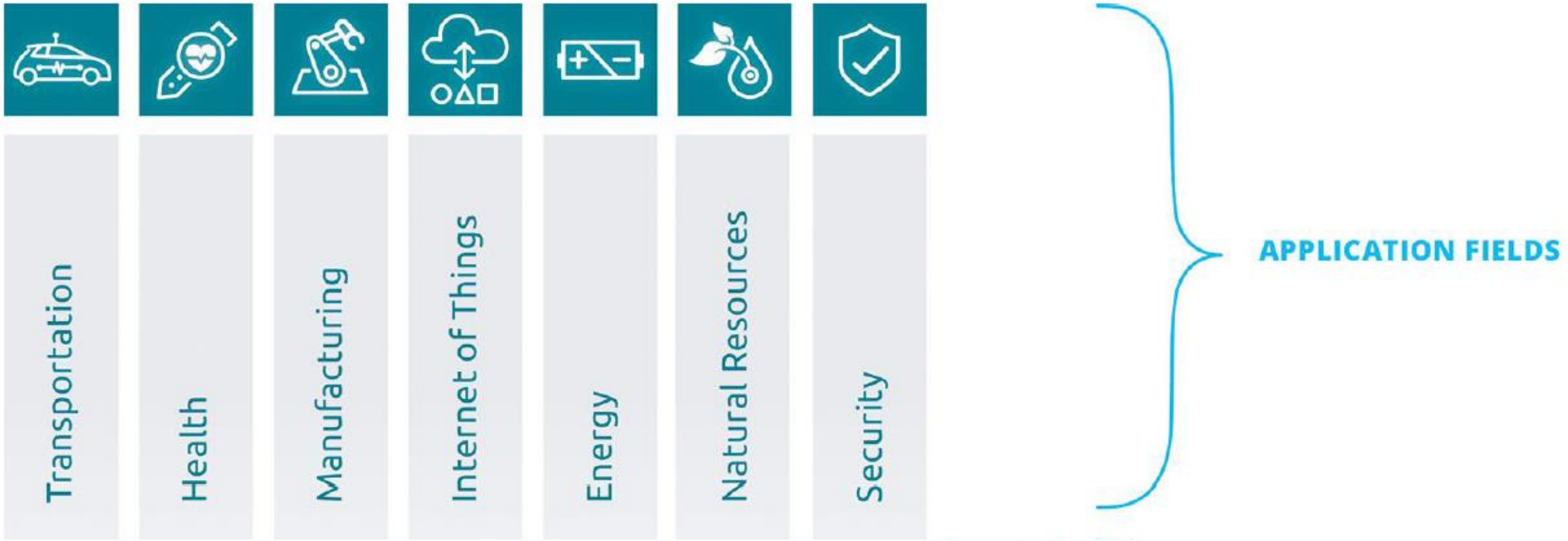
SMEs and middle size companies can experiment with new technologies, try them out in their processes and work together with the suppliers of the technology to adapt it to their specific needs.

Documentos estratégicos

- *EPoSS*
  - *http://www.smart-systems-integration.org/public/documents/publications/EPoSS_SRA2017.pdf*
- H2020
  - http://ec.europa.eu/research/participants/data/ref/h2020/wp/2016_2017/main/h2020-wp1617-leit-ict_en.pdf
- ECSEL (ENIAC, EPoSS, ARTEMIS)
  - *https://artemis-ia.eu/publication/download/masria2017.pdf*
  - http://ecsel.eu/web/documents/MASP%20and%20WP.php
- EUREKA/EURIPIDES
  - http://www.euripides-eureka.eu/vms-form
- Planetic
  - http://planetic.es/sites/default/planeticfiles/content-files/private/PLANETIC_AEII_v2016.pdf

