ecsel europe

EPoSS European Technology Platform on Smart Systems Integration

Aeneas Association for European NanoElectronics ActivitieS

ARTEMIS

EPoSS European Technology Platform on Smart Systems Integration

Smart Systems Integration - key topics in H2020

Major Achievements and Principles of EPoSS

International Symposium on Smart Integrated Systems
on the occasion of the 60th birthday of Prof. Gessner
TU Chemnitz, ENAS Center for Microtechnologies, 12 August 2014

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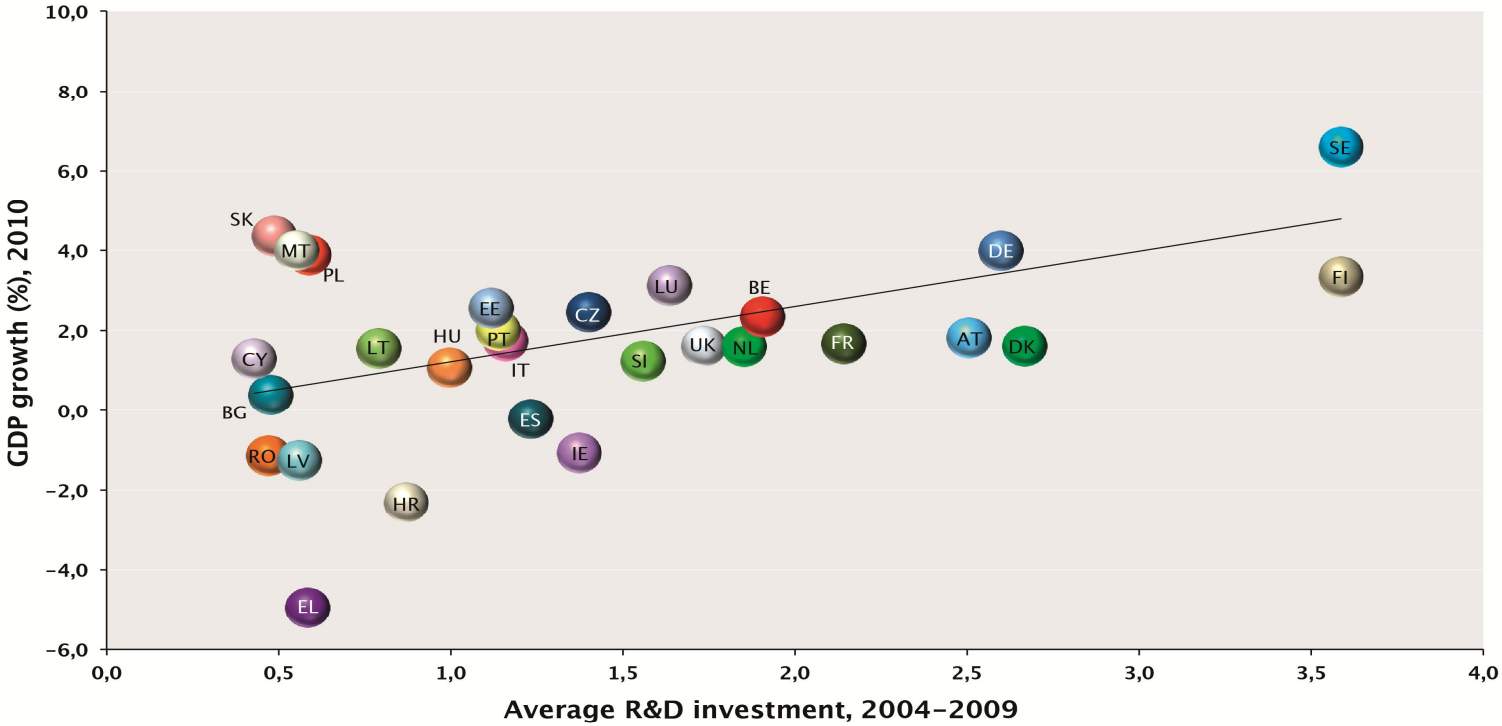
Chairman Executive Committee EPoSS
ECSEL Board member
ECSEL Germany Vice Chair
Vice Chair EGVIA

H2020 Strategy



Source: DG Research and Innovation - Economic Analysis Unit
Data: Eurostat

Notes. (1) Greece: average R&D intensity refers to 2004-2007.
(2) Denmark, Portugal, Slovenia, Sweden: Break in series between 2004-2009.

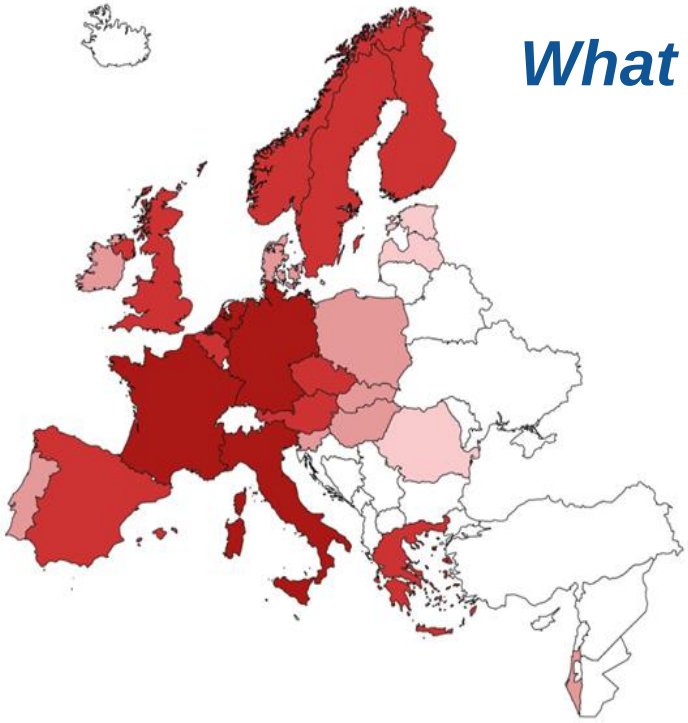
Investment in R&D is part of the solution to exit from the economic crisis

Source: W.V. Pyumbroeck, EU COM / DG CONECT, SSI Conference March 2014 ,

ECSEL - Electronic Components and Systems for European Leadership

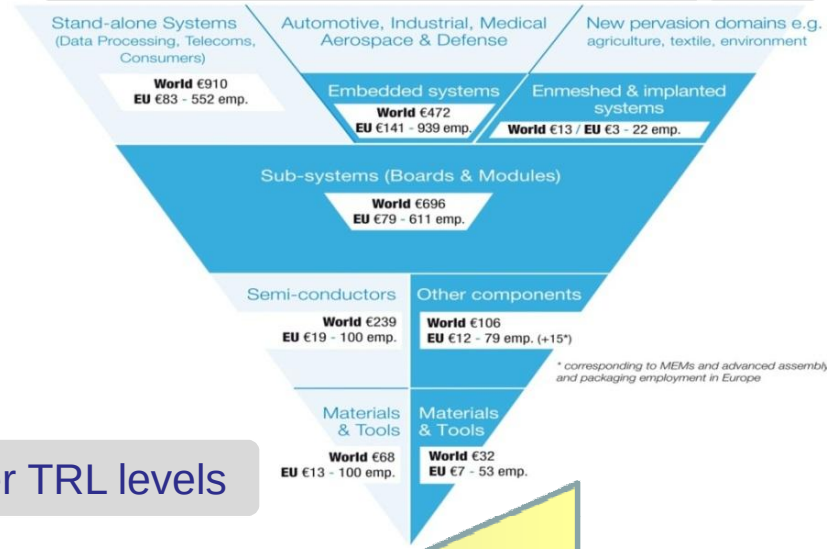
European Commission

1. Industry led tripartite PPP launched in 07-2014

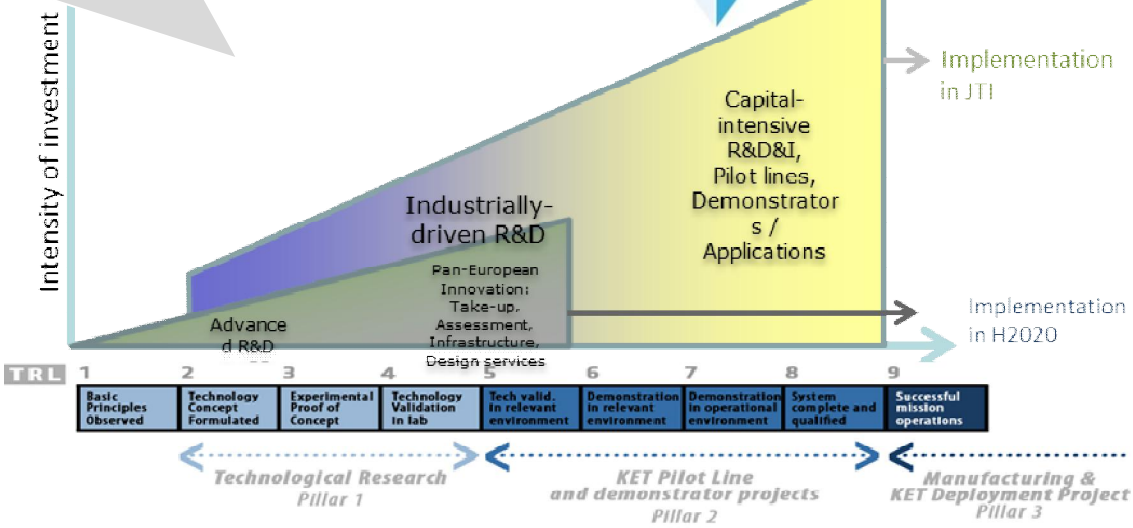


What is ECSEL?

