22 April 2010

Holst Centre

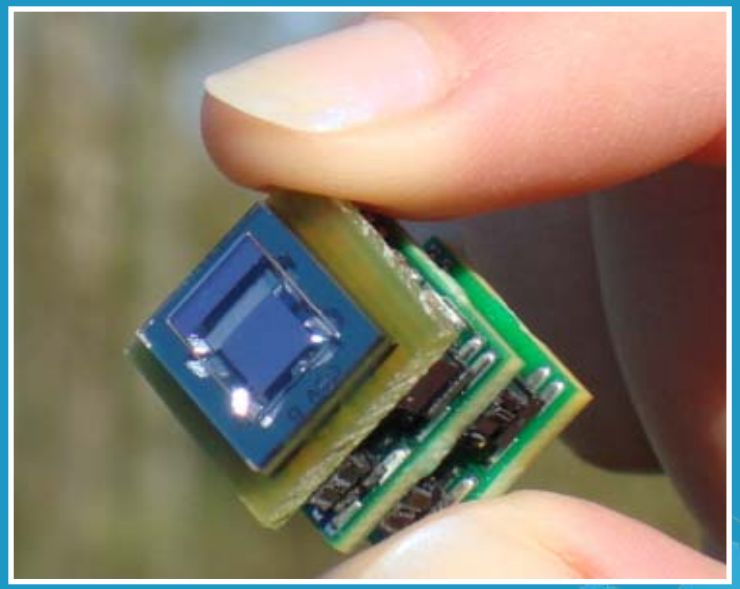
Open Innovation by IMEC and TNO

Wireless **A**utonomous **T**ransducer **S**olutions

by

N. Lallemant

Hall 6, Stand J28



Holst Centre Fingerprint

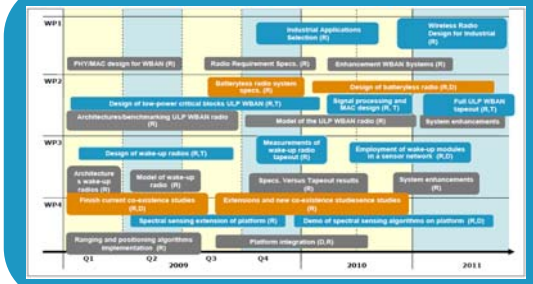
Who we are

Independent research organization co-founded by IMEC (1300 fte, Belgium) and TNO (4500 fte, the Netherlands) in 2005
150 researchers and 60 resident researchers from industry and university
Global network of industrial and academic partners
Supported by Dutch Ministry of Economic Affairs

What we do

Creating **generic technologies**, time to market 3..10 years
Research Focus on Wireless Autonomous Microsystems (WATS) AND Systems-In-Foil (SiF)
Partnering with industry and universities

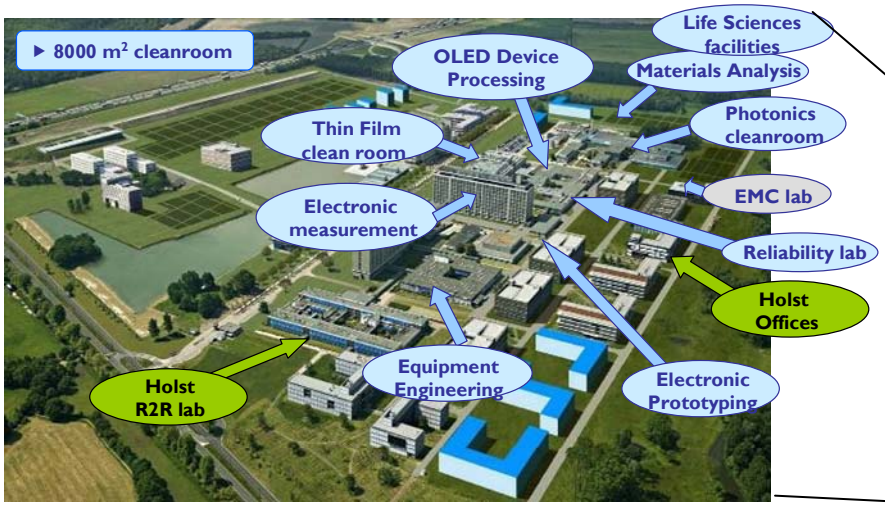
How we work



Research guided by clear **roadmap**
Day to day interaction with **industrial resident**
Regular review meetings with program partners
Open Innovation through **precompetitive** research programs
Results are shared between partners

Access to Unique Set of Infrastructures and Process Labs

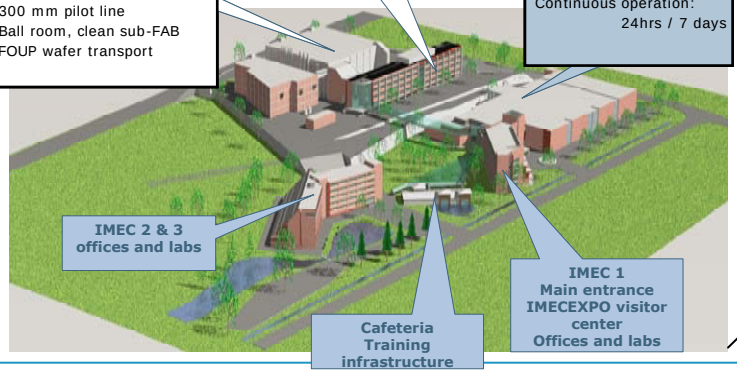
High Tech Campus, Eindhoven (NL)



IMEC clean room, Leuven (Be)