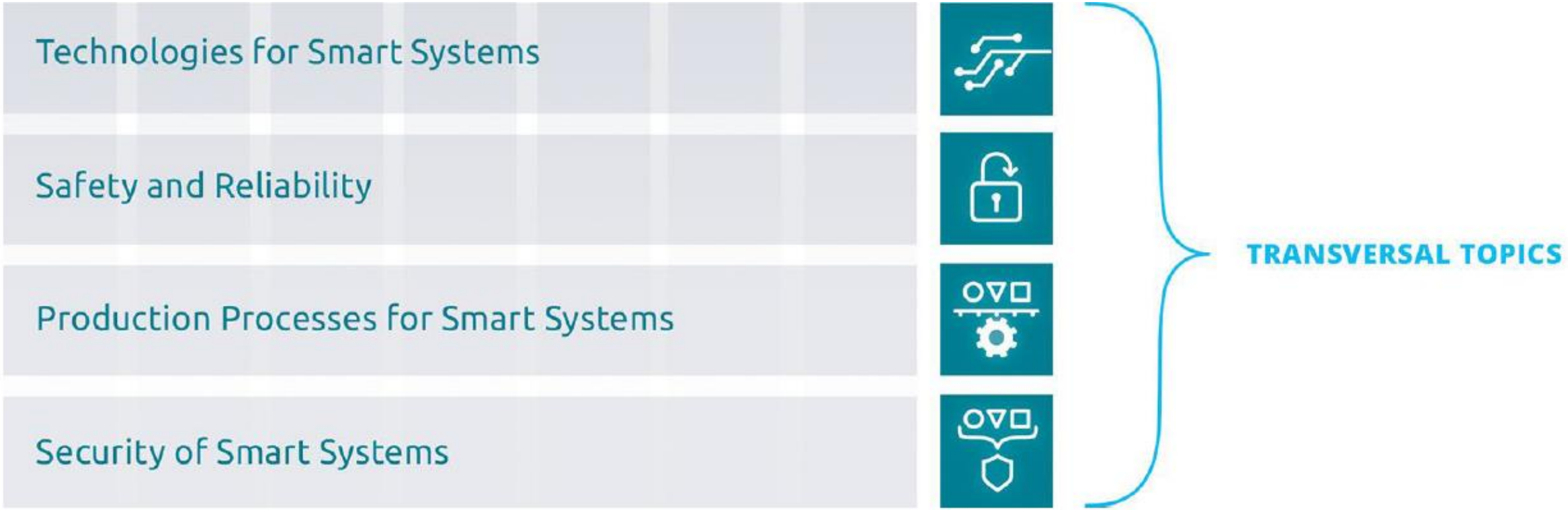
Smart Applications

EPoSS
European Technology Platform
on Smart Systems Integration

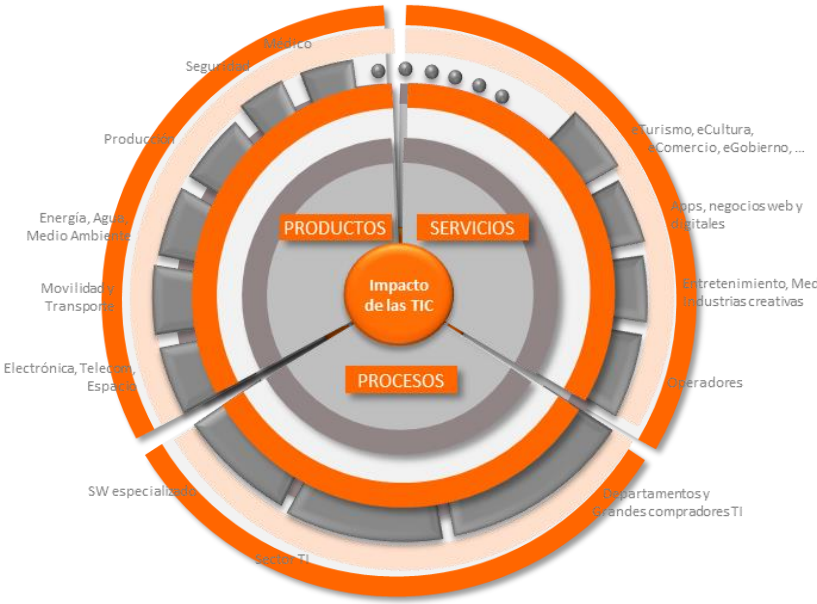


Challenges

EPoSS
European Technology Platform
on Smart Systems Integration



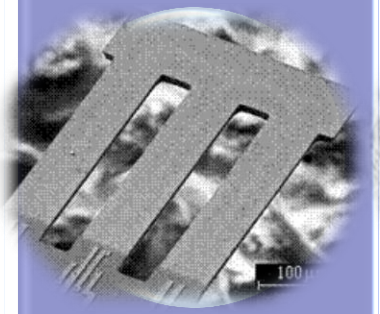
AEII - Planetic



Retos a nivel de ‘microsensor’

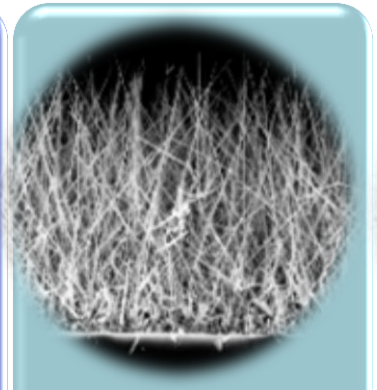
Low power consumption

MEMS
Substratos flexibles