2. Extended scope – whole electronics value chain

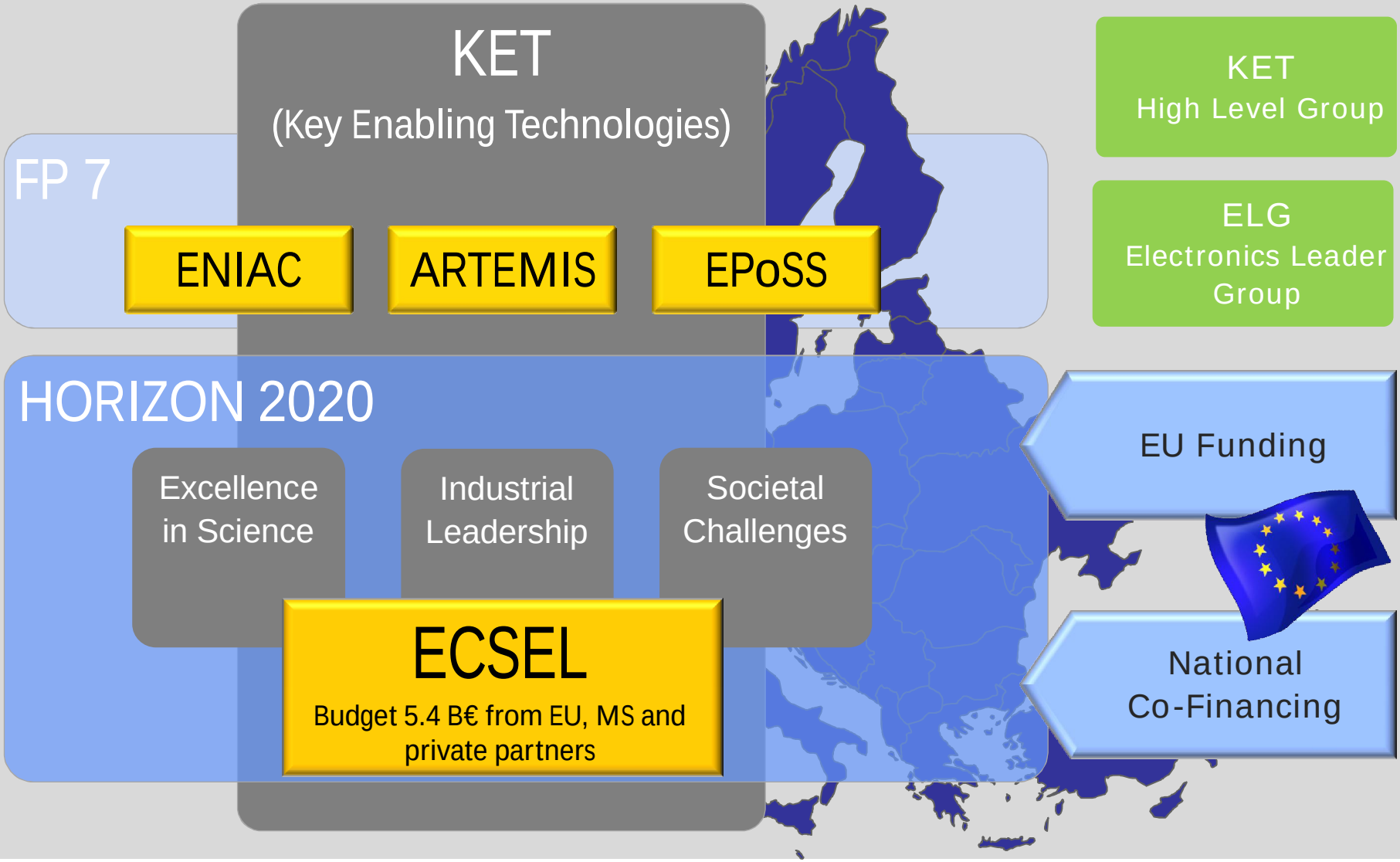


3. Focus on higher TRL levels



Source: W.V. Pyumbroeck, EU COM / DG CONECT, SSI Conference March 2014 ,

H2020 Strategy
ECSEL - Part of relevant European Initiatives



ECSEL is the most relevant Industry driven R&D&I Cooperation Platform

ECSEL Joint Undertaking stands for:

- A Public-Private Partnership of the European Union, EU member states and industry
- Holistic system approach, covering the entire value chain

- Micro- and Nanoelectronics (ENIAC)
- Embedded/Cyber-Physical Systems (ARTEMIS) and
- Smart Systems Integration (EPoSS)

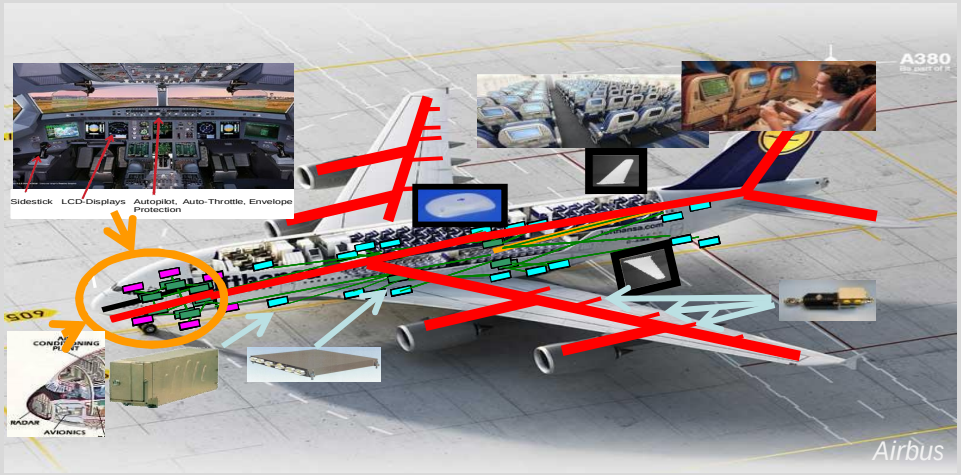
- Total R&D&I costs of about 5 billion EURO

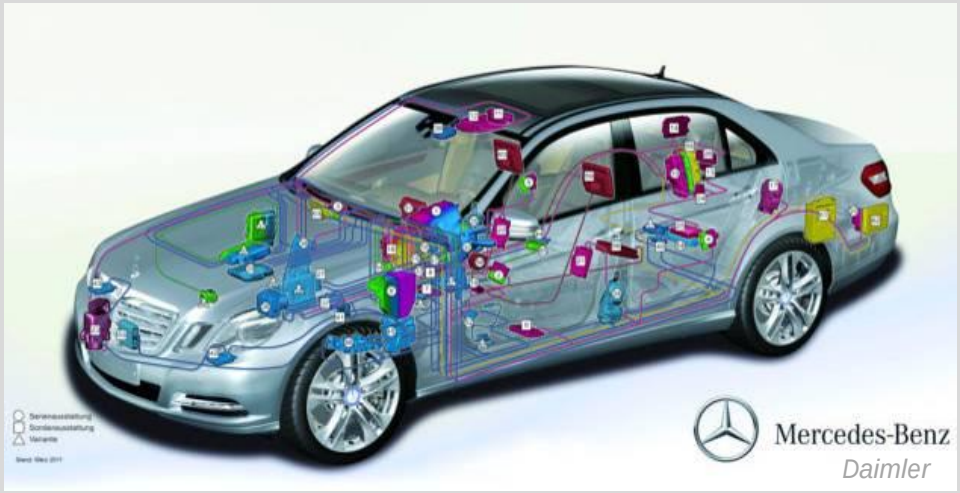
- Up to 1.2 billion EURO provided by the EU
- At least 1.2 billion EURO provided by the member states
- At least 2.4 billion EURO provided by industry

Alignment and cooperation with regions envisaged.

Electronic Components & Systems: Impact on Society and Economy

ecsel germany





Increase of Electronic Systems (HW + SW) is required

- to master complexity
- to meet environmental challenges
- to enhance competitiveness
- to improve cost efficiency

This trend will even accelerate!

