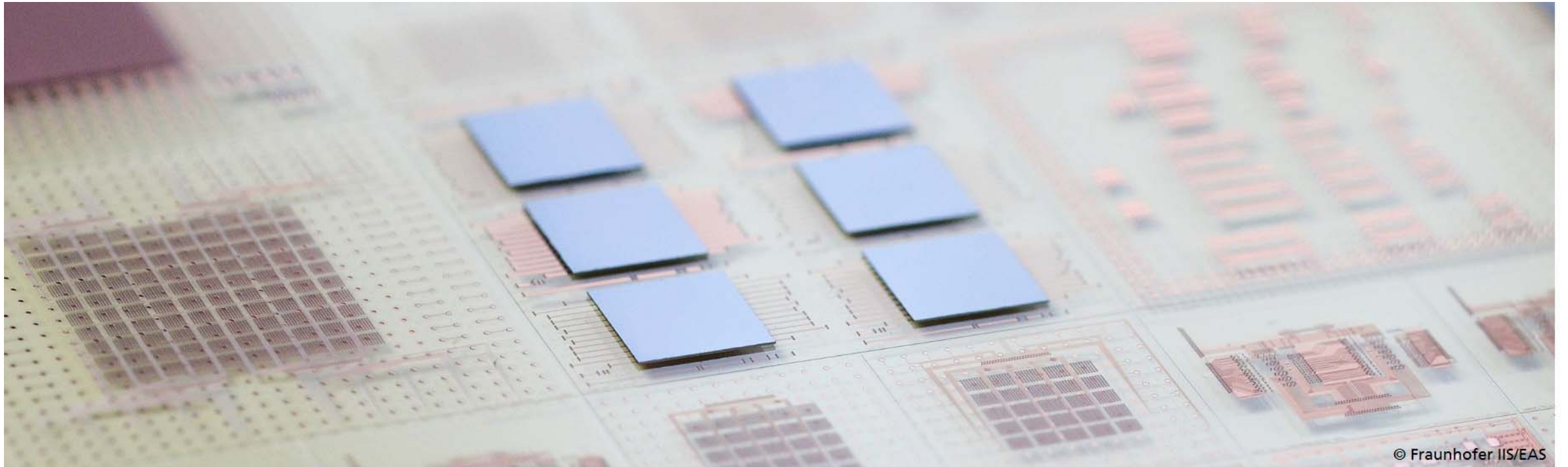

UNIVERSAL SENSOR PLATFORM FOR INTERNET-OF-THINGS APPLICATIONS

Outstanding solution for IoT system integrators



GLOBALFOUNDRIES®

 Fraunhofer

Starting situation



»IoT will be bigger than anything that has ever been done in high-tech.«

John T. Chambers, Chairman Emeritus Cisco

© MEV Agency UG, Germany



Starting situation

Product development of high-tech products is a protracted and cost-intensive process for SMEs and start-ups



Integration dilemma

The greater the desire for multifunctionality and higher integration density, the more protracted the development time.



Resource dilemma

Delivering specific, cost-efficient systems optimized to the respective requirements requires a wide range of resources.



Scaling dilemma

Seamless scaling from a few prototypes to mass production is not possible without leaps in the solution design.



Development time
> 48 months



Development costs
> 20 million euros

Starting situation

Rising market requirements call for greater function integration

- Customers increasingly demand not only product components but subsystems and complete system solutions for their applications
 - Extensive process know-how and continuous innovation are necessary for the respective market niche
 - Offering a complete problem solution to the customer is increasingly becoming the criterion for a decision
 - In order to participate in global growth on a continued basis, it is indispensable to adapt the solutions to local requirements and regional customer needs
- ➔ **Market requirements are rising, customer needs are becoming more complex and SMEs are facing the challenge of developing ever more advanced solutions for specialized niches in order to hold on to them**

Source: CAPCELLENCE, Sensor System Market Overview 2015



Starting situation

Lack of know-how and resources complicates the development of innovative products for SMEs



IoT products demand powerful, highly integrated microelectronics with high packing density and lower power consumption