Materiales sensibles



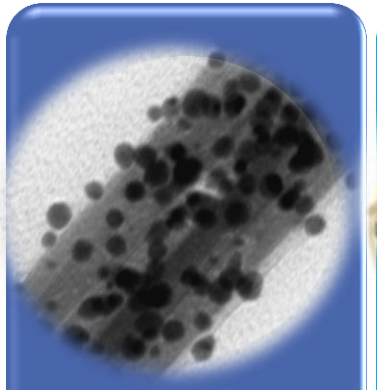
Multifunctional materials and transducers

Resistive
Capacitive
Mass sensitive



High sensitivitiy and selectivity

High S/V ratio
Control of facets



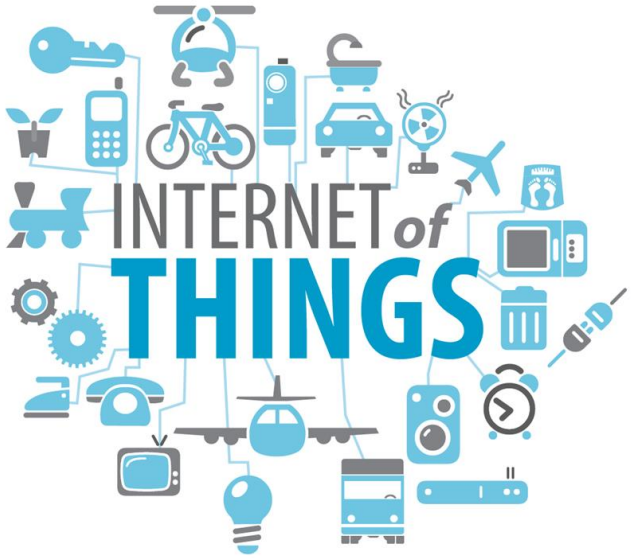
High material and device stability

Incorporation of intentional impurities

Combinatorial methodology

Sensor arrays “on board” processing

Inteligencia nodal (energía y ancho de banda)