ECSEL Germany
MASRIA: Priority Chapters and Topics (2015-16)

ecsel germany

Smart Mobility	• from assisted via partially to fully autonomous systems • systematically networked smart, intermodal transport solutions • real-time distributed situational awareness and decision making
Smart Society	• Interconnected Society • System concepts and test beds • Sensors, communication concepts, common interfaces
Smart Energy	• Efficient generation • Efficient distribution • Efficient and Smart use
Smart Health	• Clinical and in-field systems • Ambient assisted living and ageing society • system concept and pilot demos
Smart Production	• Highly automated and interconnected production • Advanced semiconductor manufacturing • Safe and secure communication in harsh environments

Semiconductor Processes, Equipment, Materials

- Smart power technologies
- RF / mixed signal for CPS
- Automation technologies and test procedures
- System packages / modules
- EUV lithography

Design Technologies

- Model-based and virtual engineering
- Managing complexity, including safety and security
- Managing diversity
- Yield, robustness and reliability

Technologies for Cyber Physical Systems

- Architectures
- Autonomy and cooperation
- Platforms: computing architecture and energy management
- Communication in distributed and connected systems

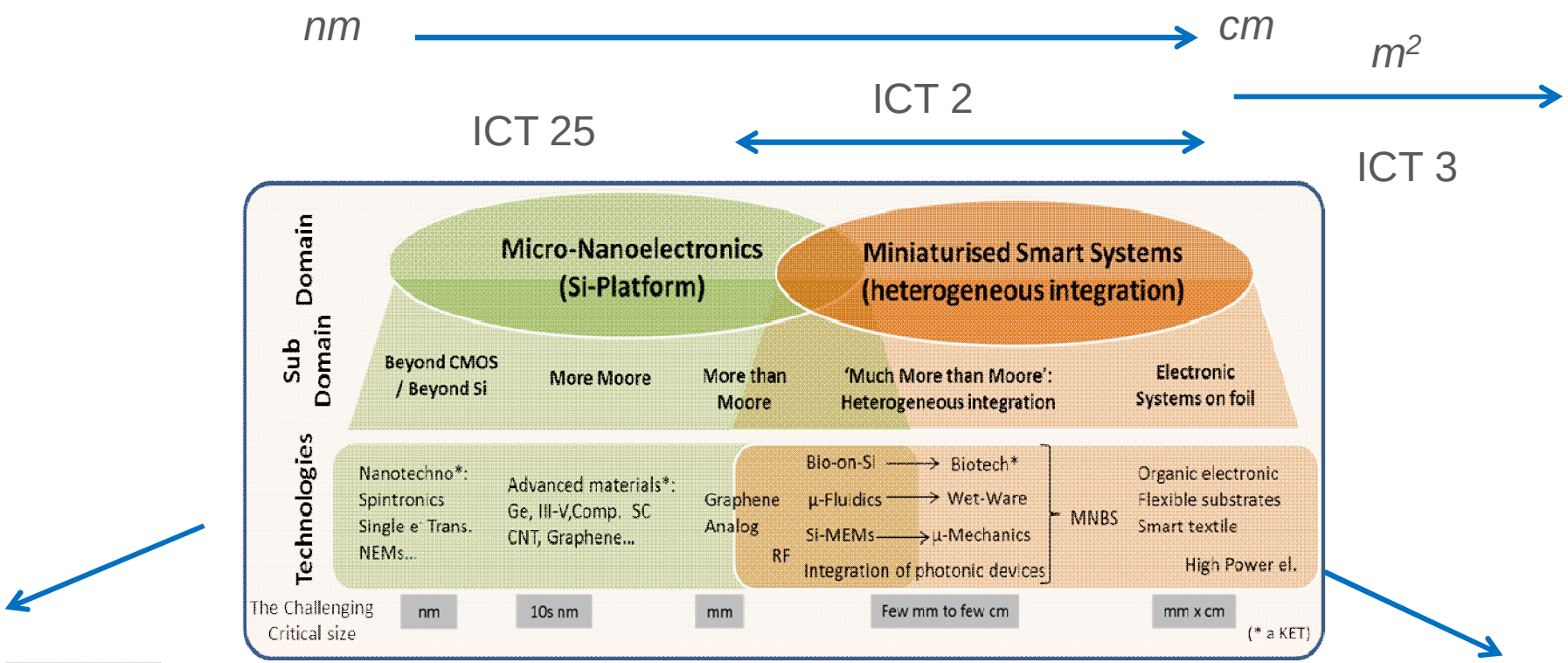
Technologies for Smart Systems Integration

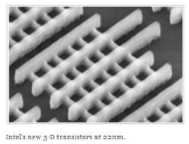
- Building blocks, and interfaces
- Integration methods enabling smart functionality, automation and reliable operation in harsh and complex environments
- Safe, secure and efficient transfer of data and power

ICT 2 – Smart System Integration

European Commission

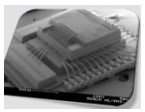
Component and Systems technologies in ICT – From nm to m²





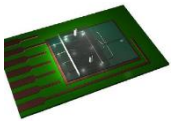
3-D transistors

CMOS 22 nm

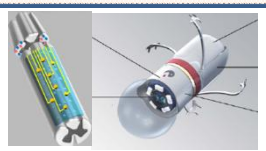


3-D stacking

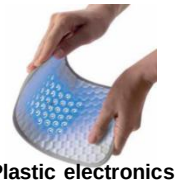
Ultra-wideband telecom



Lab-on-Chip



Miniaturised devices



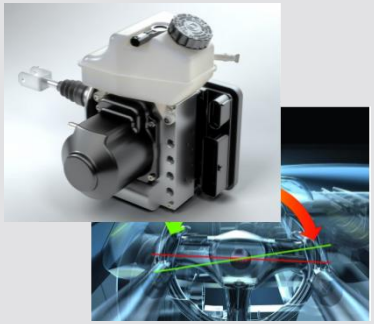
Plastic electronics (Place-it)

Source: W.V. Pyumbroeck, EU COM / DG CONECT, SSI Conference March 2014 ,

Smart Systems Integration

Smart Systems …

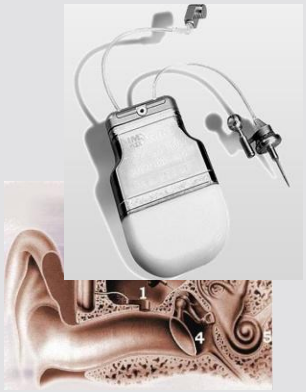
Positioning System



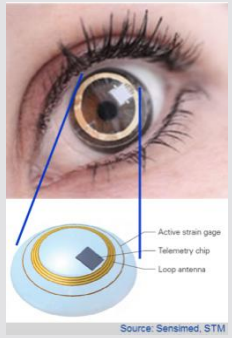
Driver Assistance Systems

Object Recognition Device

EPoSS Launch in 2006 with Commissioner V. Reding and the EPoSS Chairman Klaus Schymanietz



Cochlear implant



Intraocular Pressure Measurement Device

Smart Systems… *from 2006 on*

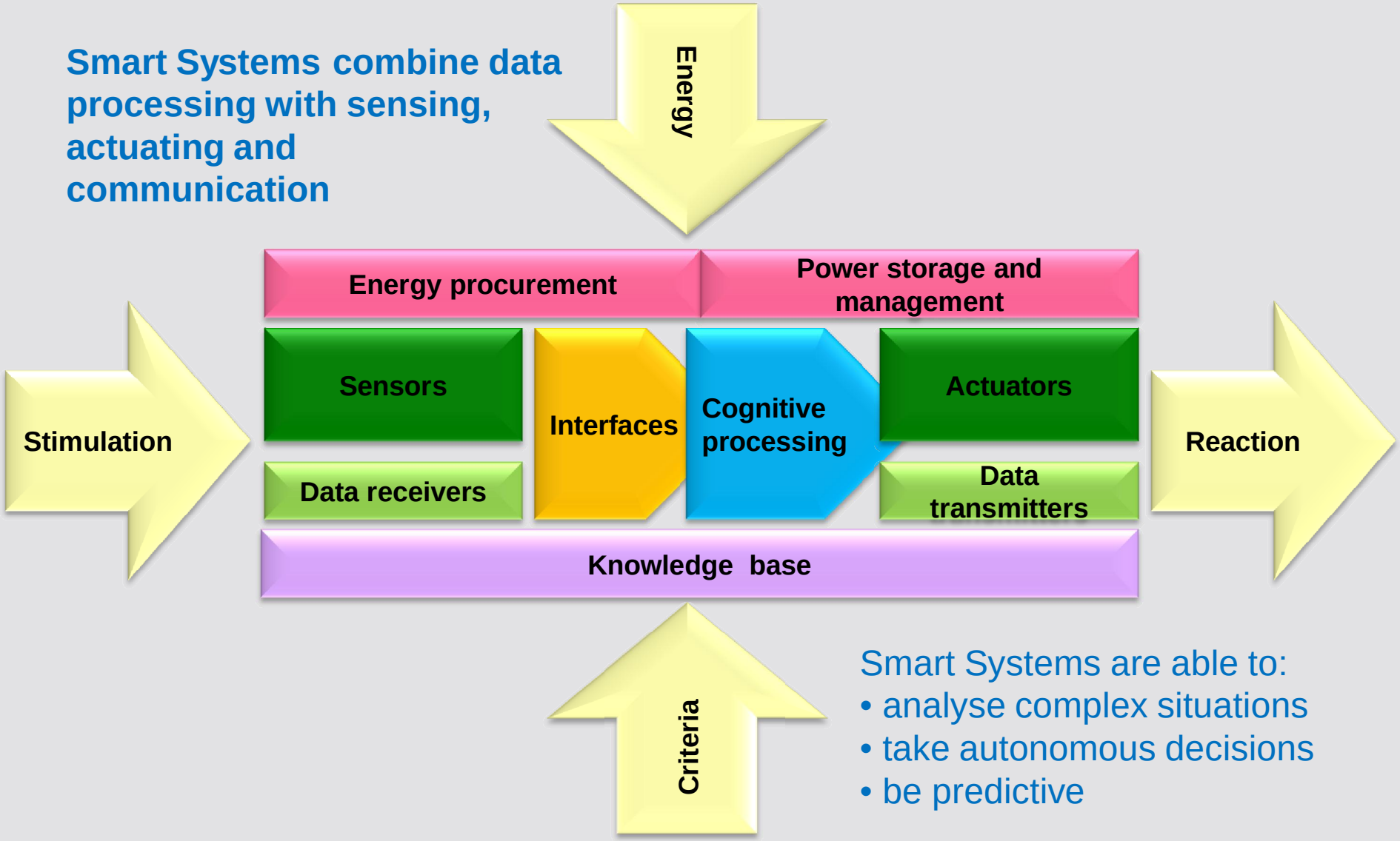
- are able to describe a situation and diagnose it
- are predictive, able to decide or help to decide
- mutually address and identify each other
- enable the product to interact with the environment