Challenges facing SMEs

Access only to standard products

Little expertise in microelectronics development

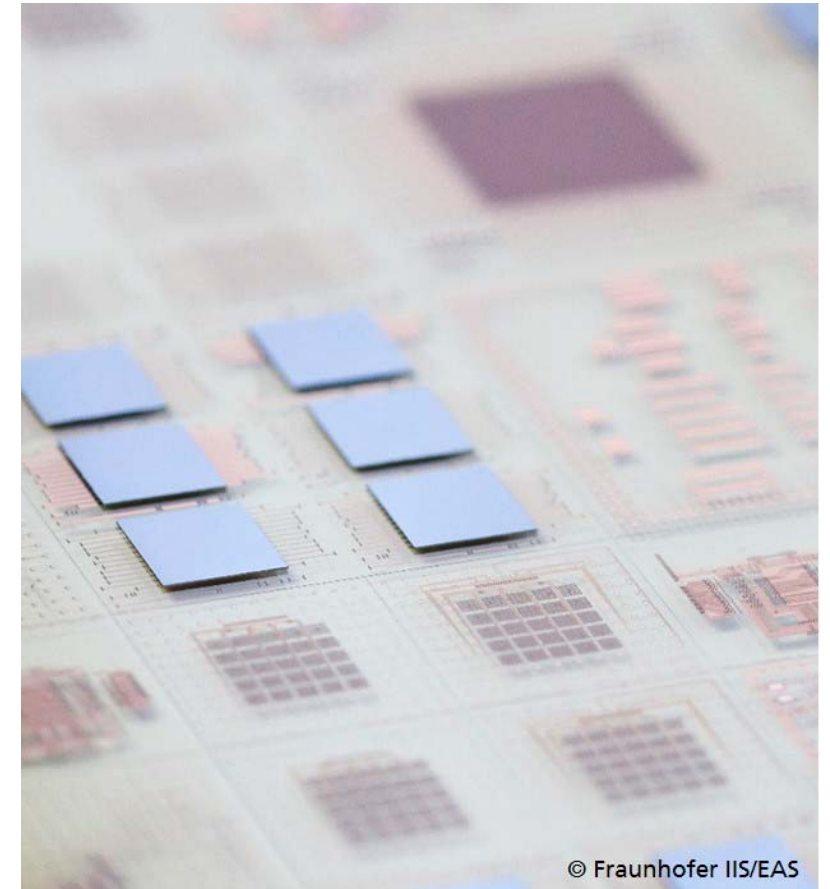
Very high development costs for electronics of the newest generation

Competitive environment requires fast time-to-market development

Universal sensor platform (USeP)

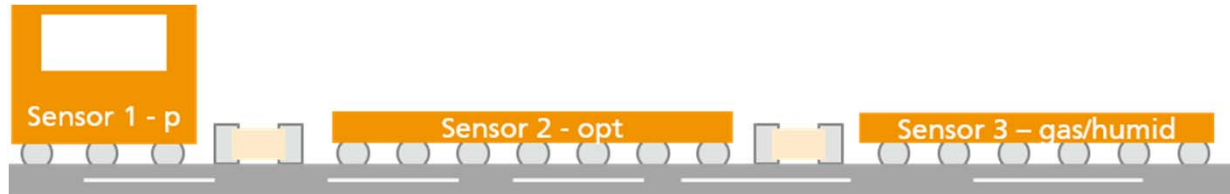
Holding niches & strengthening the competitiveness of companies

- Configurable sensor platform based on the GLOBALFOUNDRIES 22FDX[®] technology
- Especially suited for IoT systems with a high demand for local signal/data processing performance alongside low power consumption (edge computing)
- Modular design enables simple use of advanced system architectures and manufacturing methods even for prototypes and small series
- Combination of cutting-edge layout and packaging technologies with the newest design methods as well as the ability to integrate diverse sensors

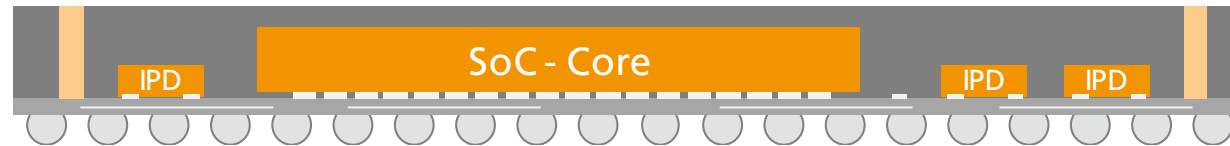


Universal sensor platform (USeP)

Modular design enables development of individual sensor nodes



..... Level 2: Core functionality of the system including selection of sensors (limited customizability)



..... Level 1: System core consisting of system-on-chip (standardized) and pre-packaging (up to 90% standardized)

Level 3: System board including power supply and other components (customizable)



