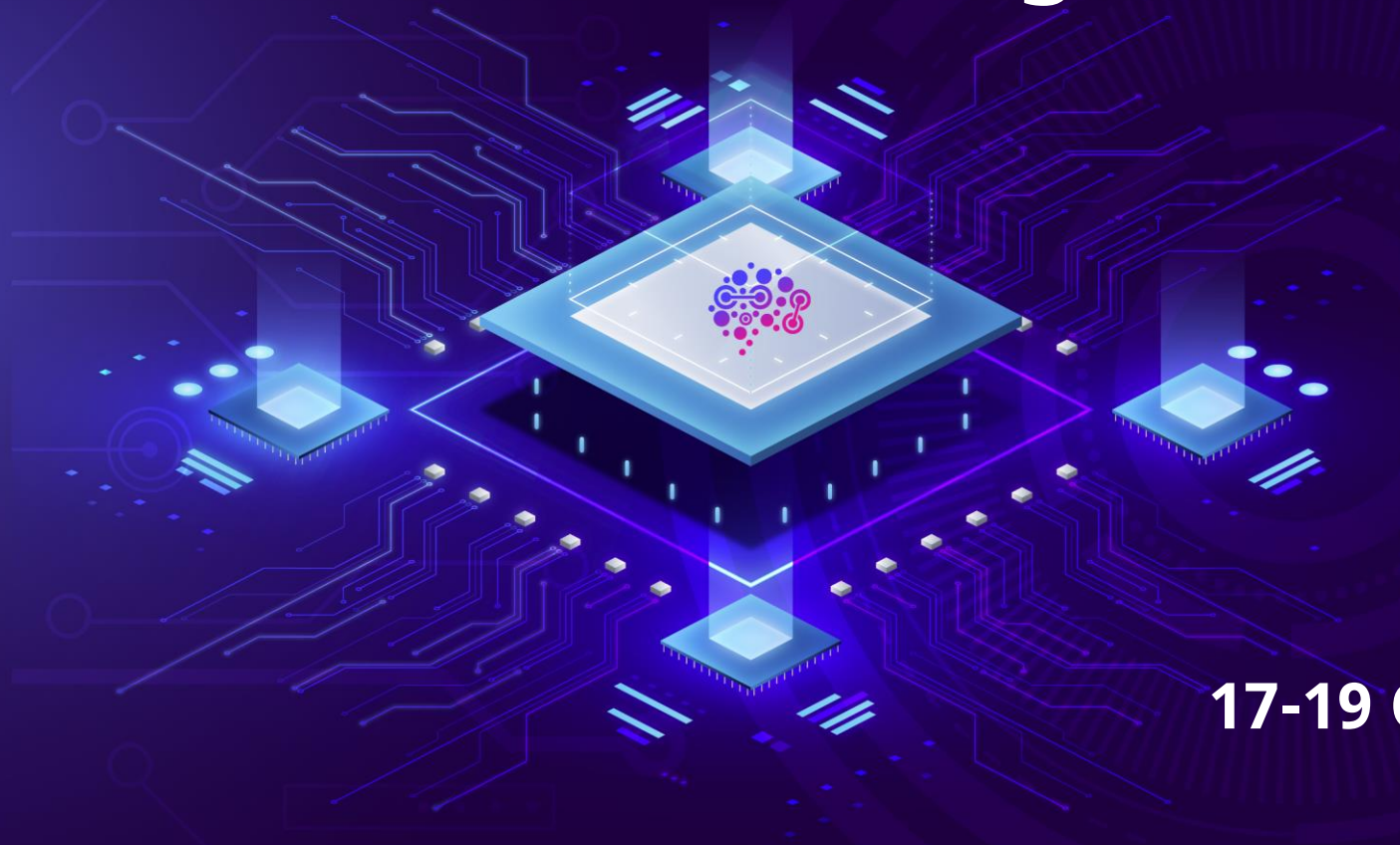
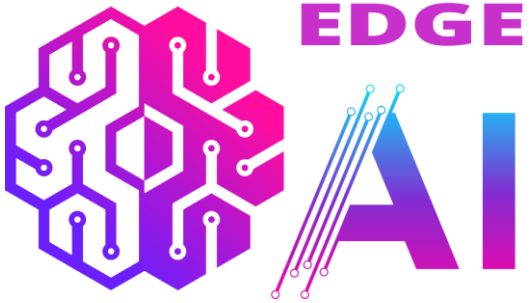
European Conference on EDGE AI Technologies and Applications - EEAI



Advancing emerging edge AI technologies and driving next generation intelligent applications.