Clean room 2

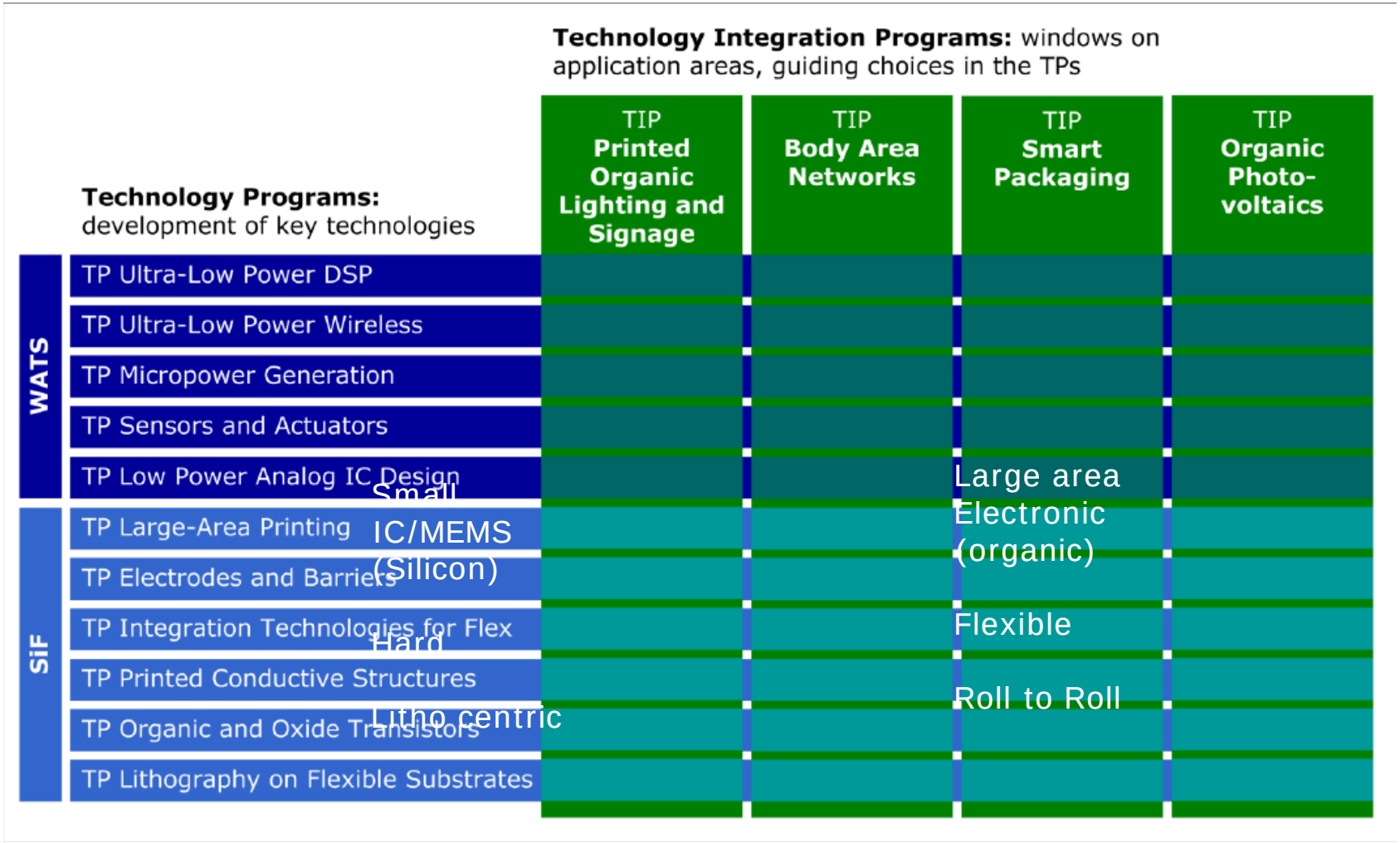
3200 m² clean room
2200 m² vibration controlled
300 mm pilot line
Ball room, clean sub-FAB
FOUP wafer transport



Clean room 1

5200 m² clean room
1750 m² class 1
200 mm pilot line
Continuous operation:
24hrs / 7 days

