ERÖFFNUNG DES INNOVATIONSZENTRUMS ADAPTSYS

Cyber Physical Systems – Sicherheit für eine Welt im Wandel

Harald Pötter
RF & Smart Sensor Systems

Fraunhofer IZM

Agenda

- CPS – Definition
- World in Transition by CPS
- Safety and Security by CPS
- Secure and Safe CPS
- Conclusion

Cyber Physical Systems (CPS) – Introduction Wording and Concepts

Smart Health

Car-to-X

Smart Home

Smart Cities

Sensor Networks

MtM

Internet of Things

Wearables

Embedded Systems

Smart Grid

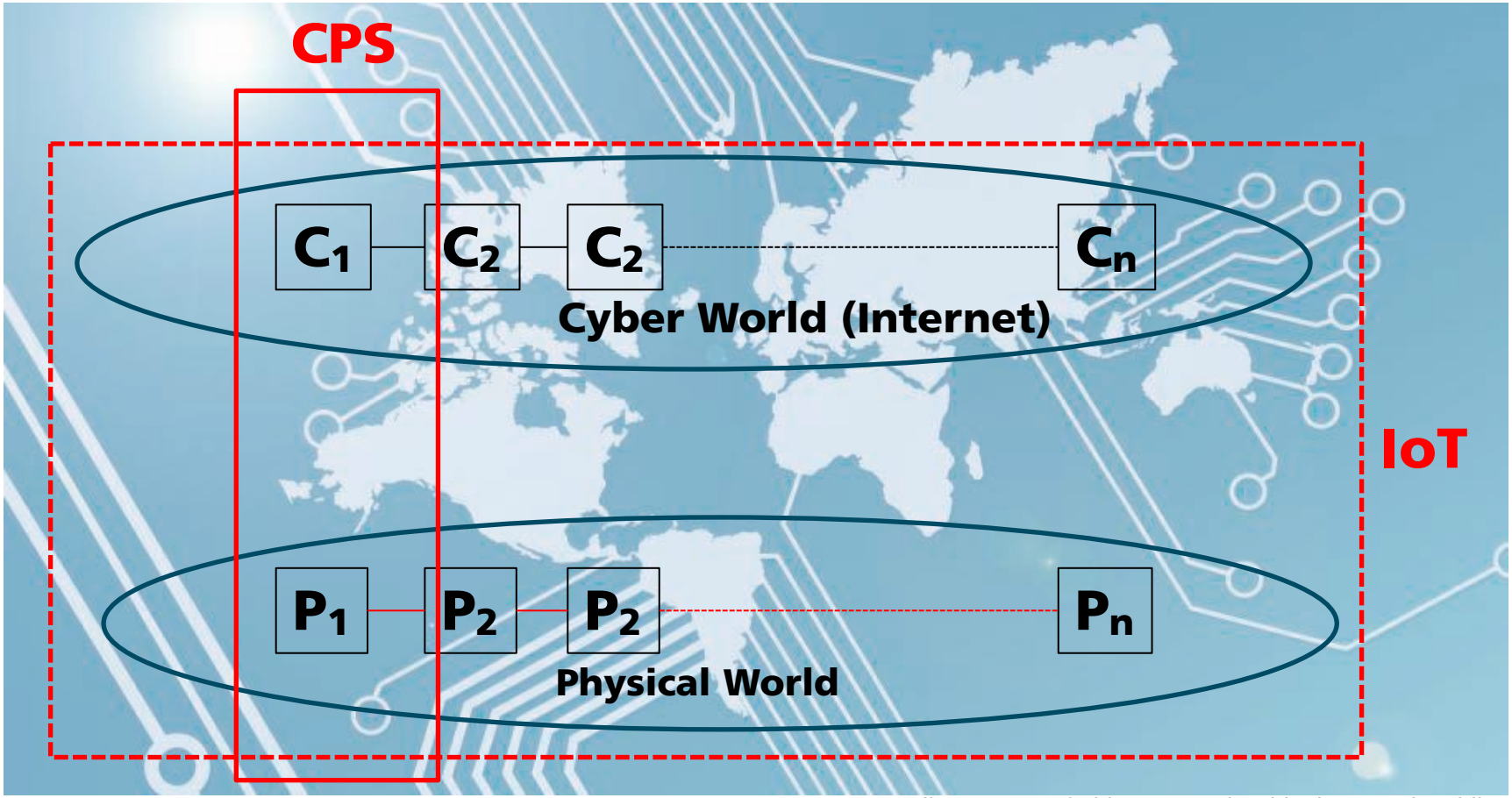
Cyber Physical Systems

Industrie 4.0

Smart Living

Big Data

Cyber Physical Systems (CPS) and Internet of Things: Structure



Quelle: Internet of Things towards Ubiquitous and Mobile Computing; Microsoft Reseach Summit Asia 2010