... are more than just electronics,

... are as small as possible, networked & energy autonomous

Smart Systems Integration
Building Blocks of a Smart System

Smart Systems combine data processing with sensing, actuating and communication

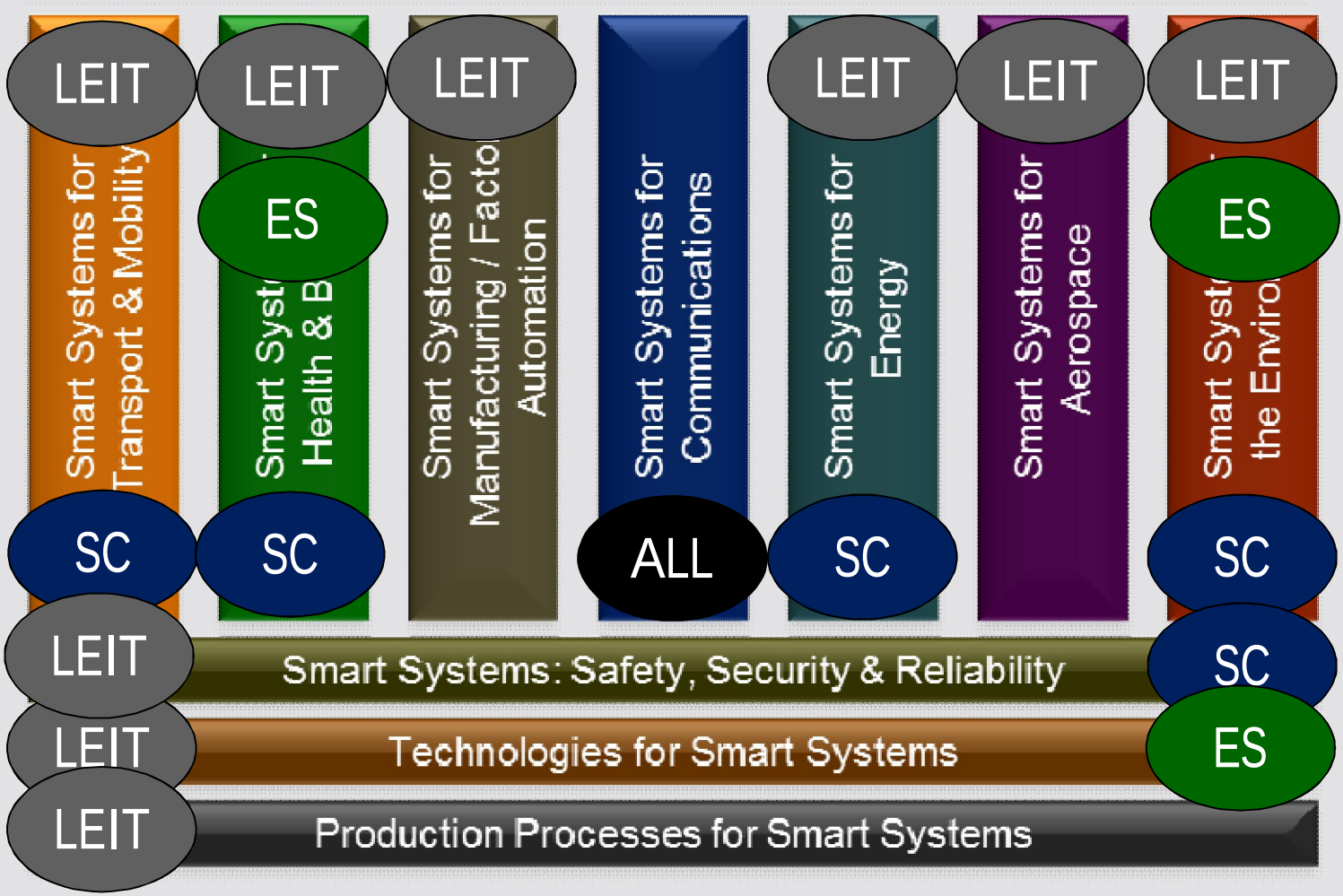


Smart Systems are able to:
- analyse complex situations
- take autonomous decisions
- be predictive

Smart Systems Integration
Application Domains and Societal Challenges

EPoSS
European Technology Platform on Smart Systems Integration

Horizon 2020 and EPoSS SRA match



Smart Systems are essential to maintain industrial workforce in Europe

Smart Systems Industry (EU 27) 2012:

- Total employment in the Smart Systems sector: 827,600
- R&D expenditures: 9.6 B€
- R&D personnel: 66,200
- R&D intensity of Smart Systems companies: 8%.

Sources:
Prognos AG: Analyse zur ökonomischen Bedeutung der Mikrosystemtechnik,
Studies about the Smart Systems economy in Baden-Württemberg and Germany;
European Competitiveness Report;
EU Industrial Structure 2011;
Figures from major industry associations.

Founding Meeting in Berlin on 18 September 2013

- 15 Founding Members
- 9 Board Members elected:
  Chairman: Carmelo Papa (ST)

Current Status

- Already 25 Members take part in the EPoSS Association
- Coexistance with ETP on Smart Systems Integration and transition of ETP Members will continue (TODAY 76 big companies, 460 individual members)

Becoming a Member

- Simply hand-in a signed application form for membership

What is a Smart System?

Camera analyses scene, decides and adjusts focus, exposure, shutter speed and white balance. Outputs a corrected and compressed image file.

A SMART SYSTEM

Application downloads an mp3 file using a predetermined algorithm.

An automated system, but
NOT A SMART SYSTEM

Radio system continually scans available frequencies, analyses signals, decides upon optimum mast, maintains connection and adjusts data rate and encryption

A SMART SYSTEM

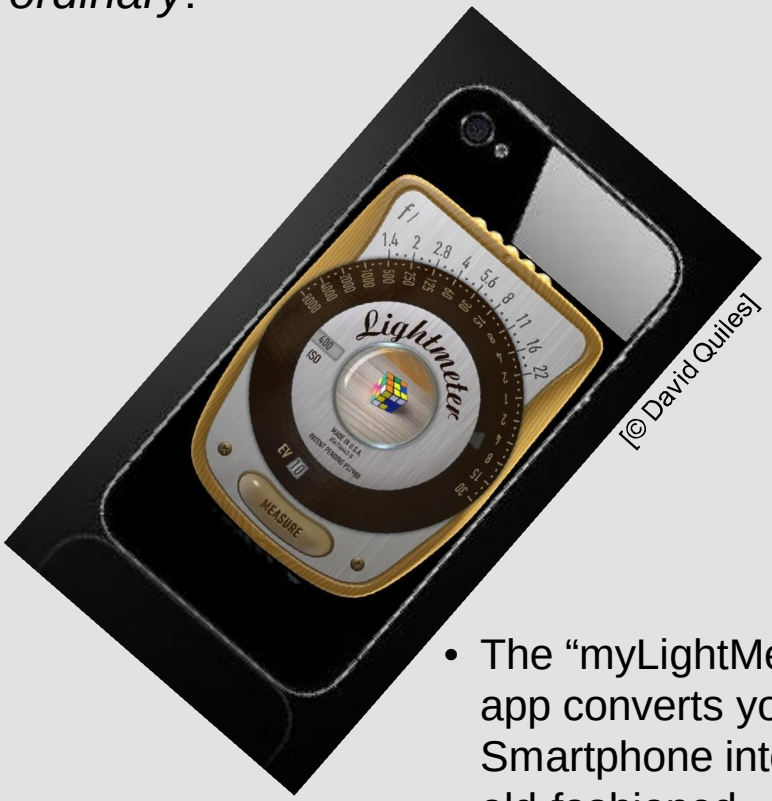
For instance...