17-19 October 2023, Athens, Greece

European Conference on EDGE AI Technologies and Applications - EEAI



Sustainable mobility by technology convergence

Synergies for the transformation towards the autonomous vehicle eco-system

Reiner John, AVL List, Austria et. all

Input from Europe´s Funded Electromobility research projects

Today´s contradictions

17-19 October 2023 Athens, Greece

KDT JU
KEY DIGITAL TECHNOLOGIES JOINT UNDERTAKING

ECSEL Joint Undertaking

FFG Forschung wirkt.

is project is funded by the European Union

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Global Competitor	(U1) Competitive Core Technology: includes application layer, functional layer	Level of Digitalization & AI Use	Global Presence & entering new markets	(U4) Competitive Diversification in connected ECO	Overall Strength related to EU
Tesla	EVs, Autopilot, Energy Storage.	High	Strong	Expanding to energy & solar	**100%**
GM	EVs, Autonomous	Moderate	Strong	Expanding EV lineup	**90%**
Ford	EVs, Autonomous	Advancing	Established	Transitioning to EV	**85%**
Toyota	Hybrids, Hydrogen FC, Autonomous	Advancing	Strong	Expanding hybrid & fuel cell	**80%**
BYD	EVs, Battery, EV Bus, Energy Storage.	Moderate	Strong	various industries.	**75%**
Rivian	EV Adventure, Battery, EV Truck/SUV	Advancing	Growing	EV adventure vehicles.	**90%**
NIO	EVs, Battery Swapping, Autonomous	Advancing	Growing	EV manufacturing.	**85%**
Waymo	Autonomous Driving	High	focused	focused	**100%**
Uber/Lyft	Ride-Hailing, MaaS. Platforms	High	focused	focused	**100%**
Tech Giants	(U2) horizontal core technologies				
Microsoft	Cloud Computing, AI Services.	High	Strong	expanding	**100%**
Alphabet	AI Tech, Search, Autonomous Driving	High	Strong	expanding	**100%**
Apple (Titan)	Self-Driving Car, Rumor EV	High	Strong	Exploring automotive	**95%**
NVIDIA	**(U3)** GPUs, AI Hardware.	High	Strong	expanding	**100%**
Semi & Sys	(U5) cutting edge technologies				
TSMC	Semiconductor Manufacturing.	High	Strong	specilized	**100%**
SAMSUNG	Diverse technology incl. AI semi	High	Strong	broad portfolio	**95%**
CATL	EVs, Battery Technology.	Advancing	Growing	expanding	**85%**