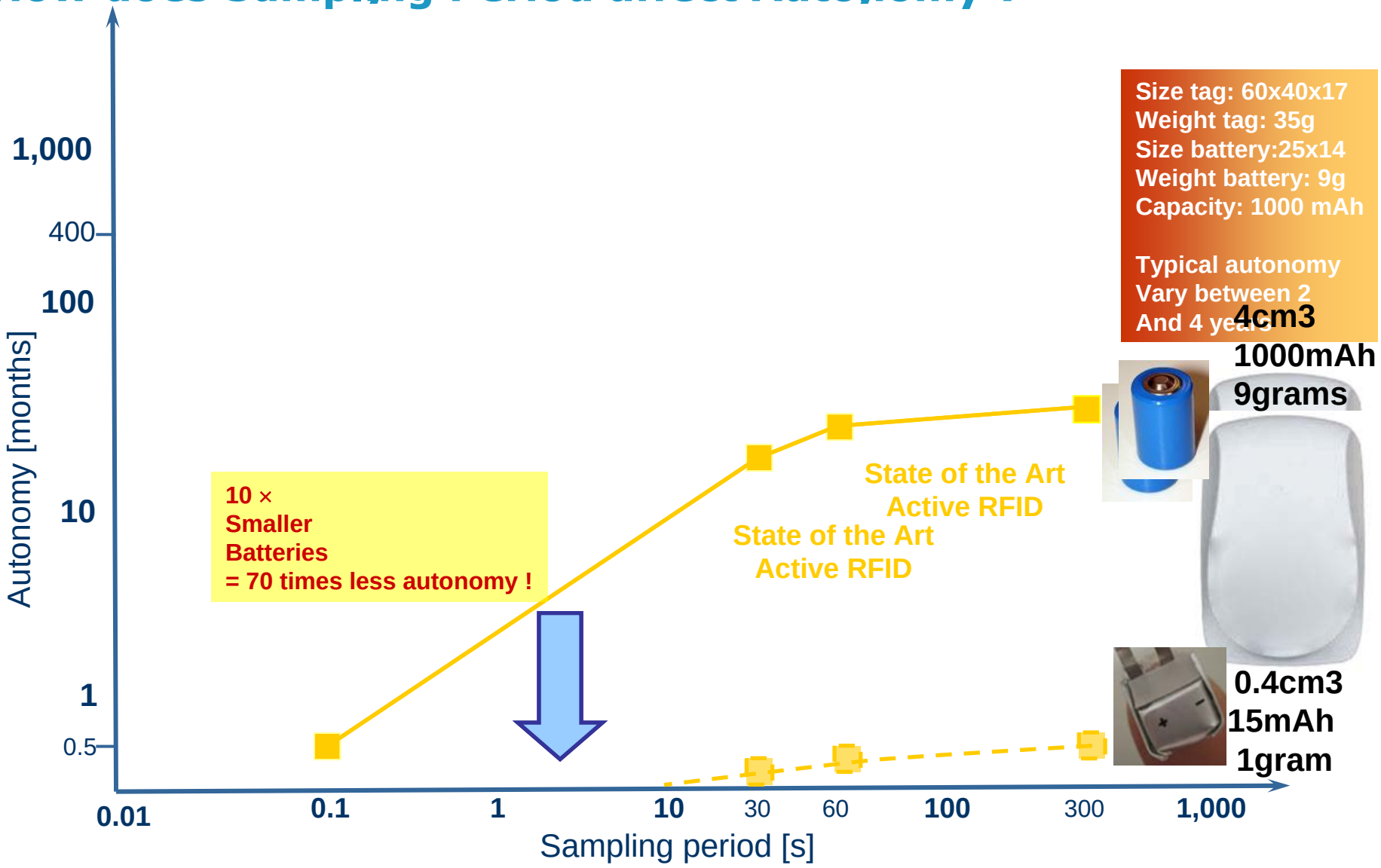
Research Program aligned with Industrial Needs