Universal sensor platform (USeP)

Modular design enables development of individual sensor nodes



- Minimization of financial risk through modular, freely configurable platform elements
- Available modules:
 - Central control and computation unit (SoC) with numerous wireless and wired communication interfaces
 - Wide selection of sensors and actuators from various manufacturers
 - Embedded software including real-time operating system
 - Integrated solutions for hardware and IT security
 - Pre-qualified packaging solutions
- Built-in calibration and self-testing at the system level
- Prototypes and series production possible

Universal sensor platform (USeP)

22FDX[®] offers high performance alongside low energy consumption

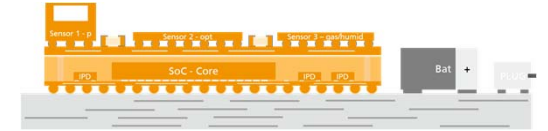
- 22FDX technology^{®*} enables the ideal combination of performance, power consumption and costs for the “Internet of Things”
 - 70% lower power consumption than 28 nm technology
 - 20% smaller chip surface and 10% fewer masks than 28 nm technology
 - 50% fewer immersion lithography layers than with FinFET
- The characteristics of the transistors can be modified via software and in real-time to the requirements for power consumption, performance and leakage current



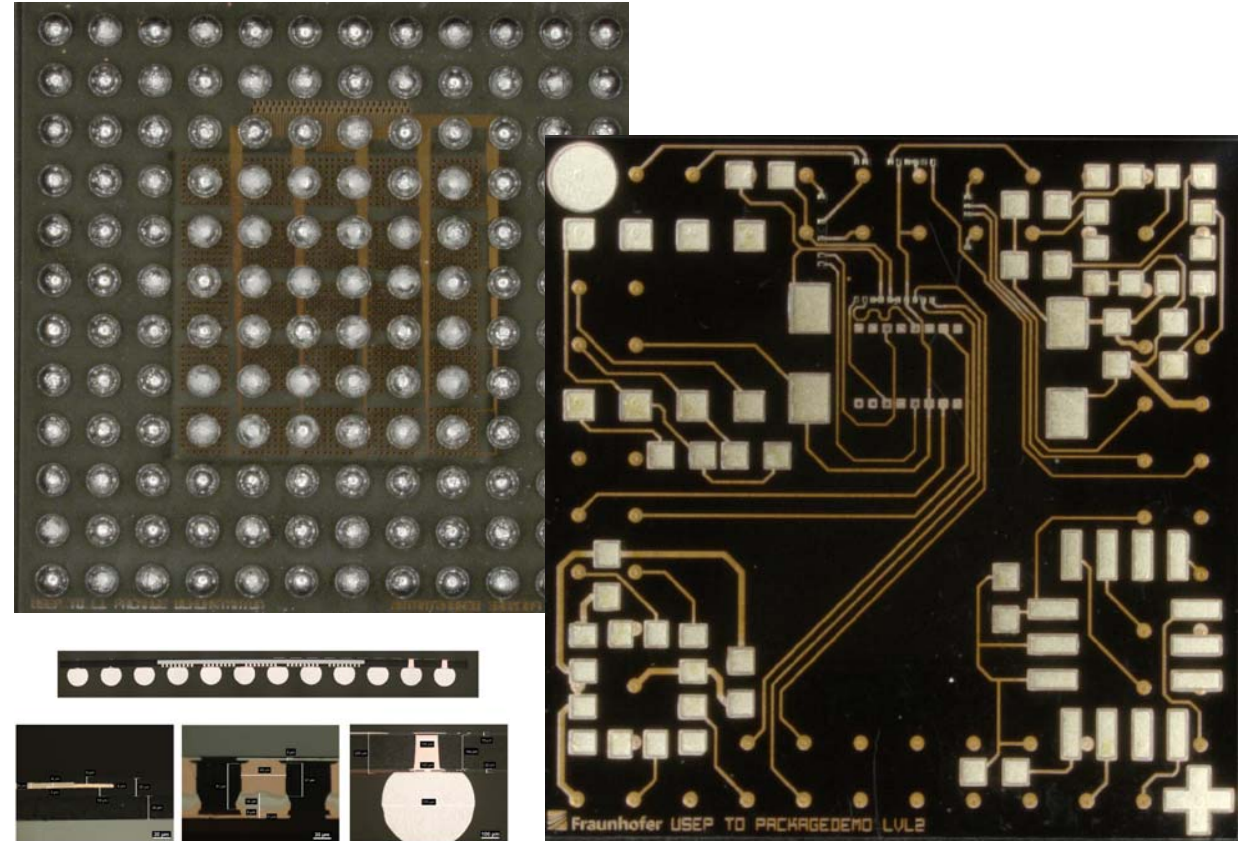
* Two-dimensional fully-depleted silicon-on-insulator (FD-SOI) technology