Figure 1: Challenges driving the sense of urgency

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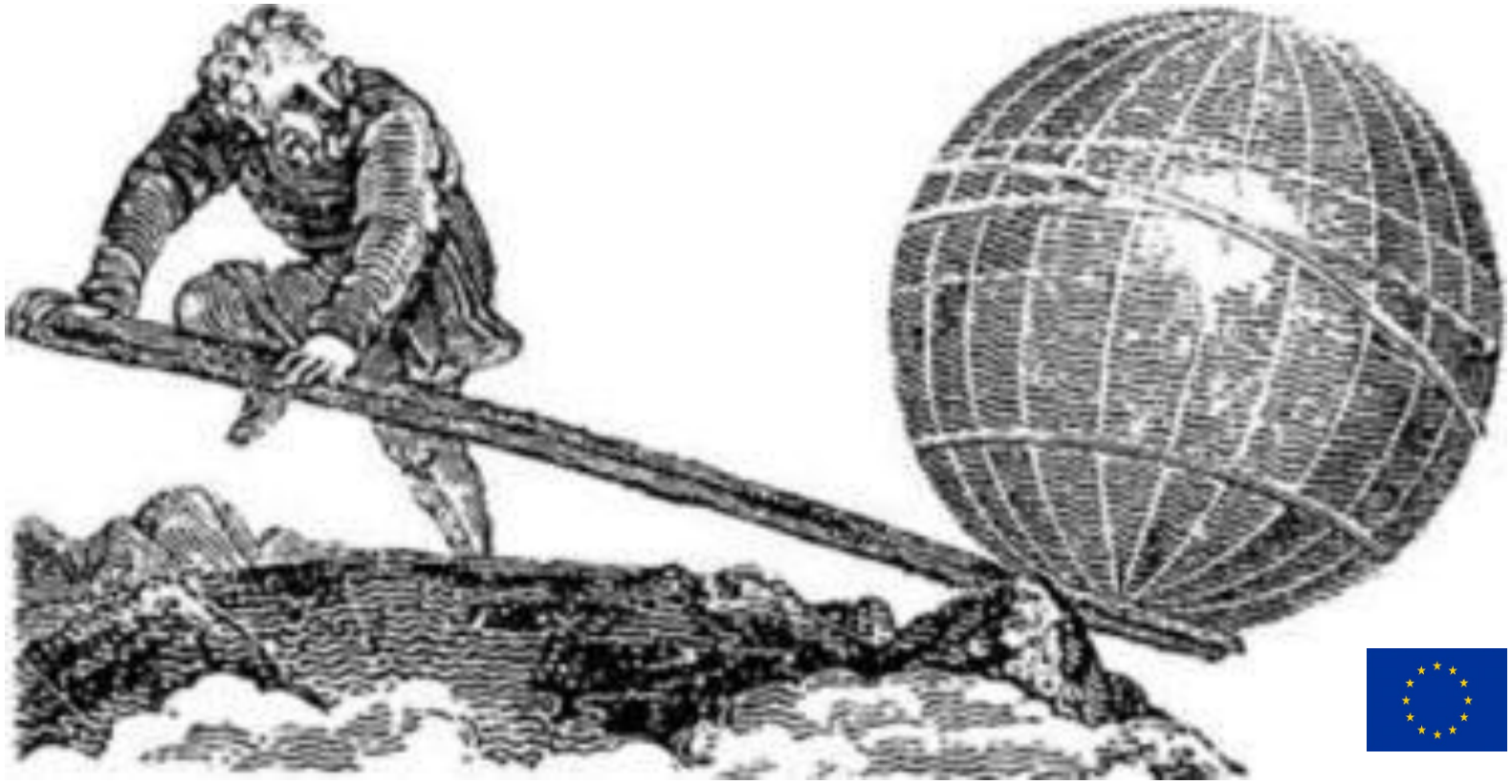
How to implemented the challenge

Mega trends
Technologies
Society
Impact



KDT JU
KEY DIGITAL TECHNOLOGIES JOINT UNDERTAKING

Emergence: the solution comes from system

The collaborative individuum knew´s nothing about the bridge

internet

internet

internet

internet

Trustfully Collaboration in complex, complicated and chaotic systems

ECSEL / KDT European funded projects in the ECO system of mobility, infrastructure & energy