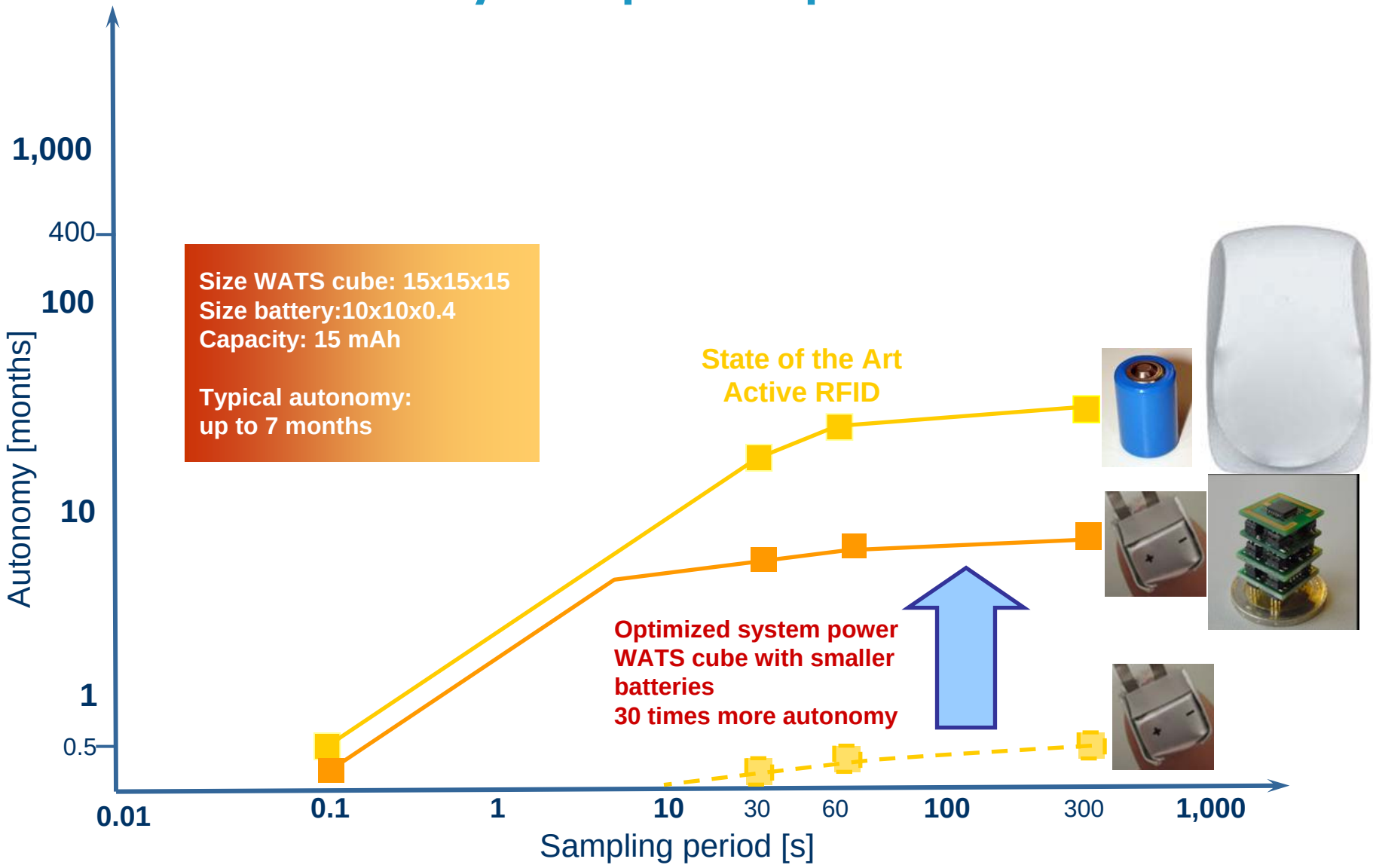
Imagine…an active RFID[1] tag

(1) Active RFID = battery powered wireless sensor node

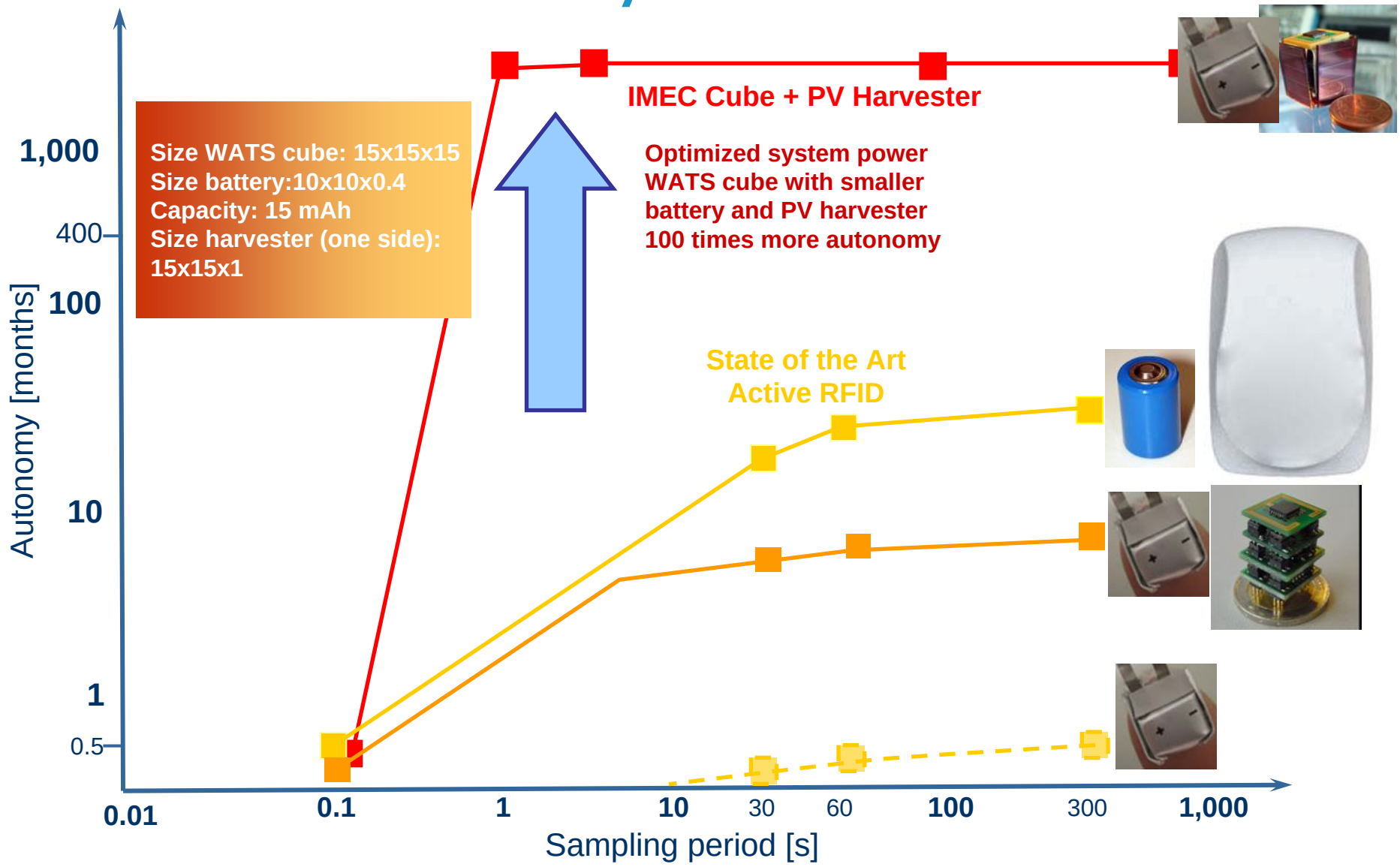
How does Battery Size affect autonomy ?