Energy footprint of computation and communication → Low power µprocessors

Inteligencia nodal

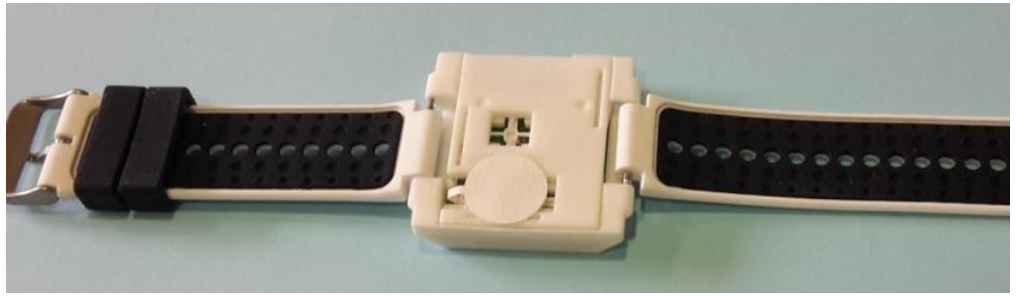
- Near sensor processing
- Edge cloud
- Fog

<u>Low power µprocessors</u>: tiny HW devices impacting big IT schemes

Energy efficient computing to judge relevant data to transmit decreasing the communication load will extend battery life and alleviate bandwidth problems

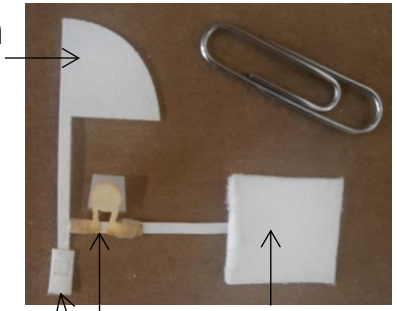
Y para acabar…

Prototipos CNM (weareable device for sweat analysis)



Paper µFludics

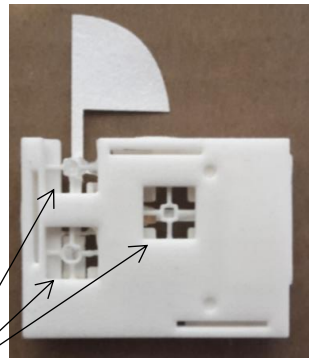
Sweat collection pad



Wicking pad

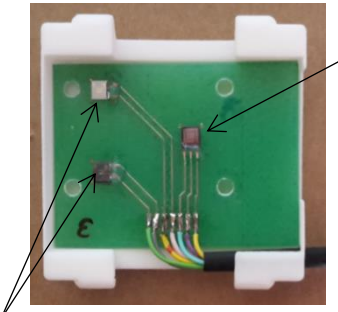
Reagent pads

µFluidics Holder

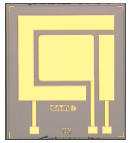


PDMS filled springs

Transducers PCB

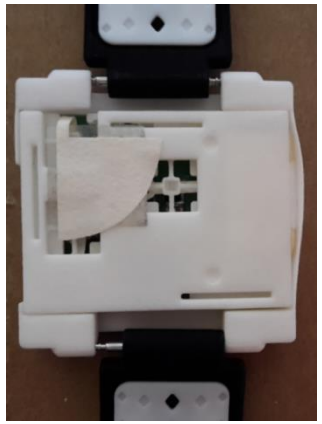


Amperometric chip



ISFET chips

Case

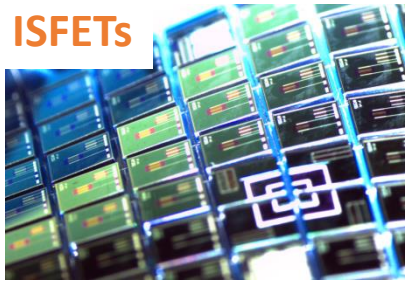


antoni.baldi@imb-cnm.csic.es

Prototipos CNM (home care device for lithiasis control)