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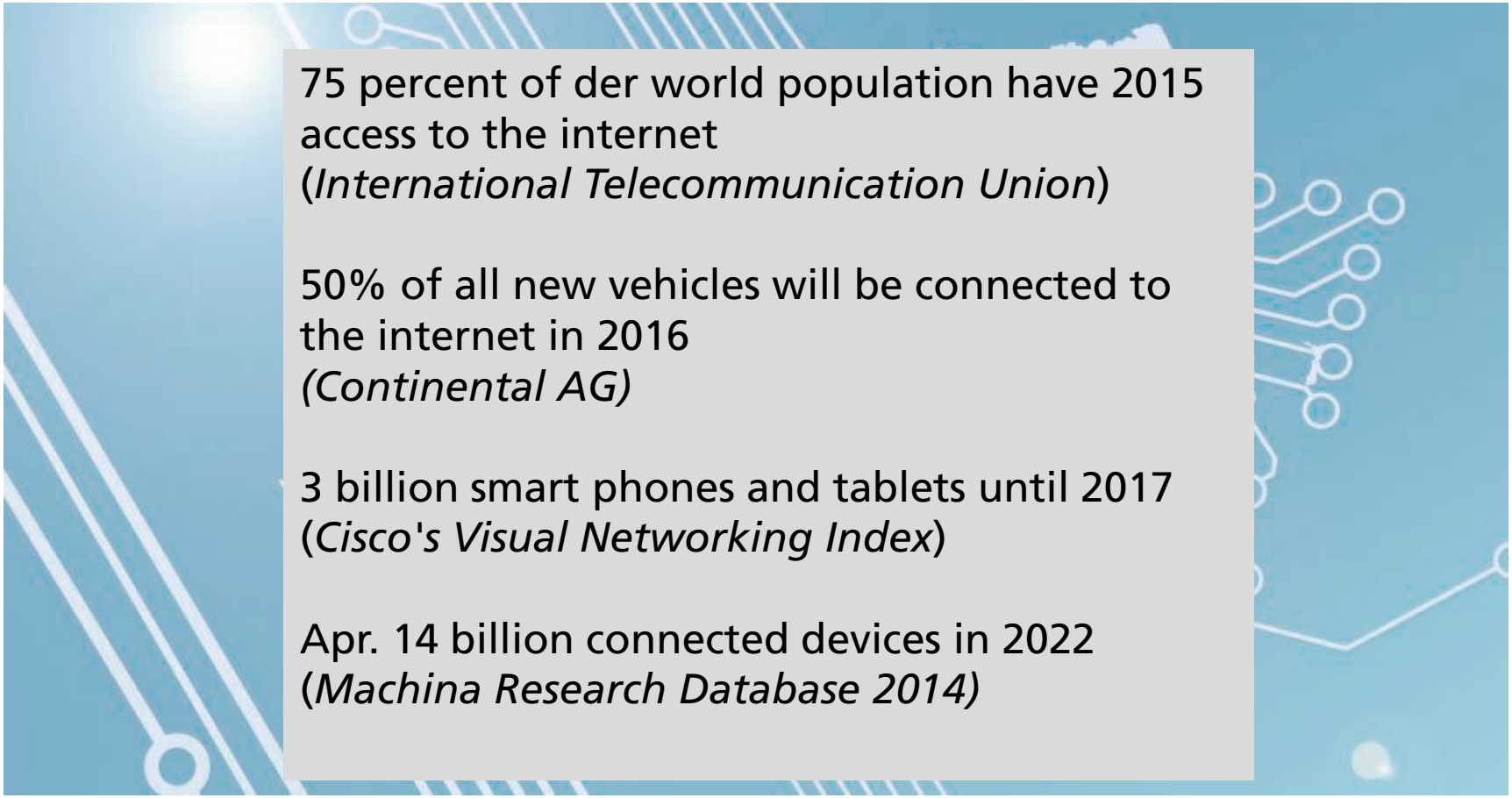
On the way towards CPS



75 percent of der world population have 2015 access to the internet
(*International Telecommunication Union*)

50% of all new vehicles will be connected to the internet in 2016
(Continental AG)

3 billion smart phones and tablets until 2017
(*Cisco's Visual Networking Index*)