Possible solution … system power optimization

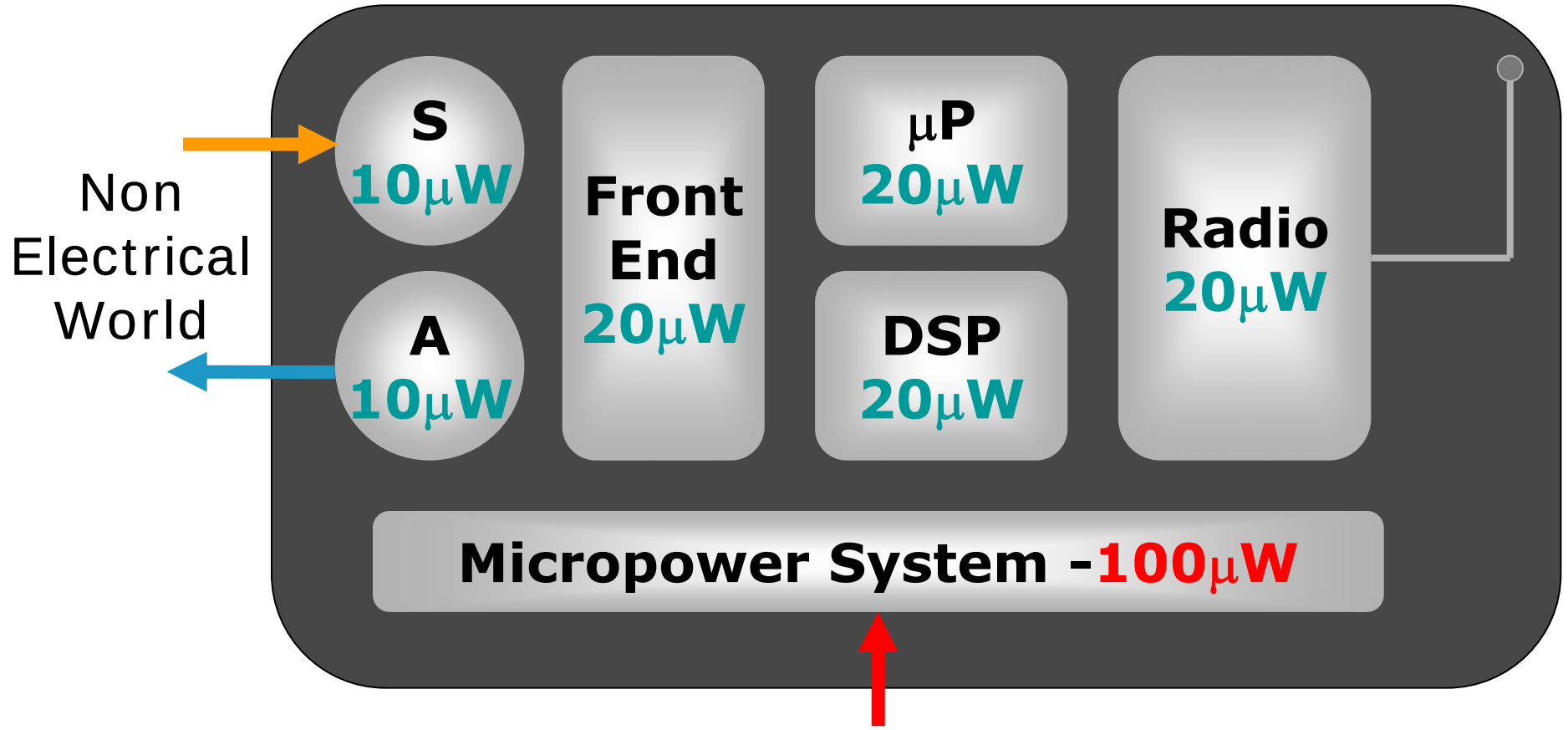


Possible solution … micro system harvesters



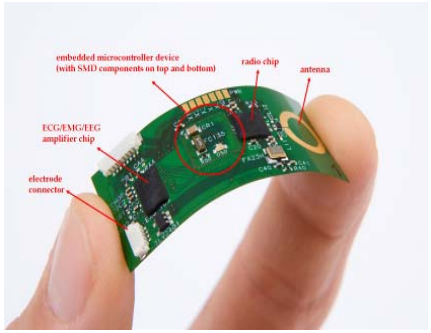
WATS …beyond battery powered RFID ?

IMEC-NL core activities: Ultra low power technology for wireless autonomous transducers



Integrated multi-application platforms

A System approach: Impact of Radio and DSP on ECG Patch Power Consumption



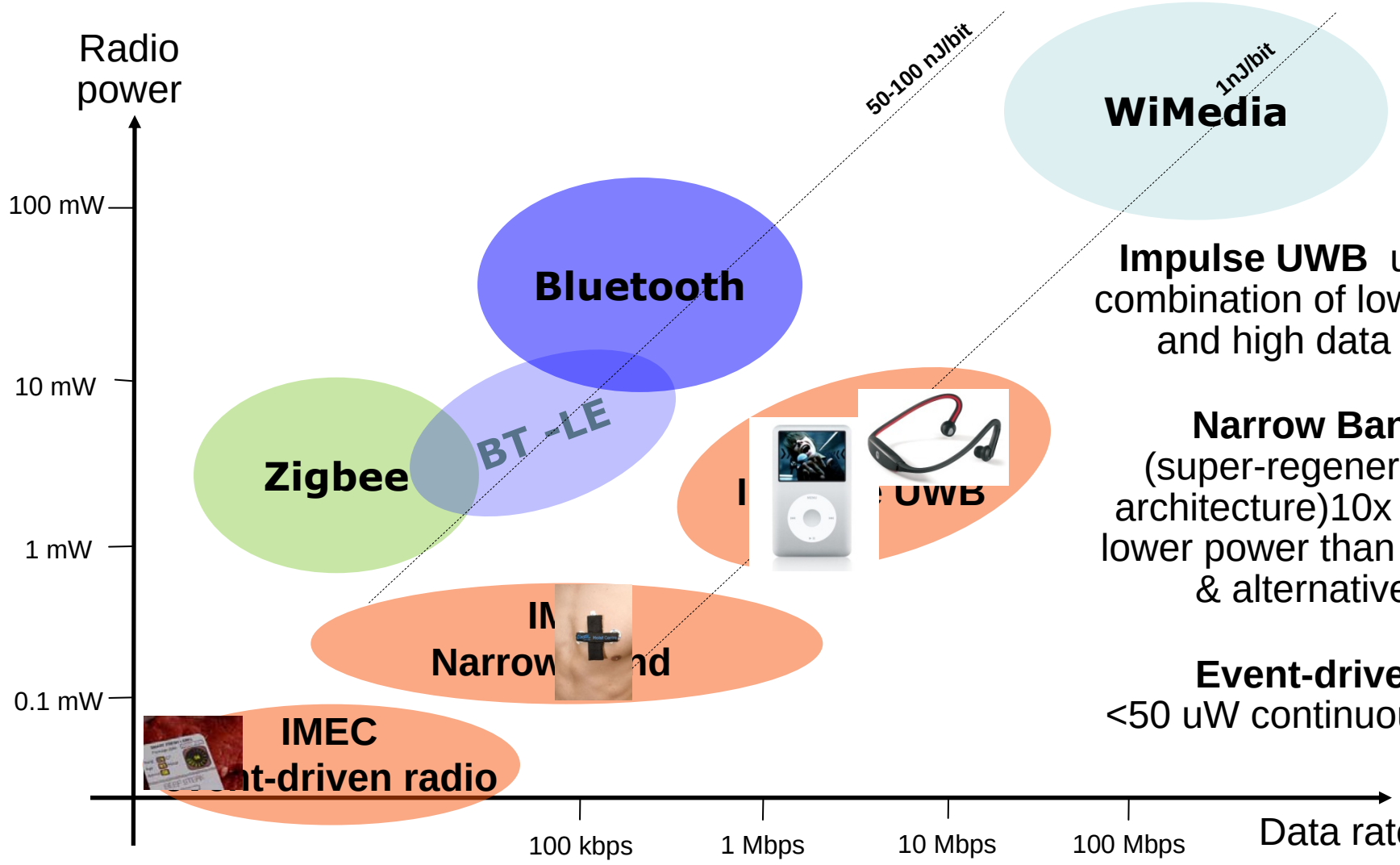
Use thinfilm battery	MSP430 only	imec BioASIP
NORDIC SEMICONDUCTOR	3.7 mW 5.1 days	0.34 mW 54 days
imec	0.34 mW 47 days	0.21 mW 89 days