Making *ordinary* things *extraordinary*:

[www.lernstift.com]

- “Lernstift” is a pen with a motion sensor. The pen vibrates when a mistake is made, either in spelling, in context, or in the formation of letters.

Making *extraordinary* things *ordinary*:



[© David Quiles]

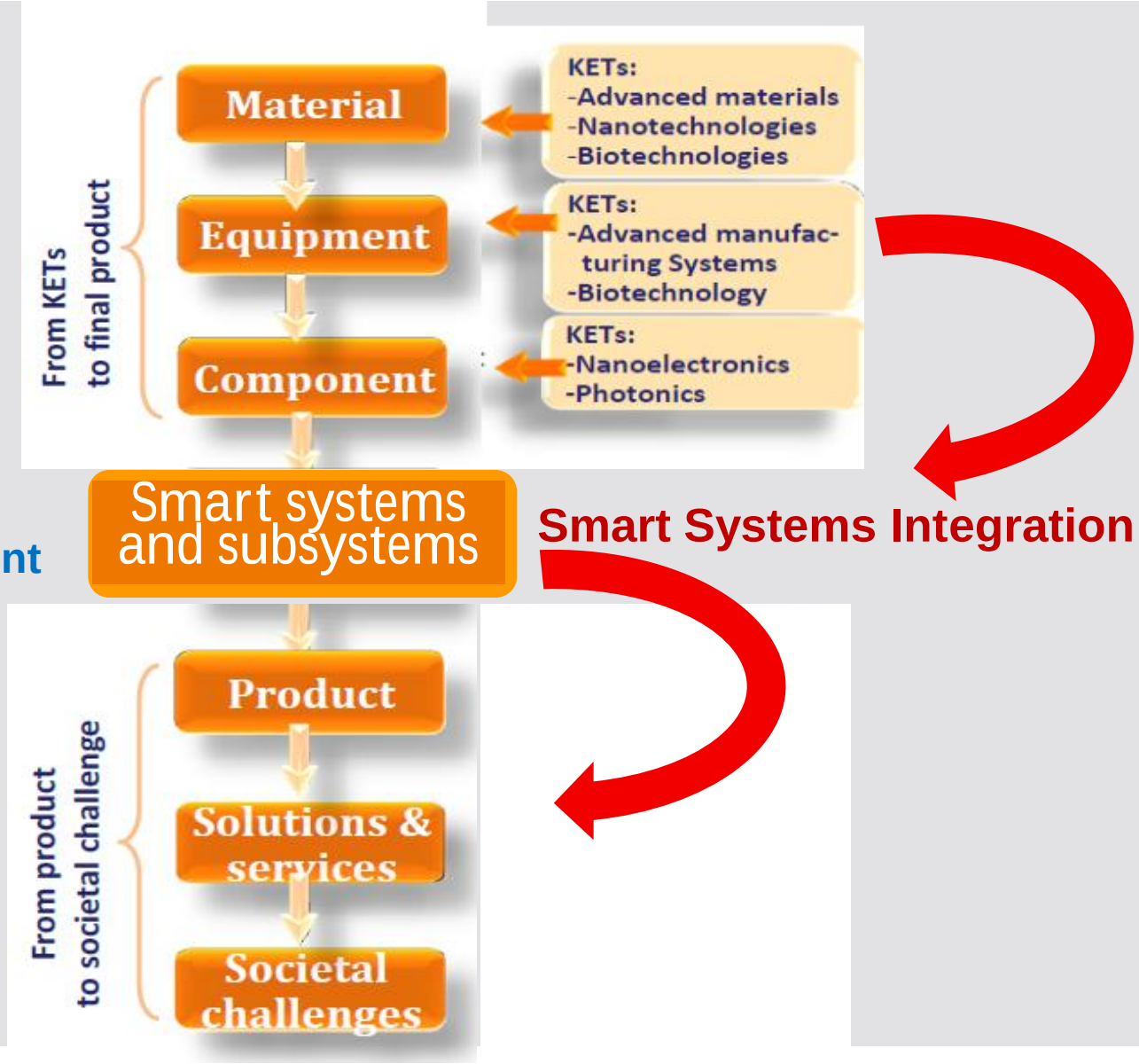
- The “myLightMeter” app converts your Smartphone into an old-fashioned lightmeter

- For many more examples see the EPoSS SRA

Smart Systems Integration
Bridge to Key Enabling Technologies

EPoSS
European Technology Platform on Smart Systems Integration

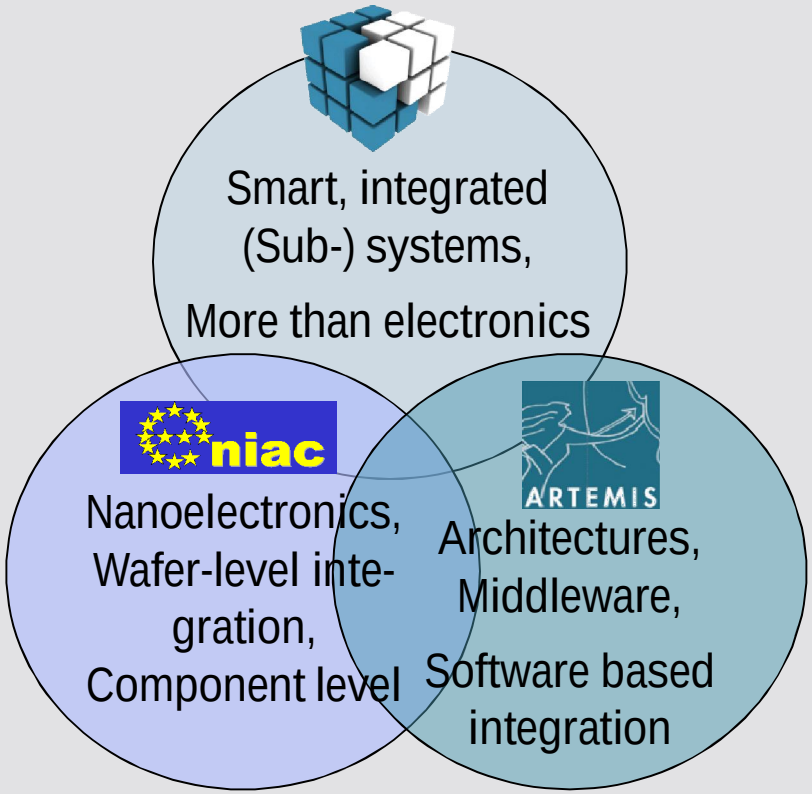
Smart systems bridge the gap from the component to the product



Smart Systems complement nanoelectronics and information technologies by unique knowhow about integration into applications and products

Synergies excpected from ECSEL

- join forces for the future of EU high tech industry
- add competitive edge to semiconductor and software products
- contribute to unique selling proposition of technology made in EU



Smart Systems Integration
Evolution and Strategic Research (SRA 2014)

First Generation

- sensing and actuation
- signal conditioning and processing
- wireless/wired communication
- hybrid and monolithic integration, system on board, chip on board

Second Generation

- multifunctional sensing, actuation and inference
- harsh environments
- predictive and adaptive
- networking function
- partially autonomous
- partially 3D-integration

Third Generation

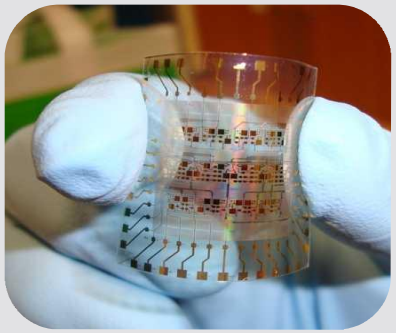
- self-calibrating and self-healing sensors and actuators
- self-aware systems
- cognitive abilities
- self-organized networks
- (energy) autonomous
- complete 3D-integration

Future is with Smart Systems

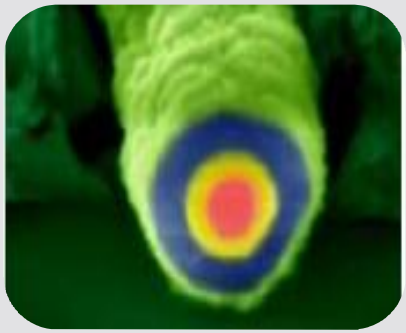
Contributions to ECSEL beyond the Chip (SRA 2104)

Implantable electronics

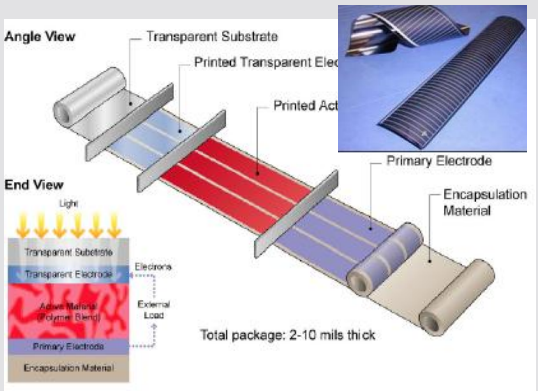
Electronics on Plastic



Solar nano-wire



Organic transparent PV



Electronics for Environment

Improved Medical Diagnostic and Monitoring

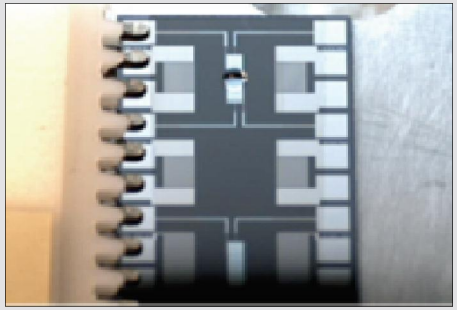
Portable Fitness

Flexible Green Consumer Electronics

Future is with Smart Systems Integration

Types of Systems Integration (SRA 2104)

Integration by construction



Integrated assemblies

show an *irreversible and intimate fusion* of technologies, as for example in semiconductor integrated circuits and “More than Moore” systems that build directly upon semiconductor devices.