Apr. 14 billion connected devices in 2022
(*Machina Research Database 2014)*

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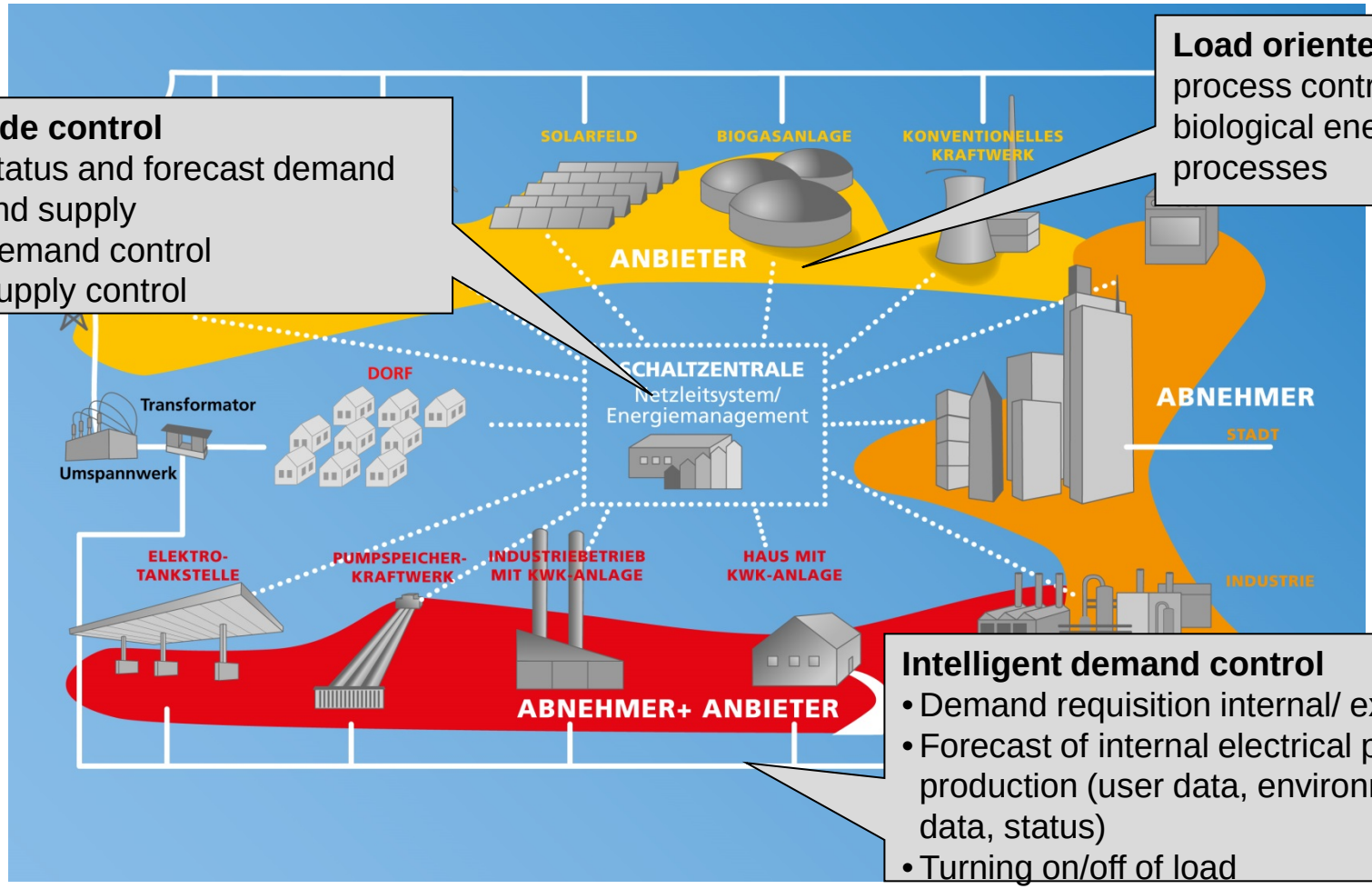
Example
Efficient Energy Load Sensing (Smart Grid)



Node control
- Status and forecast demand und supply
- Demand control
- Supply control

Load oriented process control of biological energy processes

Intelligent demand control
- Demand requisition internal/ external
- Forecast of internal electrical power production (user data, environmental data, status)
- Turning on/off of load

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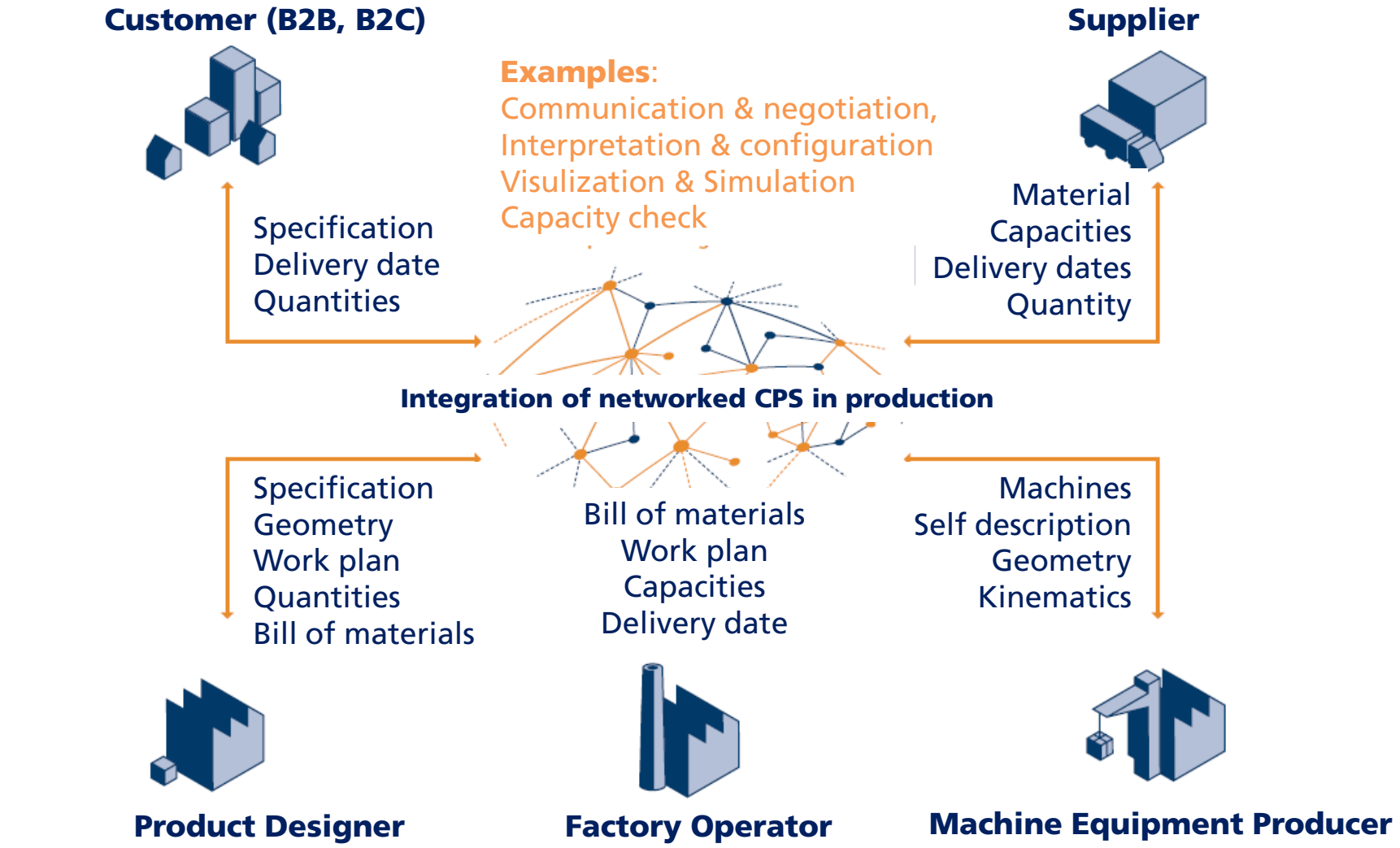
Example Industry 4.0