X 10

X 9

X 18

Novel Radios with Record Low Power Consumption

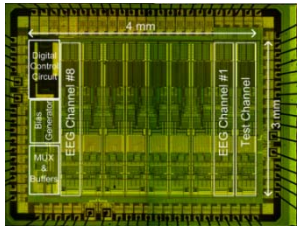


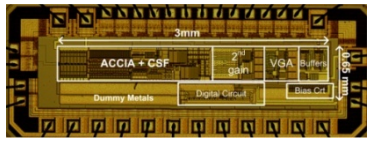
Impulse UWB unique combination of low power and high data rate

Narrow Band (super-regenerative architecture)10x to 100 lower power than Zigbee & alternatives

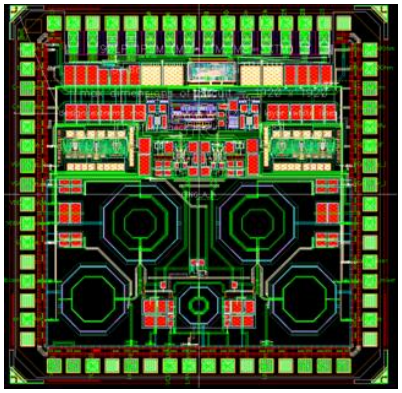
Event-driven <50 uW continuously on

Advancing state of the art : IC design

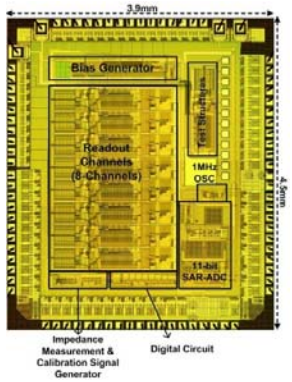




8-channel EEG 2006
1-channel ExG

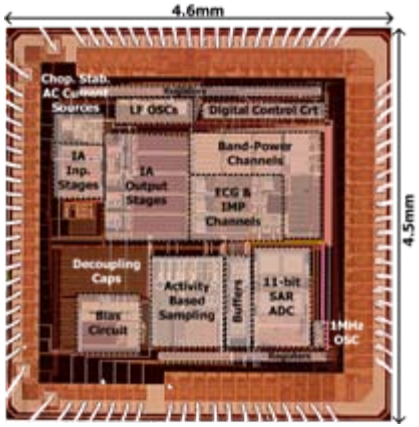


UWB transmitter 2007

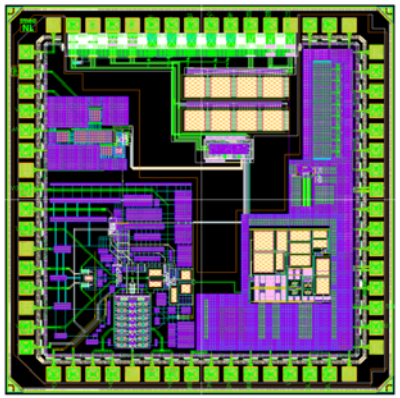


EEG acquisition frontend 2008

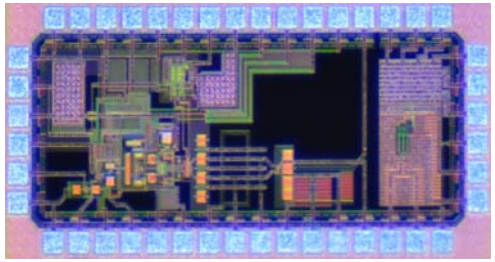
15+ patents



Analog ECG processor 2010



Radio ADC 2010



Wakeup receiver 2010

Application areas for ultra low-power sensors

The domestic sector

CO, CO_2, humidity, combustible gases

The medical sector

diagno cs and patient monitorin

The automotive, industrial, and aerospace sector

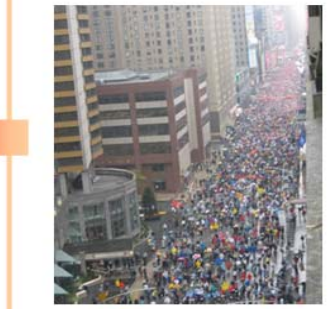
NO_x, O_2, NH_3, SO_2, O_3, hydrocarbons, CO_2