Integration by combination of function

Integration by combination

of function allows products to exploit multiple capabilities for improvements in use.

An example is the touch display that combines actuation with indication.

Integration by connection

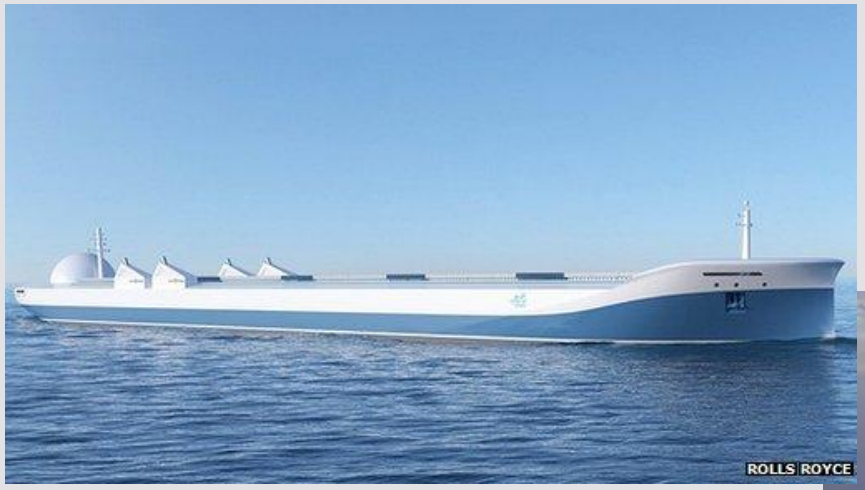
Information connectivity

is another form of integration, whether by wires, radio, photonic or other communication media such as sound or chemical signatures.

Smart Systems Integration

is not one just technology, it is a set of technologies

Integration is not always miniaturisation!



Moore Stephens LLP industry consultant:
... crew costs account for 44% of total operating costs for a large container ship.

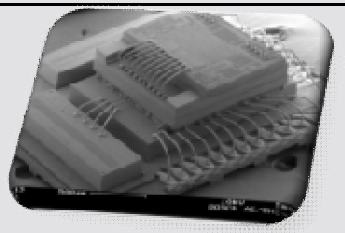
Rolls-Royce :
*... u*nmanned cargo ships could become a reality within the decade

"What was unthinkable yesterday is tomorrow's reality"
Oskar Levander, Vice President of Innovation, Rolls-Royce

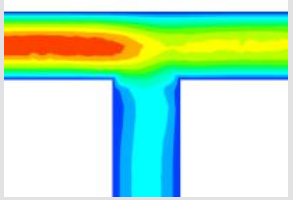
Enabling Technologies
Priority topics (1/3 – for MASRIA 2015-16)

Research Area	Priority Topics	Examples
Technologies for Handling Signals, Energy and Matter	electronics: mixed-signal, analogue, high-frequency, and power electronics; micro- and nanoelectronics; electronic circuits with novel form factors (e.g., large-area or flexible electronics)	 Battery monitoring system *STMicroelectronics*
	energy management: components for energy storage, energy management, energy generation and scavenging	
	other components: photonic, microoptical, microfluidic, and micro-electromechanical components	 Labcard™ diagnostic system *IK4-IKERLAN*

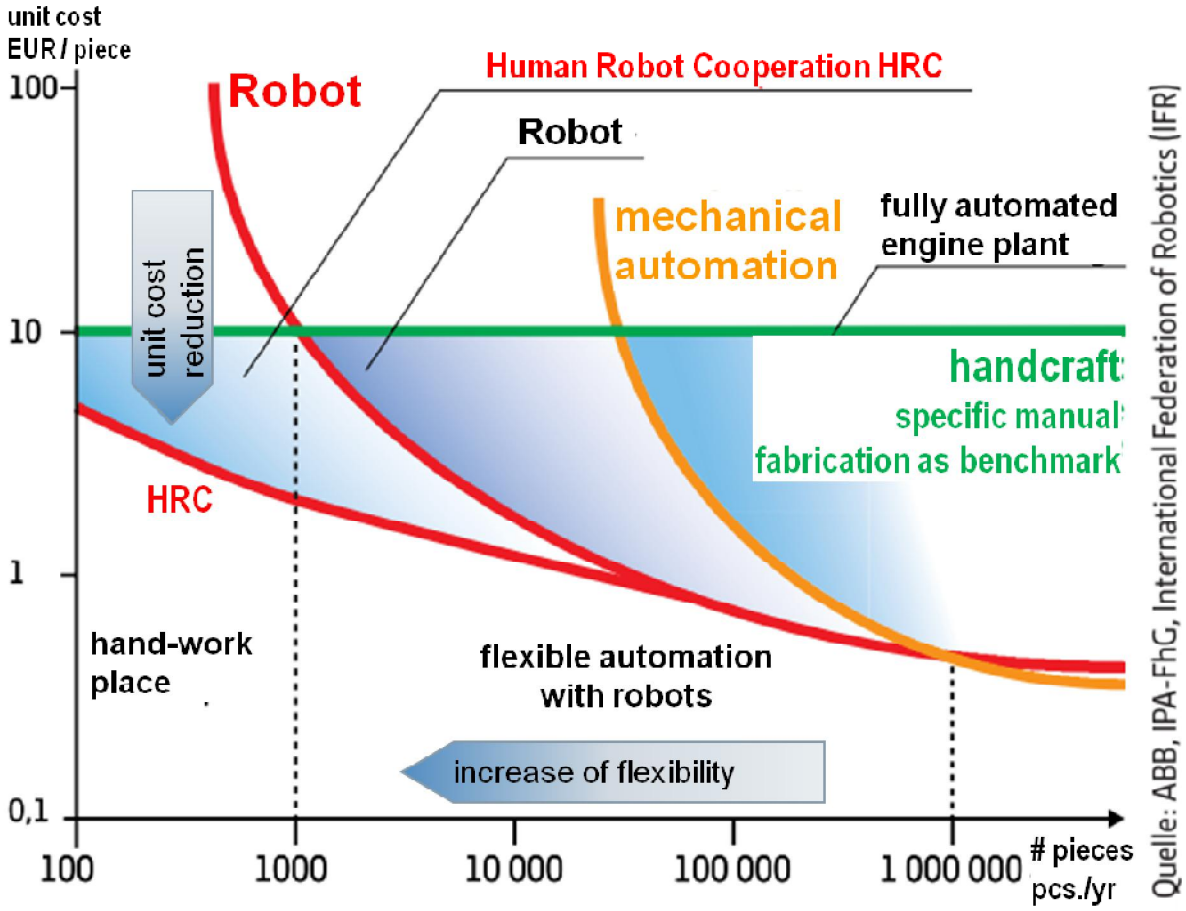
Enabling Technologies
Priority topics (2/3 – for MASRIA 2015-16)

Research Area	Priority Topics	Examples
Technologies for Interfacing	sensing: physical, chemical, and biological sensors and sensor systems for complex and harsh environments; remote sensing	 Microminiature eCompass *Bosch Sensortec*
	actuation: mechanical, piezoelectric, electromagnetic, thermal, optical, and chemical actuators and stimulation mechanisms	 rapyuta.org – *Bart Van Overbeeke Fotografie*
	communication: communication systems, in particular based on wireless, near-field, and RFID technologies	

Enabling Technologies
Priority topics (3/3 – for MASRIA 2015-16)

Research Area	Priority Topics	Examples
Methods, Tools and Standards	computational and mathematical methods: methods for signal processing, data analysis, data fusion, and data storage	 Automotive sensor data fusion
	modelling: multi-physics and multi-scale models and simulations; steady-state as well as time-dependent analyses; methods for life cycle reliability	 Microfluidic simulation *University of Greenwich*
	design: methods and tools for automated design, rapid prototyping, co-design	
	standardisation: design rules, certification standards, testing and inspection methods	
	system-level technologies: adaptation, self-testing and self-healing	

Smart Actuators
Towards the Robotic Co-Worker in Manufacturing



Trends relating to customers / markets, sectors / divisions

- Industry 4.0 needs new cyber physical systems
- Human robot collaboration enables new production processes (batch size 1 production)
- Autonomous machines enable new solutions in service, logistics and transportation
- Ageing society needs new forms of treatment and care

Smart Actuators
Biomimetic Actuator for Humanlike Dexterous Manipulation

With current-generation robots, human-robot cooperation is risky and injury-prone, mostly due to the high weight and stiffness of current robots. Drives for next-generation robots will therefore imitate the muscles and tendon of animals. Their high elasticity and damping provides passive safety. The ability to absorb impact forces protects both themselves and their environment.