Quelle: Agenda CPS, Acatech Studie 2012

Example Industrie 4.0
Self-Organized Production

VDMA

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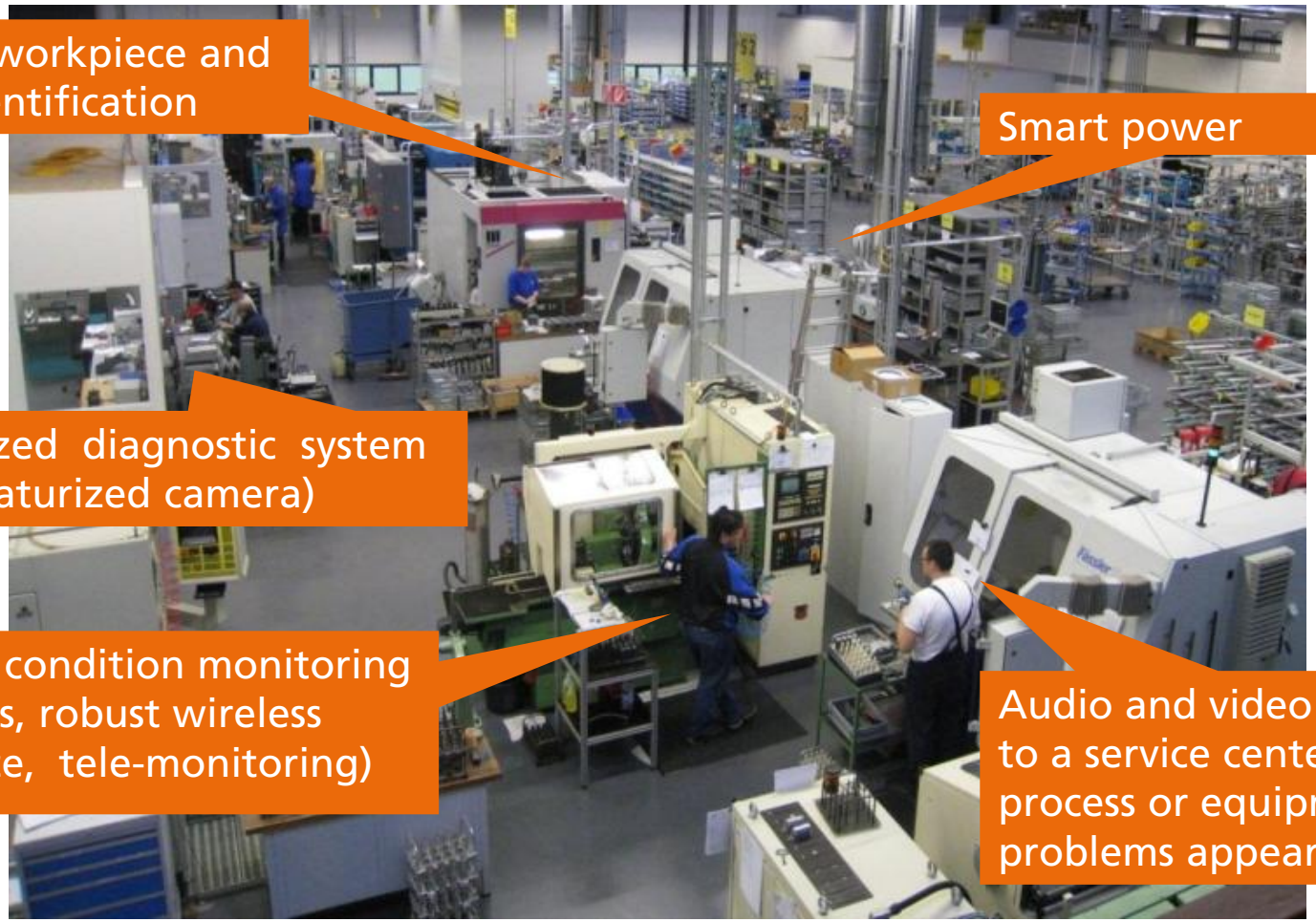
Example Industrie 4.0
Self-Organized Production



Secure workpiece and tool identification

Smart power

Miniaturized diagnostic system (e.g. miniaturized camera)

Online condition monitoring (sensors, robust wireless interface, tele-monitoring)

Audio and video streaming to a service center when process or equipment problems appear