ECO Design, Efficiency, Material substitution, reduce yield losses

Carbon debt visibility, environment impact bill, supply chain resources

Components and data for cyclic economy

ECA 2030 → clean → connected → collaborative

Society 5.0 → Mobility 5.0 → Sustainability,

www.mobilitye.eu

MOBILITY>E LIGHTHOUSE

2009 **E3Car**

2010 **Castor**

2012 **Motorbrain**

2014 **3CCAR**

2016 **AutoDrive**

2019 **Architect**

Standardization
Life time monitoring
Certification framework

Electric Car

Efficiency

Functional Integration

Multi-propulsion

Multiphase

Redundancy

Complexity

Fail operational

Fail-aware

New Control

2017 2018 **Prystine**

Sensors & platforms

Complexity explosion

2022 **Archimedes** Sustainability

2022 **A-IQ Ready** Emergence

2020 **AI4CSM** Connected shared Mobility

2018 **AI4DI** Platform for cross-cutting requirements
AI for cloud to edge

Multi-domain

Fleets
Vehicle in Traffic
Emergence
Cyclic economy
Green Deal
Ecosystems

Complexity solved by trustable AI

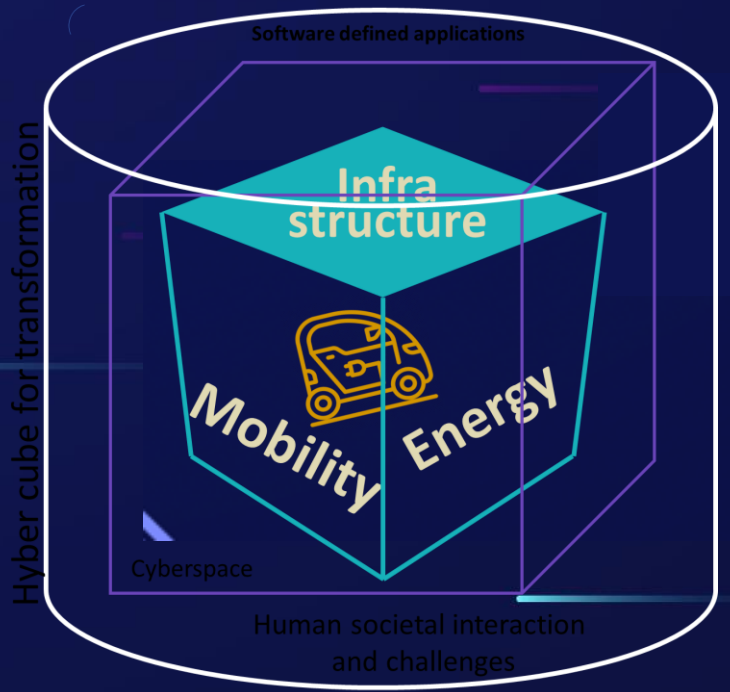
Quantum encryption
Quantum sensor
Quantum computing

Scalable embedded Intelligence for Edge and edge/cloud operation

Propulsion | **Perception** | **Connectivity** | **L3, L4, L5 Control**

Autonomous | Digitalization

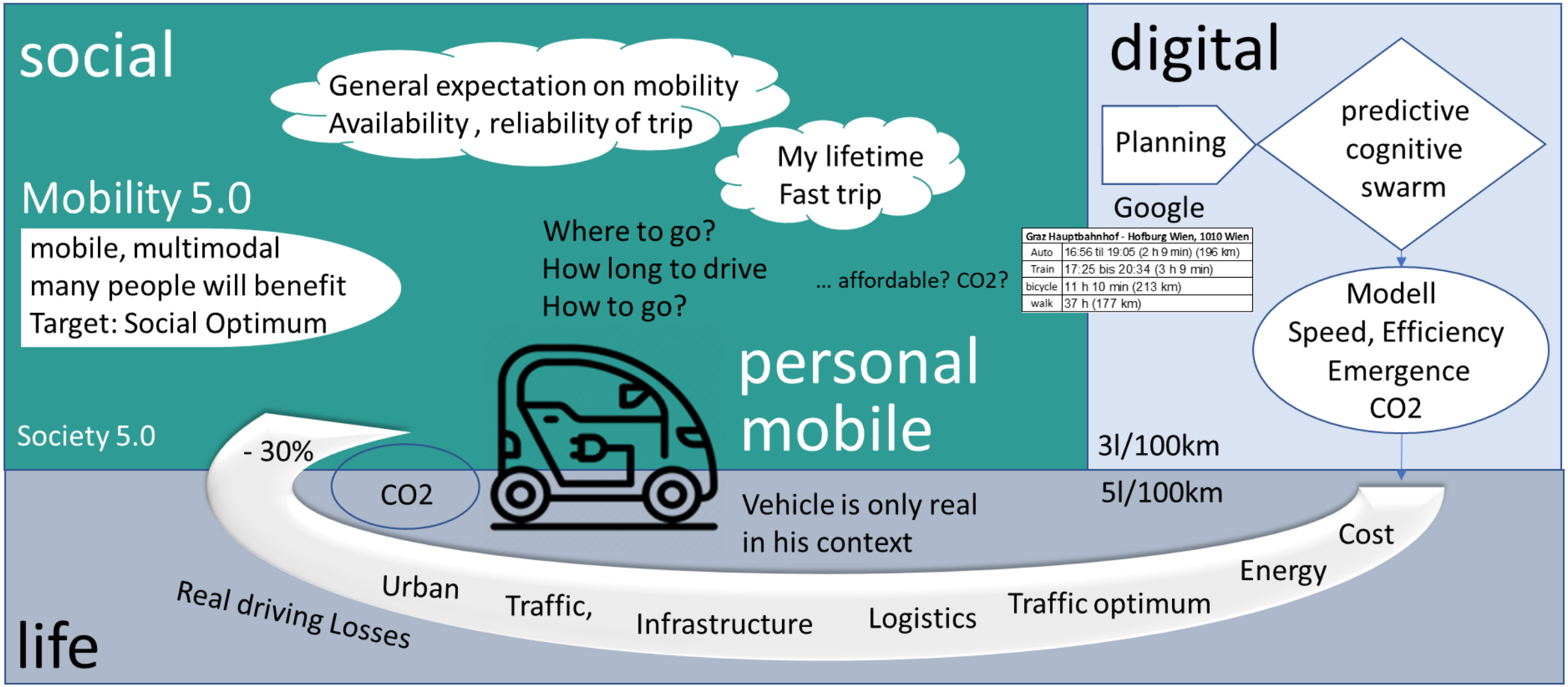
FFG Forschung wirkt.