(Personal) Environment

State of the art breath analysis

IMEC wireless technology

Next personal generation



Personalized environmental analysis (pollution)

Air quality monitoring: on & around the body

Vehicles

Working environment

Personal environment

- CO_2, NO_x → asthma risk prediction
  → lung cancer prevention
- Volatile mixtures → Indoor comfort & health

Living spaces

Open spaces

fatigue

eye irritation

anxiety

lightheaded

headaches

nausea

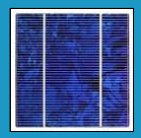
drowsy

Micropower Program: an integrated approach

Harvesting Sources

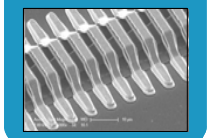
Design, Fabrication and Testing

Photovoltaic



Vibration

Thermal

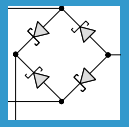


RF

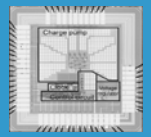
Power management

IC Design and Testing

AC/DC



DC/DC



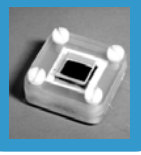
Energy Storage Systems

Characterization and Selection

Battery

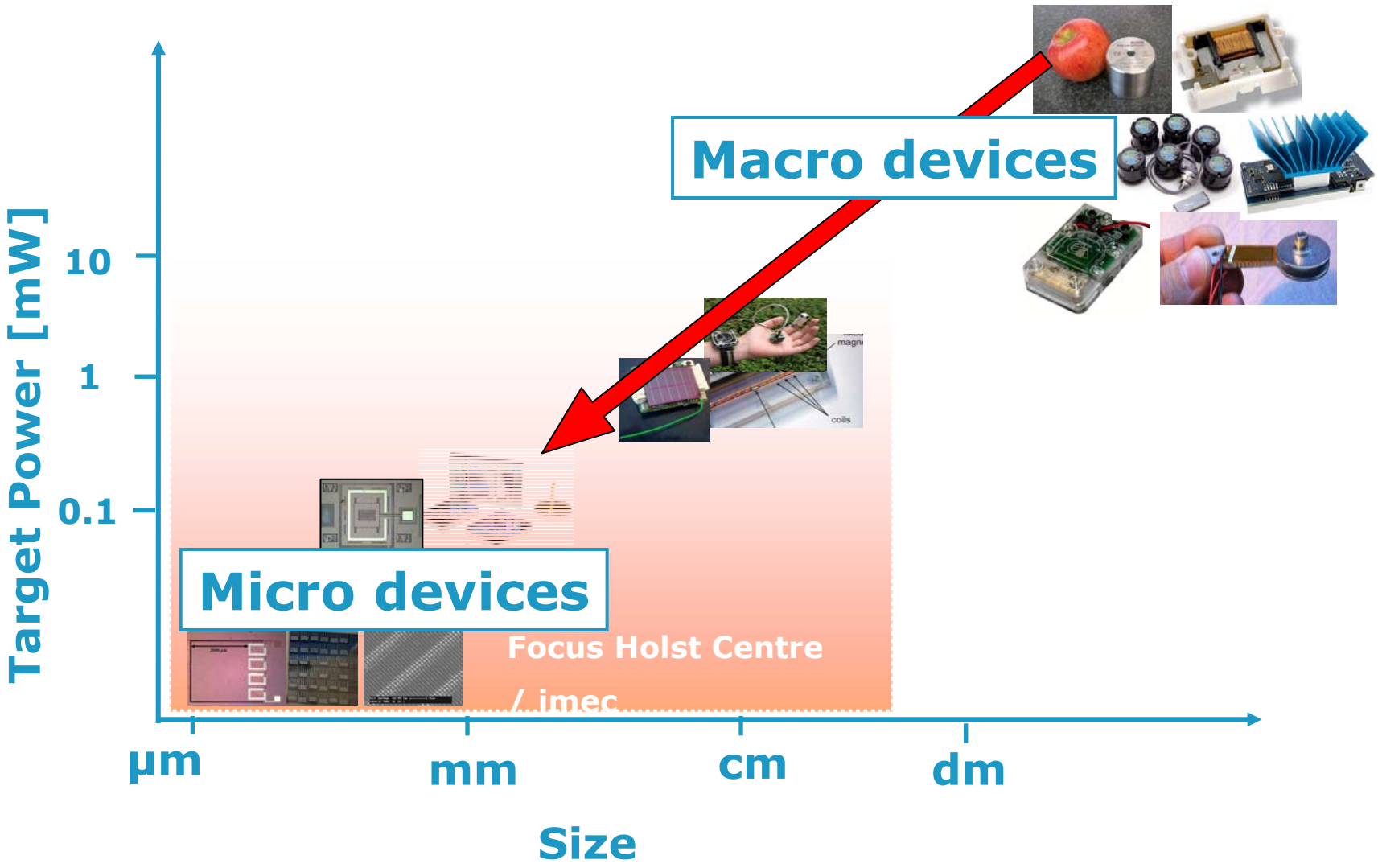
Supercap

Biofuel cell



Micropower Module

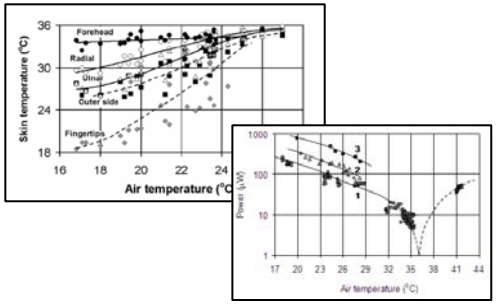
Positioning of micropower research: size matters !