Universal sensor platform (USeP)

Technical specification 3D-USiP (level 1&2)



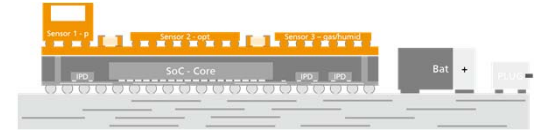
- Package: BGA 144 balls (0.8 mm pitch)
- Dimensions: 10 mm x 10 mm
- Topmost level contains additional sensors and UPL oscillator
- Microcontroller-based multi-sensor nodes (RISC-V)
- Acquisition, pre-processing and analysis of sensor data
- Reaction to detected events
- Communication over network



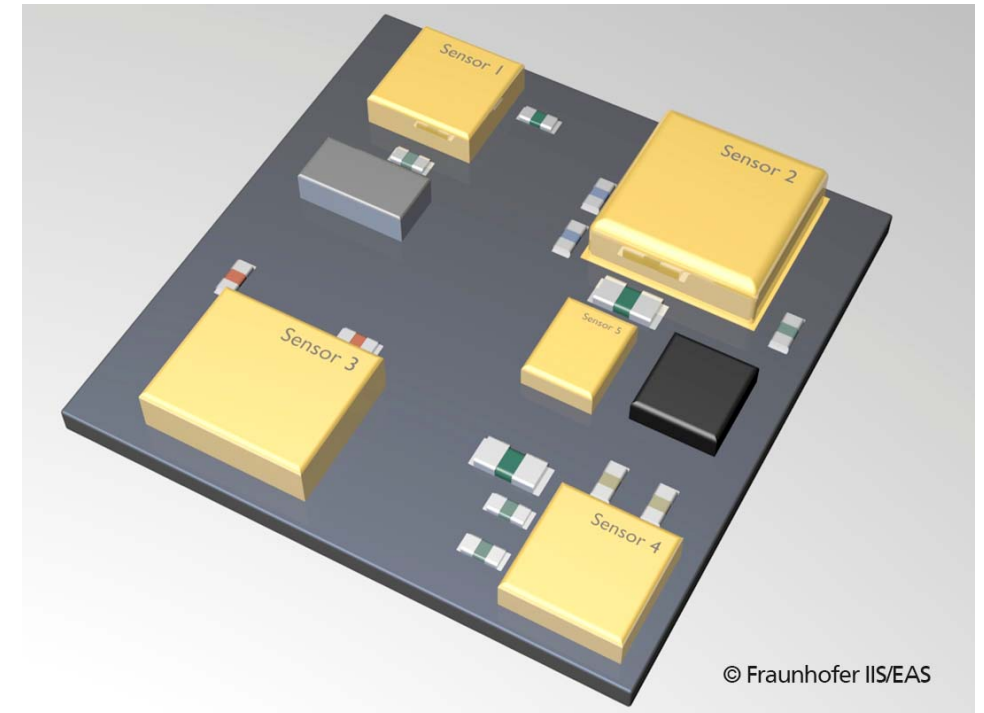
© Fraunhofer IZM

Universal sensor platform (USeP)

Integrated sensors of the 3D-USiP (level 2)

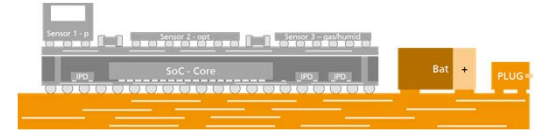


Measured value	Measuring range	Resolution
<ul style="list-style-type: none"> Triaxial acceleration 	<ul style="list-style-type: none"> ± 16 G 	<ul style="list-style-type: none"> 16,384 ... 2,048 LSB/g (@25 °C)
<ul style="list-style-type: none"> Humidity Temperature Air pressure Gas (VOC) 	<ul style="list-style-type: none"> 0 ... 100 % r.H. -40 ... +85 °C 300 ... 1,100 hPa IAQ Index 	<ul style="list-style-type: none"> 0.008 % r.H. 0.01 K 0.18 Pa
<ul style="list-style-type: none"> Angular rate 	<ul style="list-style-type: none"> ± 125 ... ± 2000 °/s 	<ul style="list-style-type: none"> 16.4 LSB/°/s
<ul style="list-style-type: none"> Vibration 	<ul style="list-style-type: none"> 1 Hz ... 5.3 kHz 	<ul style="list-style-type: none"> 0.98 mg/LSB
<ul style="list-style-type: none"> Biaxial acceleration 	<ul style="list-style-type: none"> ± 5 G 	<ul style="list-style-type: none"> 3.75 mg (@measurement rate 1kHz)