VDMA

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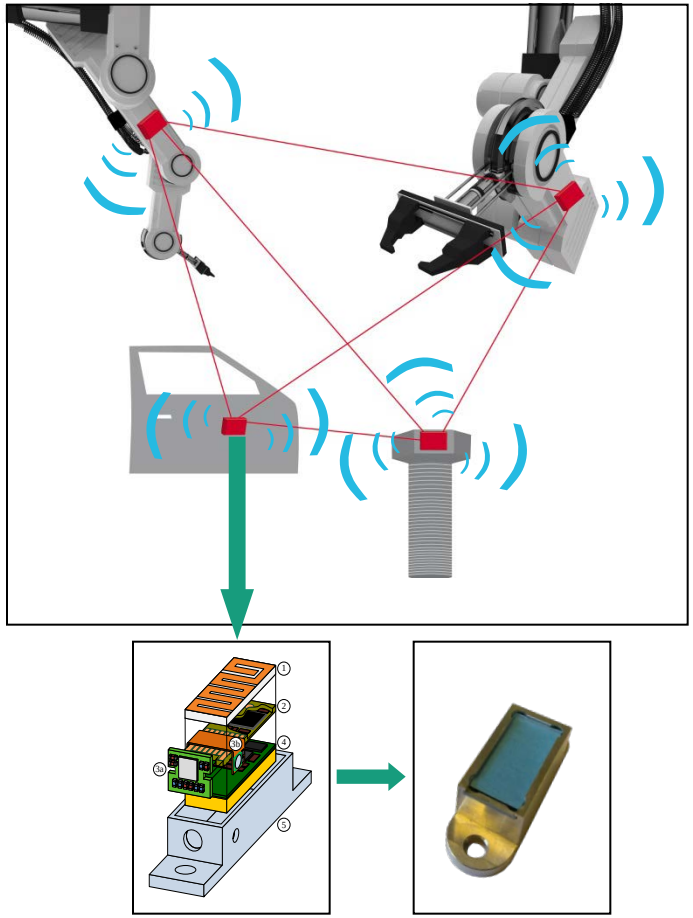
Example: Sopro – Self Organizing Production Requirements on autarkic sensors

- **Ultra robust, reliable process eGrains**
  - Design Platform for Process eGrains
  - Technology Platform for reliable eGrains
- **Wireless Interface in Harsh Environments**
  - Robust, energy efficient RF architecture
  - parameterisable, reliable protocols
- **Reliable, configurable operating systems**
  - Java-runtime environment for different performance classes
  - Implementation of a programming and simulation suite



Project SOPRO, gefördert durch das Bundesministerium für Bildung und Forschung (BMBF)

Quelle: Fraunhofer IPK und IZM

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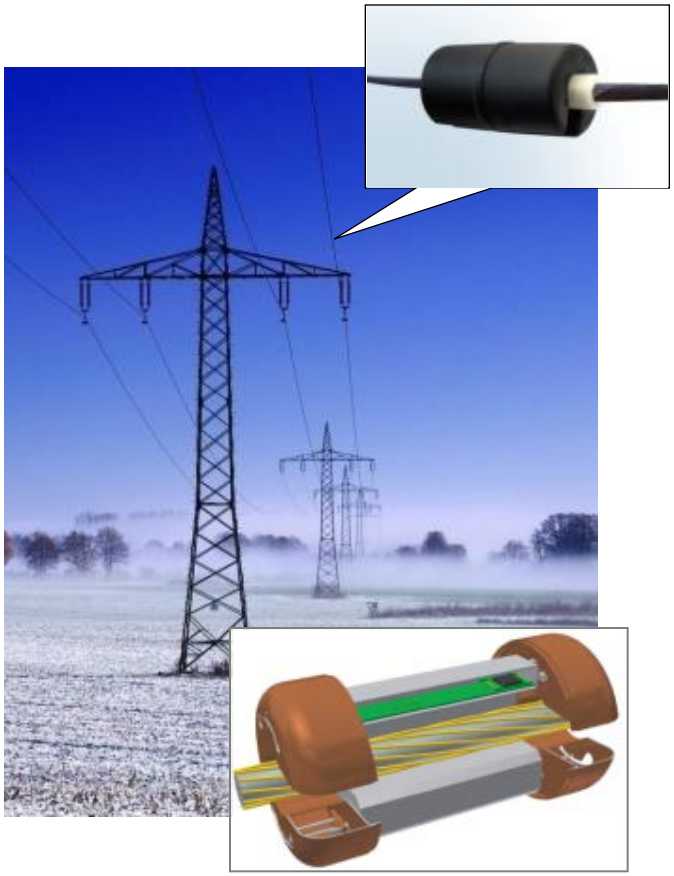
Safety and Security by CPS
Scope of Application

Civil Safety and Security by CPS

Example: Sensor Network for Line Monitoring and Hazard Control



Projects ASTROSE und Isostrose, funded by Bundesministerium für Bildung und Forschung (BMBF)