Compact and lightweight

degrees of motion:

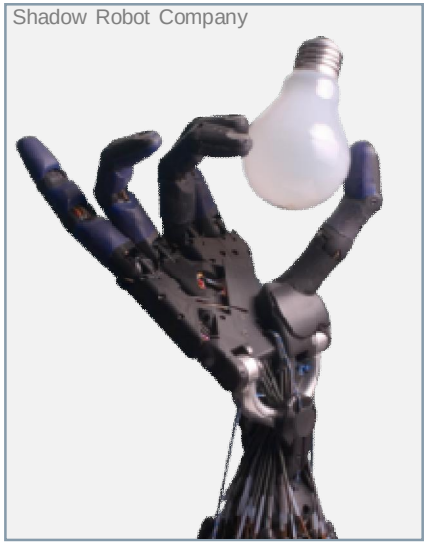
- human hand: 22
- Human arm: 7

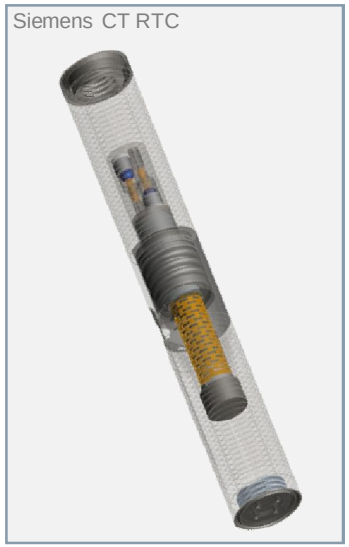
Absorb energy due to degrees of motion ring impact

- High passive safety
- Robust against collisions and hard impact

From fine motorics up to high forces

- compact, long-stroke actuator
- potential for muscle-like Power-to-weight ratio
- unique self-protection capability
- passive safety, i.e. without control





First concept of a biomimetic actuator based on piezo-hydraulic technology with physical parameter close to human muscle

Dexterous Manipulation

is an area of robotics in witch multiple manipulators or fingers cooperate to grasp or manipulate objects. Therefore required is precise control of force and motion which cannot be accomplished with conventional robot grippers.
Fingers or specialized robotic hands must be used. The majority of dexterous manipulators will be anthropomorphic in design.
(Stanford University; ICRA 2000)

Smart Actuators
Roadmap – From Internet to Robotics (status 2013 US Robotics)

SIEMENS

Critical Capabilities for Manufacturing

- **Adaptable and Reconfigurable Assembly**
- Autonomous Navigation
- Green Manufacturing
- **Humanlike Dexterous Manipulation**
- Model Based Integration and Design of Supply Chain
- Nano Manufacturing
- Perception for Unstructured Environments
- **Intrinsically Safe Robots working with Humans: The Democratization of Robots**
- Education and Training

Goals over the next

5 years	10 years	15 years
Achieves ability to set up, configure and program basic assembly line operations for new products with a specified industrial robot arm, tooling and auxiliary material handling devices in under **24 hours**.	Achieves ability to set up, configure and program basic assembly line operations for new products with a specified industrial robot arm, tooling and auxiliary material handling devices in under **8-hours**	Achieves ability to set up, configure and program basic assembly line operations for new products with a specified industrial robot arm, tooling and auxiliary material handling devices in **one** hour.
Low-complexity hands with small numbers of independent joints will be capable of robust whole-hand grasp acquisition.	**Medium-complexity hands** with ten or more independent joints and novel mechanisms an actuators will be capable of whole-hand grasp acquisition an limited dexterous manipulation.	**High-complexity hands** with tactile array densities, approaching that of humans and with superior dynamic performance, will be capable of robust whole-hand grasp acquisition and dexterous manipulation of objects found in manufacturing environments used by human workers.
Broad implementation of **easily programmed** and adaptable safety-rated **soft axis** guarding for fixed or mobile assembly robots **on the factory floor**	Systems that **automatically detect** and respond appropriately to conforming/non-conforming human behaviors in the **workplace** while maintaining consistent performance	Systems that can **recognize**, work with, and adapt to human or other robot behaviors in an **unstructured environment** (e.g. construction zones or newly configured manufacturing cells

Smart Actuators
Existing Projects with Piezo-Hydraulic Actuators

Technology transfer from Automotive: Piezoelectric injection valves for gas turbines

Demonstrator of an ultrafast wafer manipulator without temperature compensation (Piezo-Hydraulic)

“Intelligent Mobility” means that the vehicle becomes a part of a greater service network

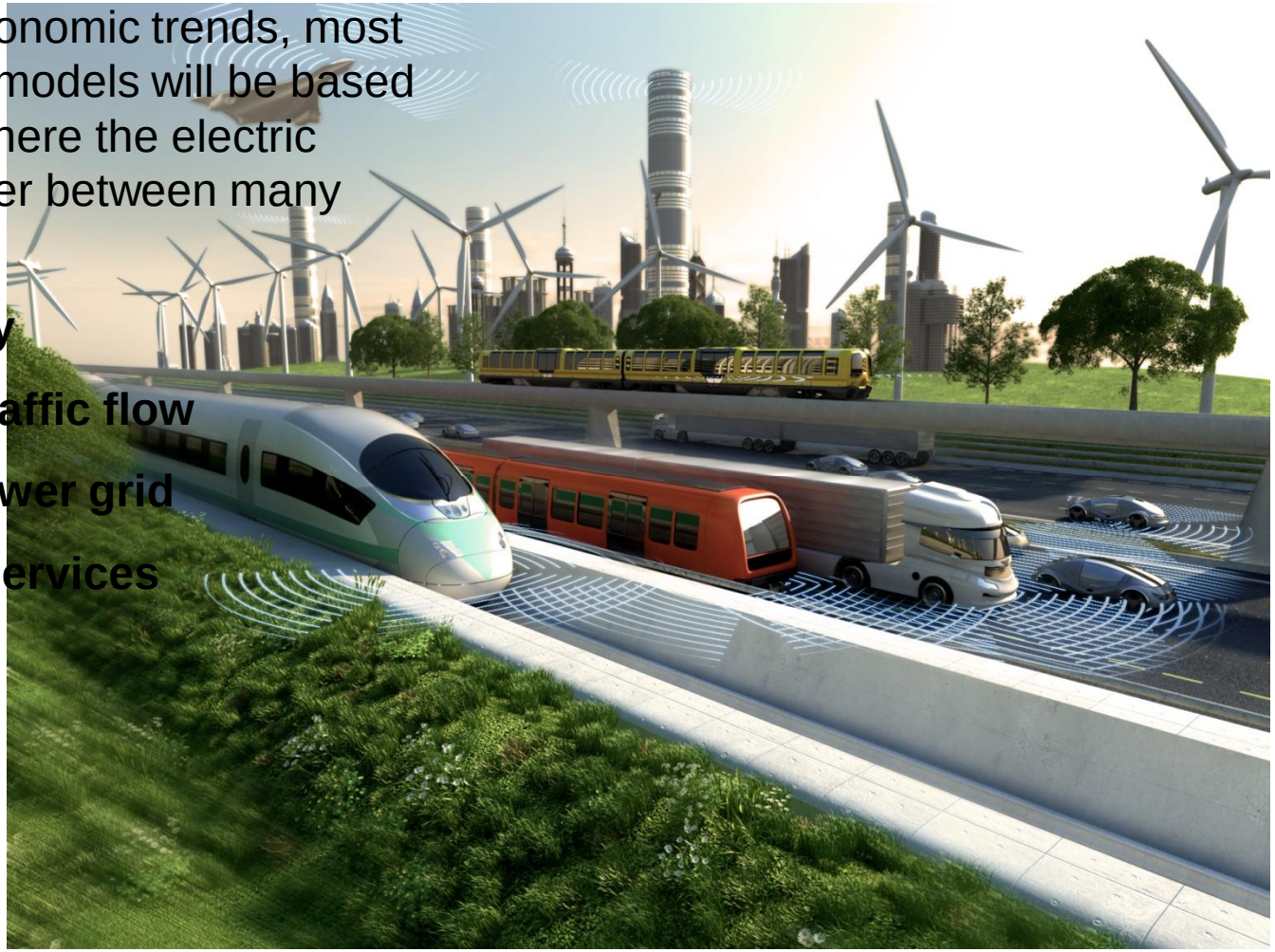
Driven by socio economic trends, most of future business models will be based on new services where the electric vehicle is one player between many others:

Seamless Mobility

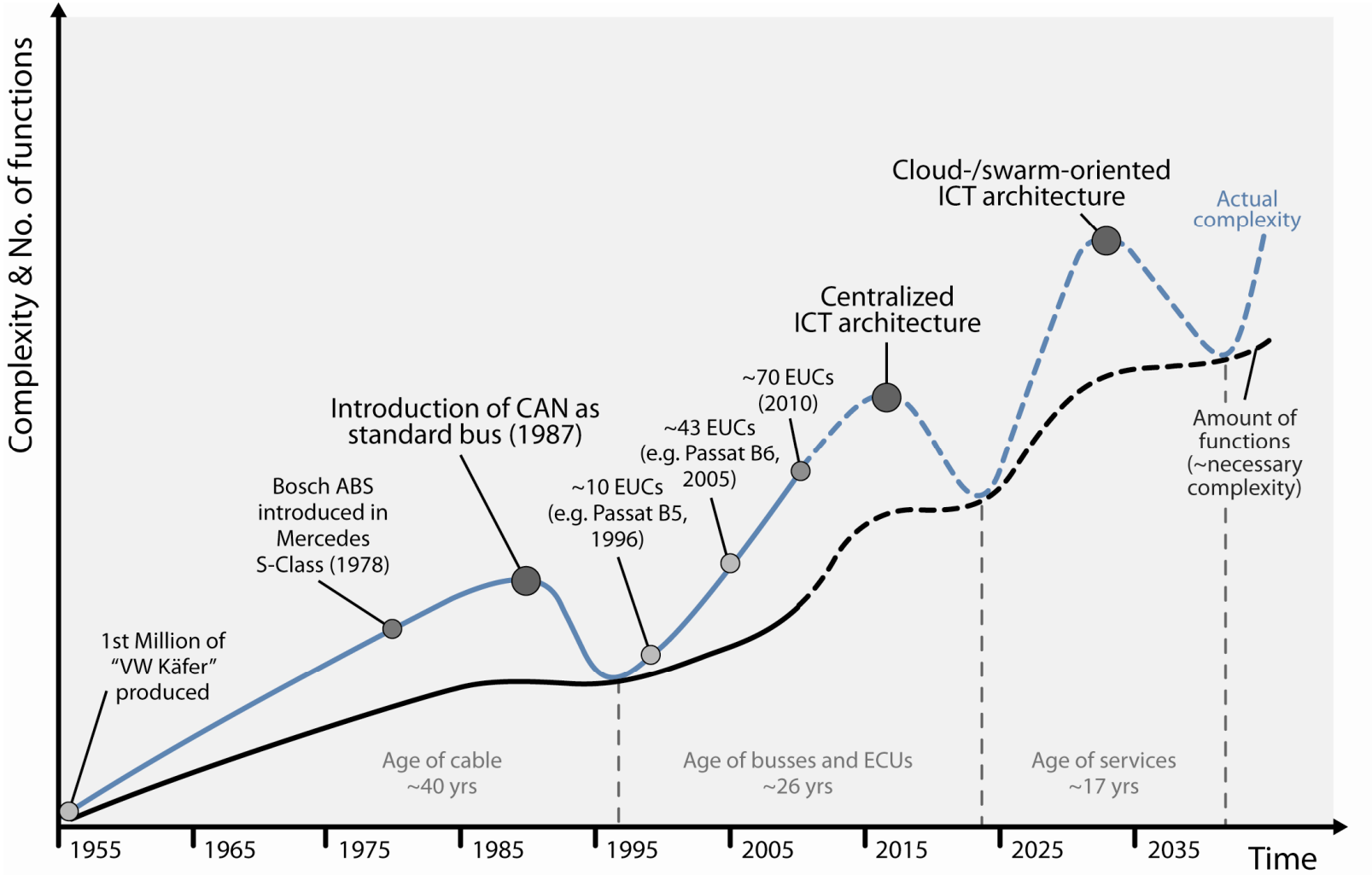
Optimization of traffic flow

Stabilizing the power grid

Location Based Services

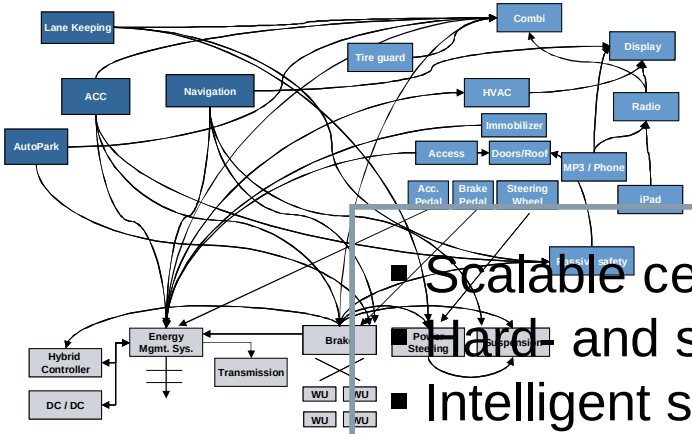


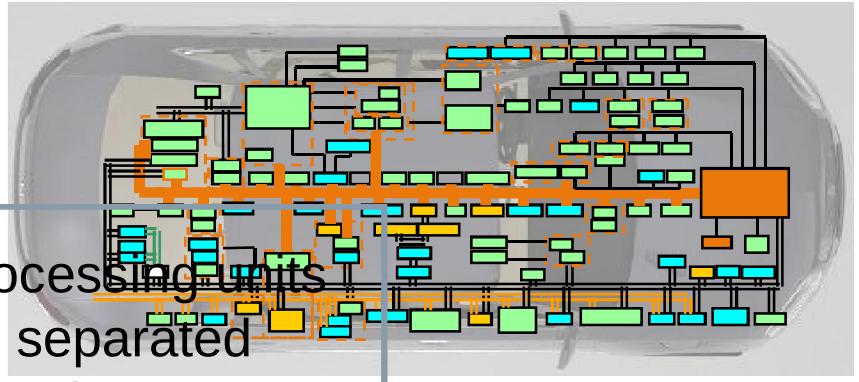
One major driver of today's system architecture is the Evolution of complexity



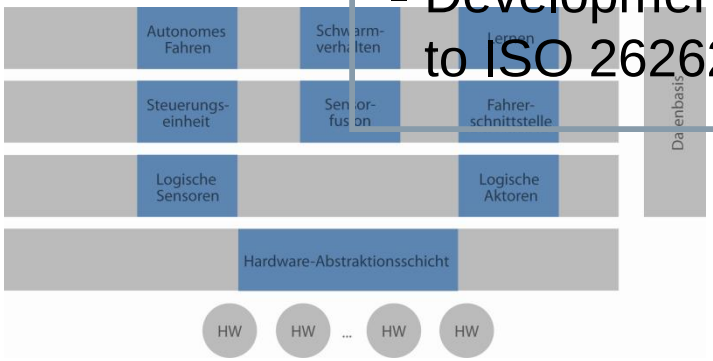
Source: "The Software Car: Information and Communication Technology as an Engine for the Electromobility of the Future", page 48

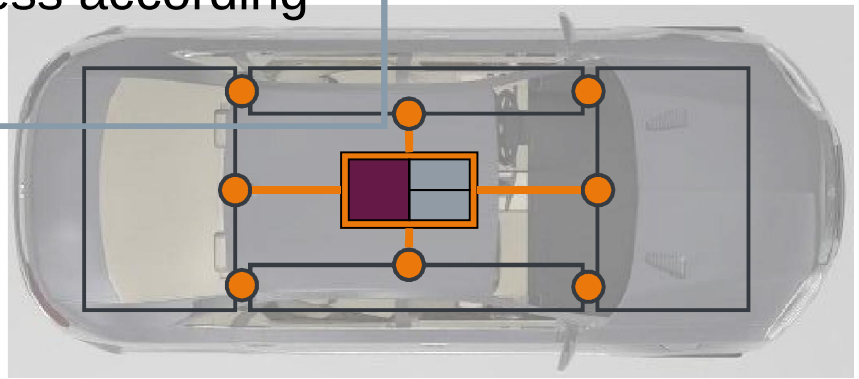
To cope with the challenges, mentioned before, a new kind of System Architecture is mandatory





- Scalable central processing units
- Hard- and software separated
- Intelligent sensors and actuators
- Well defined information flow
- Hierarchical decision making
- Development process according to ISO 26262





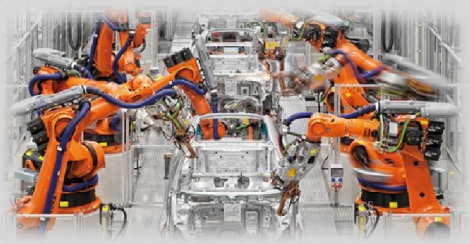
***Symbolic pictures**

Conclusions &
Thank for inviting and listening

SIEMENS

Electronic Systems are core and

- differentiating factor for innovative systems,
- drive economical positioning
- enable solutions for Grand Challenges



Joining forces in ECSEL enable holistic approach to cover the

- full value chain
- full innovation process
- balanced opportunities to funding for large enterprises and SMEs
- alignment of policy, funding and required resources

Foster dialogue among stakeholders for the benefit of our economy and society

On behalf of Smart Systems community the best for You Thomas in future and congratulations to Your 60th birthday