Universal sensor platform (USeP)

Customer-specific sensor nodes (board level 3)



- Customer-specific selection of sensors based on numerous interfaces made available via 3D-USiP
- Provision of the supply voltages for various assemblies: 0.8 V; 1.8 V; 3.3 V; 5 V; 12 V
- Communication interfaces:
 - Ethernet
 - WiFi / Bluetooth
 - CAN-FD
 - HyperRAM
 - JTAG
 - USB
 - Power supply
 - Connections for external sensors (SPI, I2C)
 - Connections for actuators (I2C, SPI, GPIO)

Measured values of example sensors:

- Vision
- Sound
- Deformation
- Carbon monoxide
- Temperature
- Pressure

Universal sensor platform (USeP)

USeP is suitable for a diverse range of applications

Industry automation

- Industrial image acquisition and processing
- Condition monitoring and intelligent process control



Smart health

- Image and voice processing for personal assistance systems
- Intelligent prosthetics



Smart living

- Distributed monitoring and control of networked buildings and energy systems
- Image and voice processing for smart household devices



Economy of things

- Multi-sensor system including security wallet – smart contract ready
- Uniquely identifiable hardware with digital ID for analysis and billing



Universal sensor platform (USeP)

Application example »Presence detection«

Intelligent detection of persons and objects for appropriate control of building services or traffic systems and for human-machine interaction in industrial automation

Challenge

Requirements with regard to information processing, energy efficiency and compliance with data protection regulations are currently difficult to satisfy simultaneously



Solution approach

Integration of an image sensor system-on-chip with local data processing for further process control

Your benefits

Energy-efficient presence detection in real-time
High data security and protection of privacy via local processing
Fast data transmission, such as to control systems

Universal sensor platform (USeP)

Application example »Condition monitoring in industry«

Acquisition of various physical values on machines and plants for continuous monitoring of the system condition, for error detection and failure forecasting

Challenge

Limited potential for retrofitting existing machines or plants with diverse sensors



Your benefits

Energy-efficient acquisition of various signals
Flexible positioning of sensors
Easy retrofitting of plants and machines

Solution approach

Wireless multi-sensor node with local or global data processing, as needed

Universal sensor platform (USeP)

Application example »Electronic nose«

Multi-channel analysis of chemical sensors and sensor data integration for technical evaluation of odors in the process industry, logistics or public security

Challenge

Combination of various discrete sensors as well as local data processing negatively impacts size and power consumption



Solution approach

Combination of simple gas sensors with local, intelligent data processing on the USeP platform

Your benefits

- Flexible and space-saving positioning
- Improved sensitivity and selectiveness thanks to multi-sensor solutions
- Location-independent monitoring via cloud integration

Universal sensor platform (USeP)

More innovation - less development risk

- USeP offers access to leading edge technologies
- Drastic product cost optimization via self-tests and sensor calibration
- Risk minimization in the development of innovative IoT systems through the use of standardized hardware and software as well as pre-qualified packaging solutions
- Reduction of development costs by a factor of 40+
- Reduction of development time by a factor of 10+
- Rapid and cost-optimized implementation of prototypes and small series
- Outstanding security – *“Security Made in Germany”*



UNIVERSAL SENSOR PLATFORM FOR YOUR IOT APPLICATIONS

YOUR CONTACT PARTNER



Dr. Klaus Meyer

Technical project manager USeP

✉ klaus.meyer@eas.iis.fraunhofer.de

☎ +49 351 4640-763



Anne Loos

Marketing manager

✉ anne.loos@eas.iis.fraunhofer.de

☎ +49 351 4640-807

Fraunhofer Institute for Integrated Circuits IIS
Division Engineering of Adaptive Systems EAS
Zeunerstrasse 38
01069 Dresden | Germany



USeP is funded by the European Union and the Free State of Saxony as part of the European Regional Development Fund (EFRE).