Source: Fraunhofer IZM und ENAS

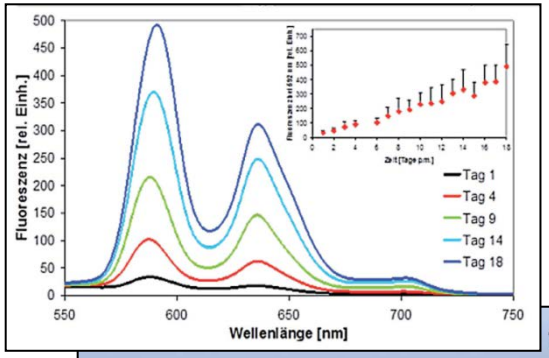
Line monitoring

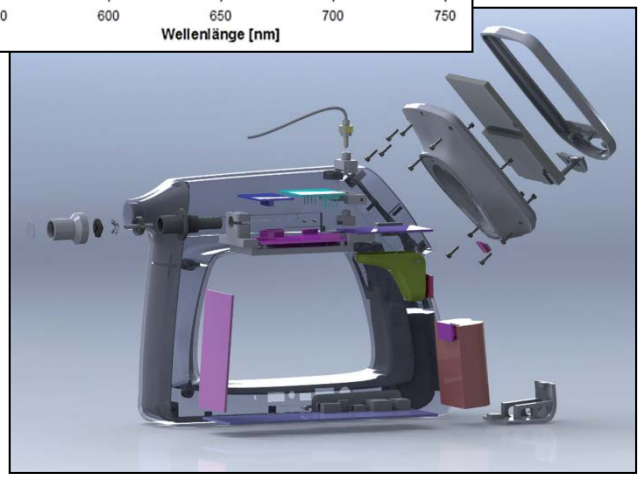
- Line capacity limited by line sag
- Compact wireless sensor network for integration in overhead lines
  - Measures are inclination and temperature,
  - Radio range is more than 1km, data transfer from node to node
  - Energy supply by use of capacitive and/or inductive harvesters
- Tight cooperation with local energy supply companies
- Currently field test with 100 sensors

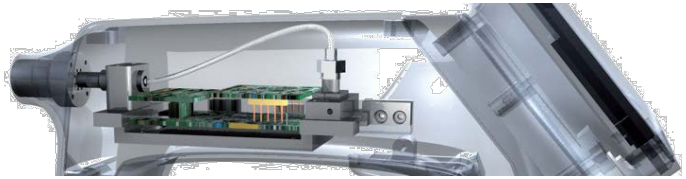
Hazard Control

- Short circuit current detection and localization for hazard control
- Broken wire detection

Civil Safety and Security by CPS







Example: Mobile device for optical and contact free quality estimation of meat (1)

Detecting method:

- Quantitative recognition of porphyrin
- Fluorescence spectroscopy with two different detector peaks (405nm + 420nm)

Technical realization:

- Fiber optical waveguides between laser, detector and head
- Full color touchscreen display
- ARM9 based architecture for high speed data processing and user interaction

Bundesministerium für Bildung und Forschung
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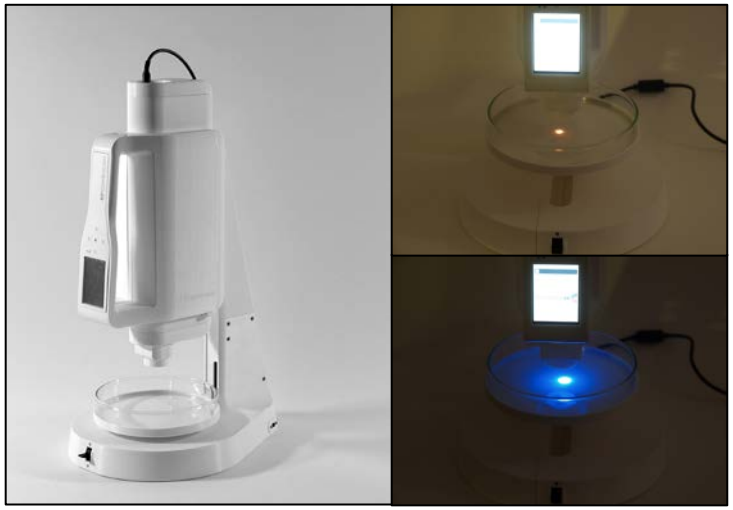
Civil Safety and Security by CPS

Example: Further development of a mobile device for optical and contact free quality estimation of meat

RFKOMBISCAN



Detecting methods:

- Quantitative recognition of porphyrine by fluorescence spectroscopy
- Recognition of e.g. lactic acid by Raman spectroscopy

Technical realization:

- High level integration of two different spectroscopic units
- Direct or remote wireless access possible

Supported by:
Federal Ministry for Economic Affairs and Energy
on the basis of a decision by the German Bundestag
ZIM Zentrales Innovationsprogramm Mittelstand
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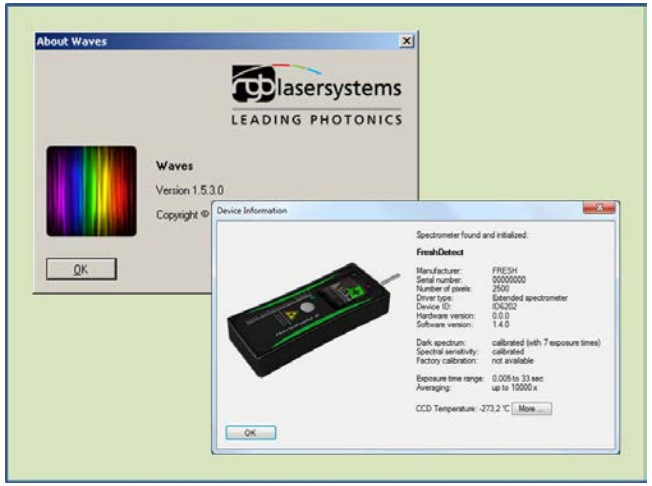
Civil Safety and Security by CPS