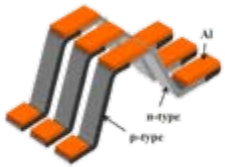
Understand, Design, Manufacture, Integrate and Characterize

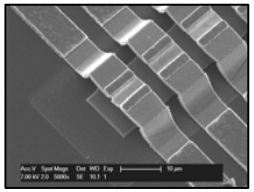
Thermal Energy Harvester

Field data



Concept

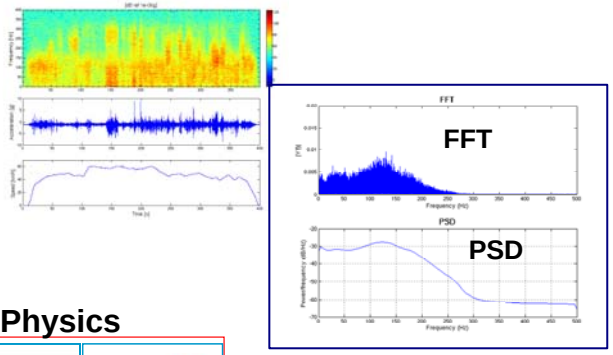




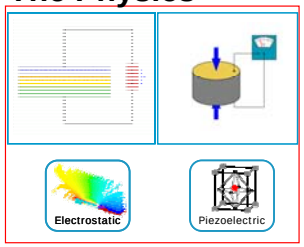
Integration, Validation & Test

Vibration Energy Harvester

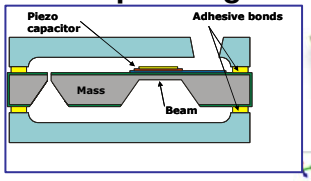
Spectral Analysis



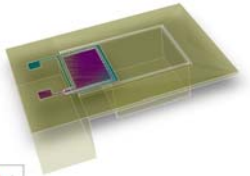
The Physics



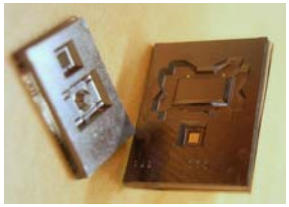
Concept Design



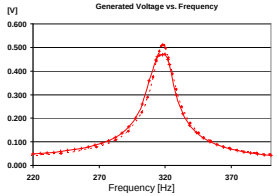
FEM modeling



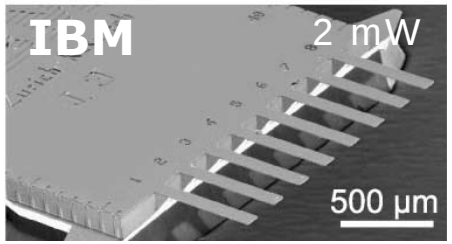
Micro machining



Simulation and Validation tests

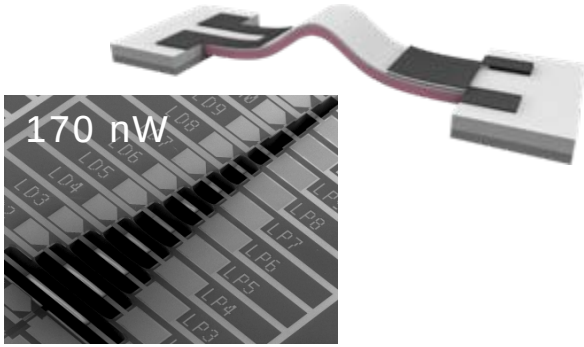


Advancing state of the art : Harvesters and Sensors



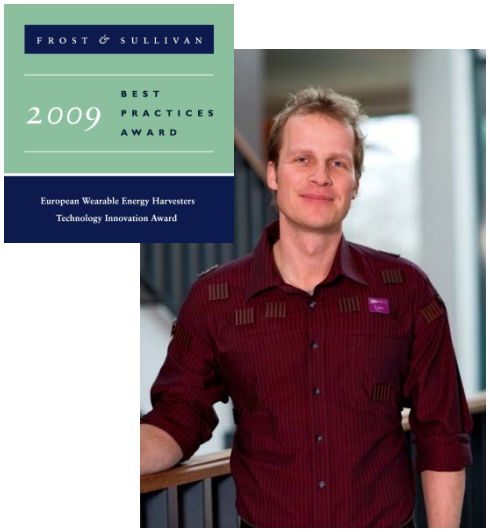
>260x Responsivity Increase

10^4x Power Reduction

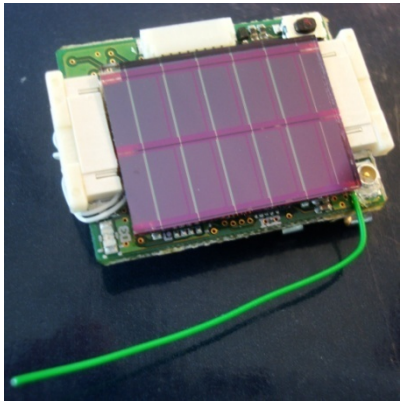


Vapor (EtOH) sensor 2009

Piezo vibration harvester
With record output power
(85 µW)



Thermal harvesters on body
Frost&Sullivan award



ULP T-sensor (10µW)

15+ patents

Holst Centre Industrial partners from across the value chain

Reaching out to Partners in Open Innovation

Holst Centre
Open Innovation by IMEC and TNO

QUESTIONS ?

Stand J28 – Hall 6

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