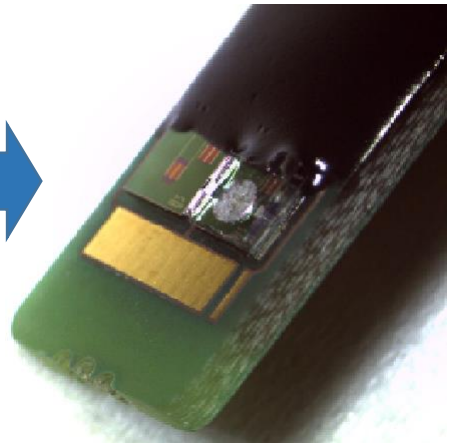
Transducer Chips

ISFETs



REFETs

Encapsulated sensor

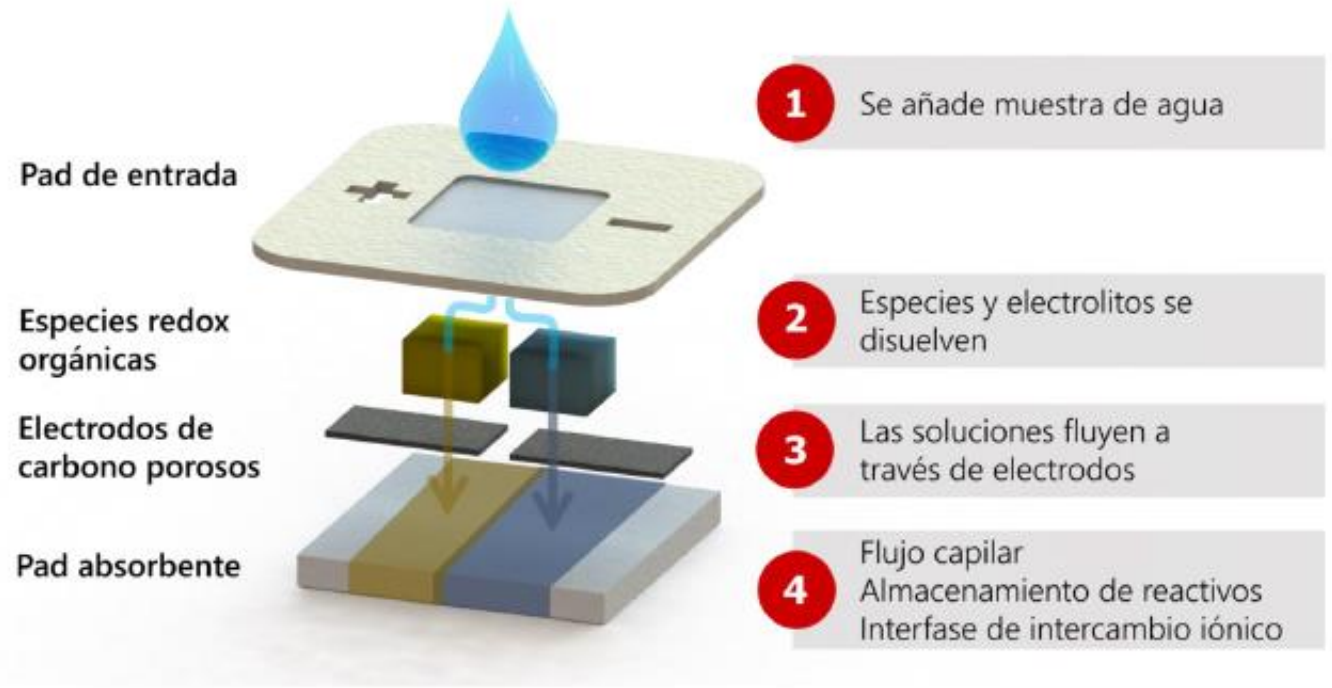


LitControl®: a Home Care Device for urinary pH control

antoni.baldi@imb-cnm.csic.es

Prototipos CNM (biodisposable battery)

juanpablo.esquivel@csic.es



Ejemplo TEKNIKER-IK4 (Contador micropartículas)

jon.mabe@tekniker.es

IK4 TEKNIKER
Research Alliance

Detector miniaturizado (6x5x4 cm) de partículas micrométricas con integración y customización optoeléctrónica