Example: Industrialization of a mobile device for optical and contact free quality estimation of meat

freshdetect



Freshdetect lab

freshdetect™

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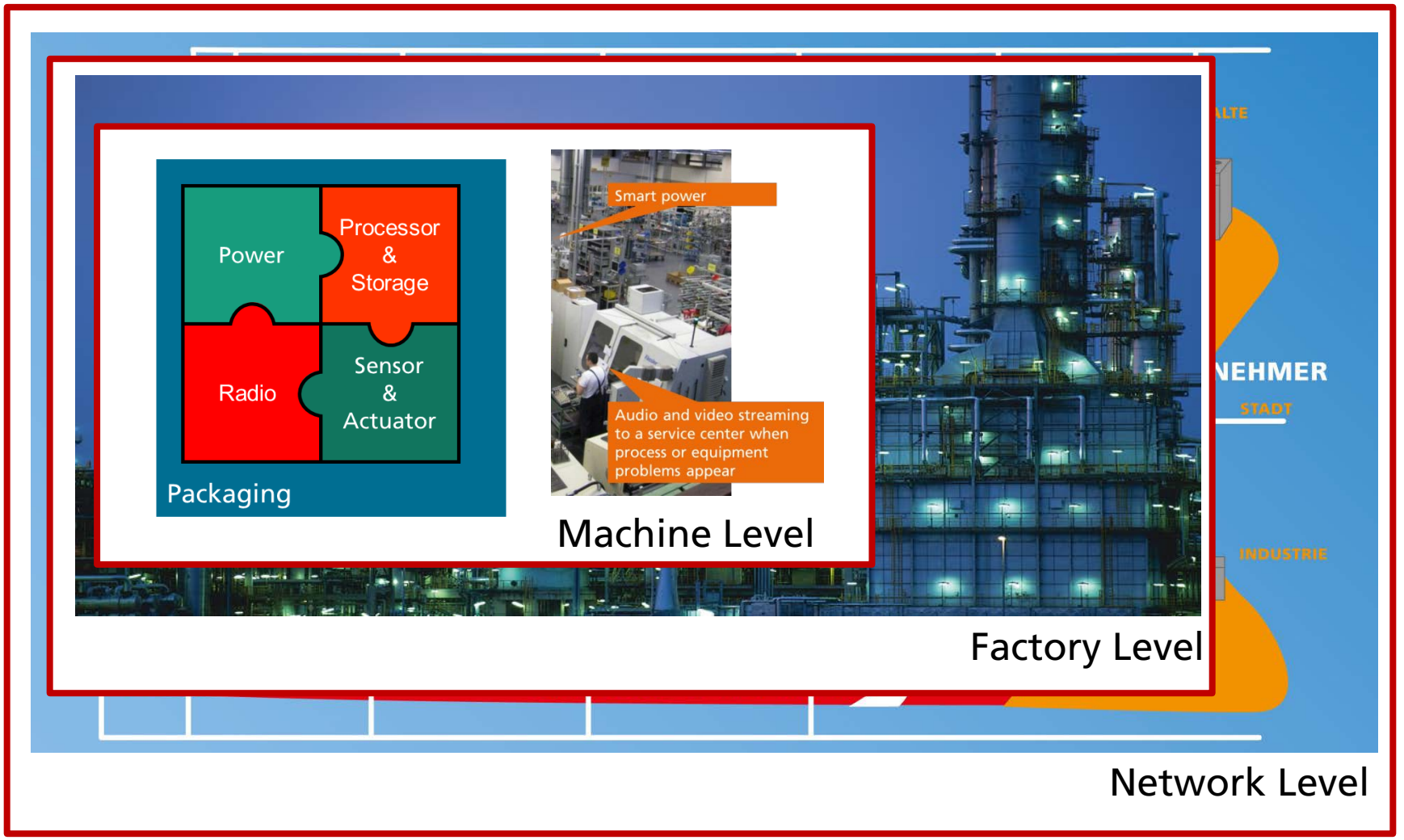
Secure and Safe CPS Challenge

- **Software security** esp. by (distributed) operation/ software
- **Security of communication** path und infrastructure
- **Secure CPS-hardware** components (sensor nodes, computer nodes, …)

- operating in **distributed** systems
- with **many and different** components
- with **heterogeneous communication** structures
- with **local restricted hardware** and energy resources
- with **little latency**
- operating in interference-prone, **harsh environments**

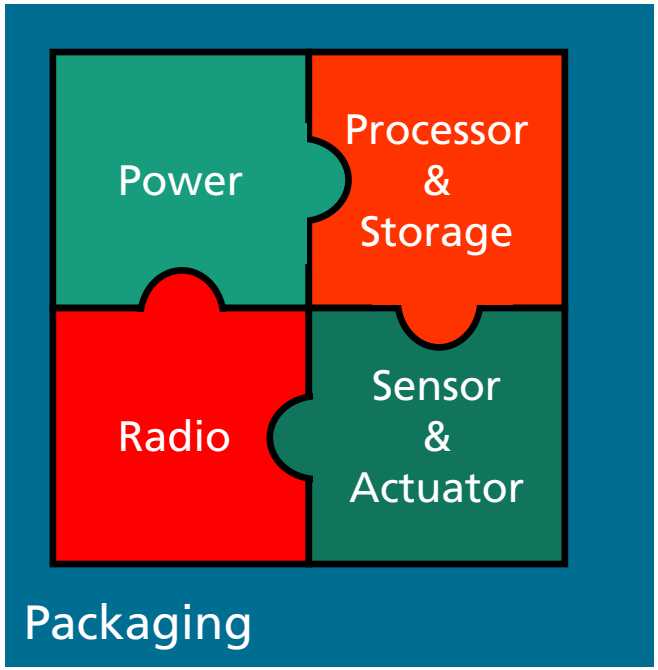
Security level using the example of Industrie 4.0



CPS security on machine and floor level

Energy efficient safety and security concepts

Self control and diagnosis



Secured identity

High security but little latency

Secured integrity

Robust data transmission with inherent security

Redundancy in data acquisition

Tamper resistance

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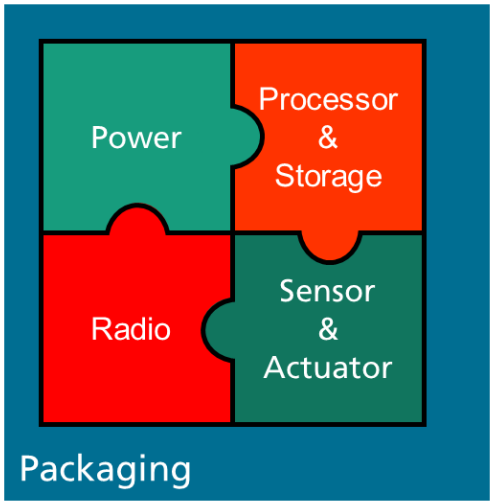
CPS Building Blocks by Adaptsys

System Design + System Integration

Power
- Supply Source
- Management

Wireless Interface
- Operating Frequency
- Wireless Standards

Data Akquisition
- Data Processing
- Sensing
- Data Security

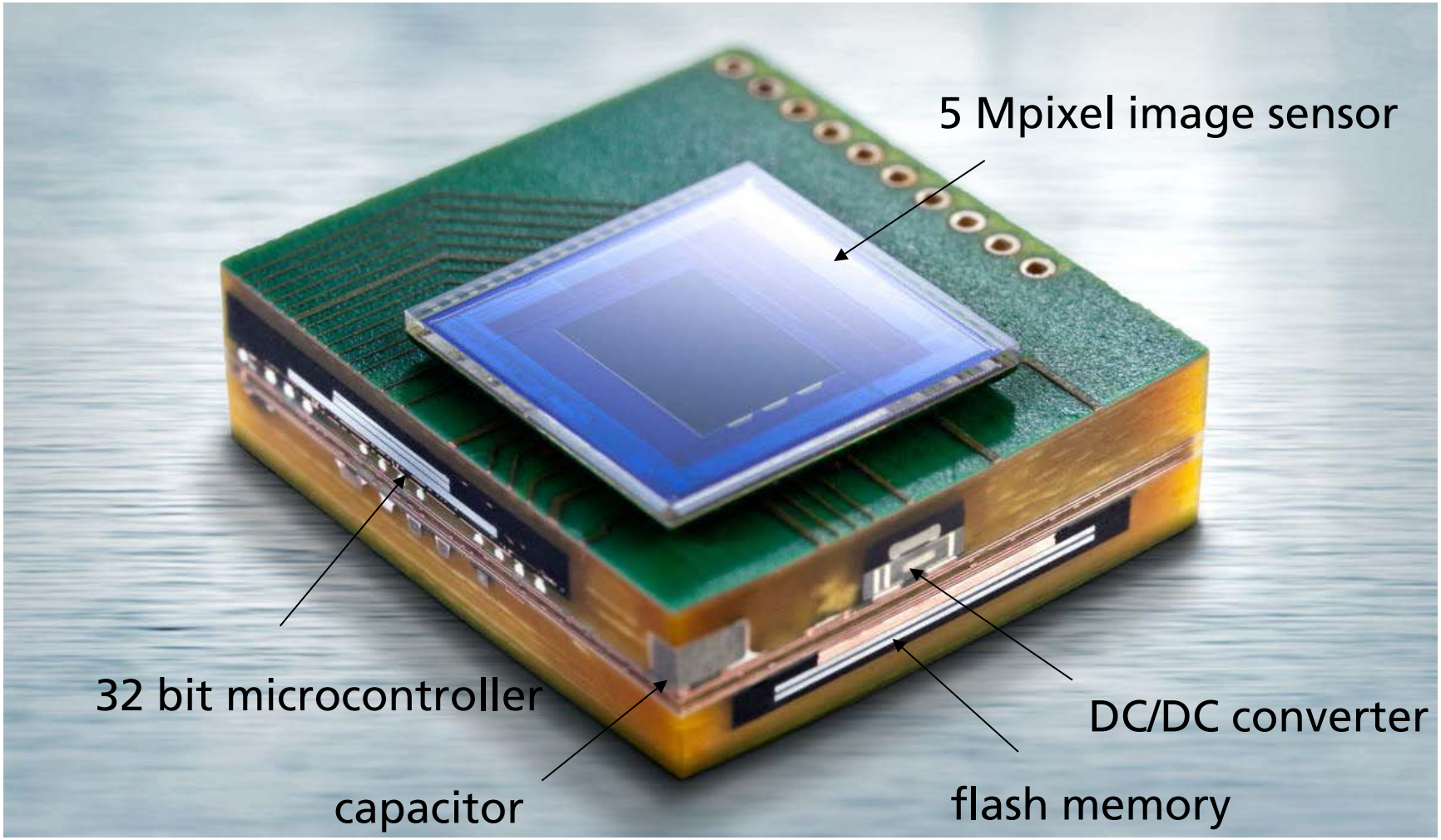


Nano-Interconnect Technologies
- Materials
- Technologies
- Reliability

Module and Board Integration
- Molding
- Substrate Integration

Non-Digital Waferlevel Heterointegration
- Thin Film Multilayer
- Interposer Technologies

MoMiCa – **Mo**dulare **Mi**cro **Ca**mera



Modular camera with integrated 32 bit image processor and memory

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Thank you for your attention

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