Human friendly goods and services

Driving, connected assets, digital twin

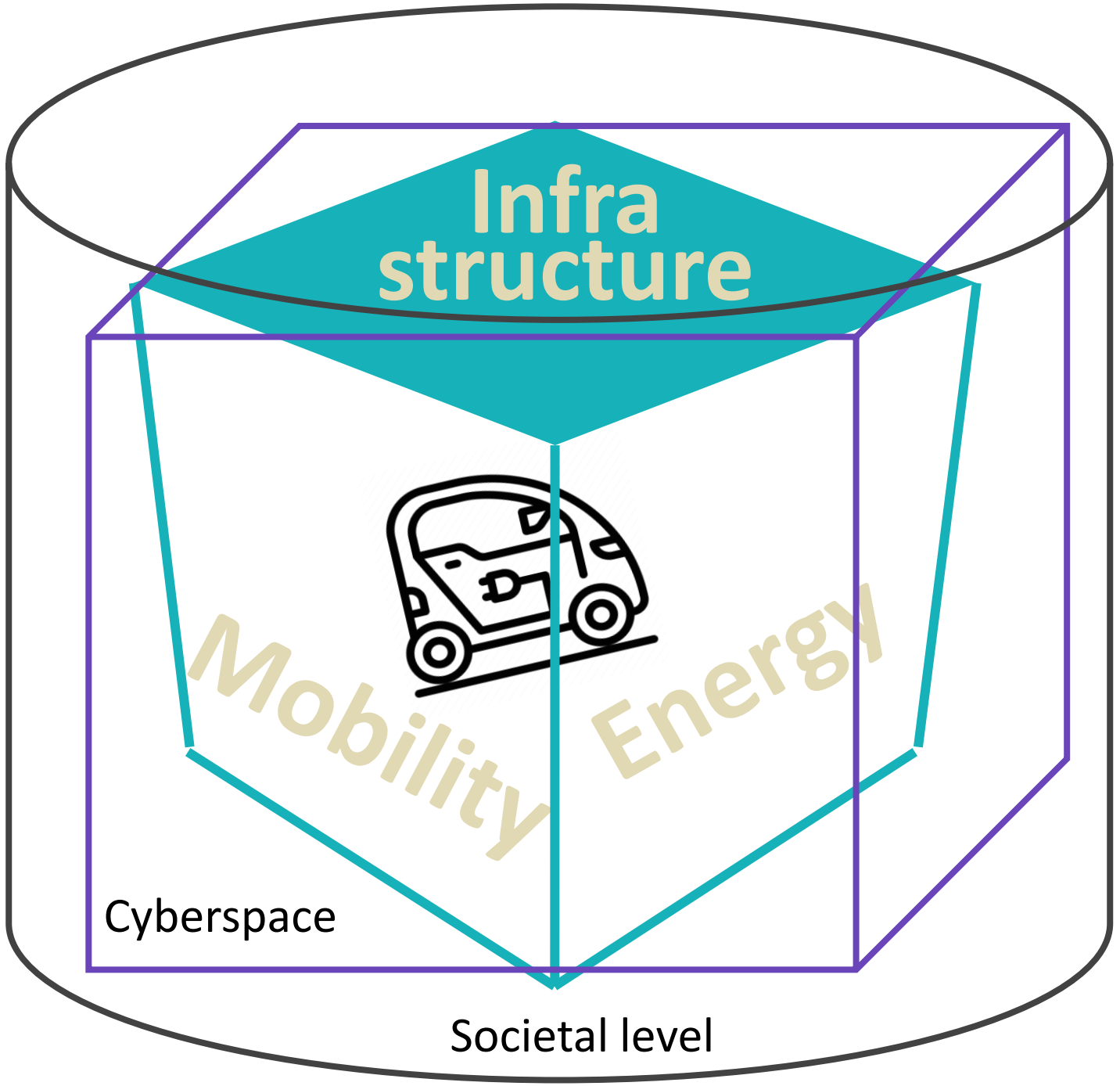
The individual human will choose his way of mobility,
technology will minimize emissions, optimized by extrinsic intelligence
and efficiency from electric, connected, automated and shared mobility



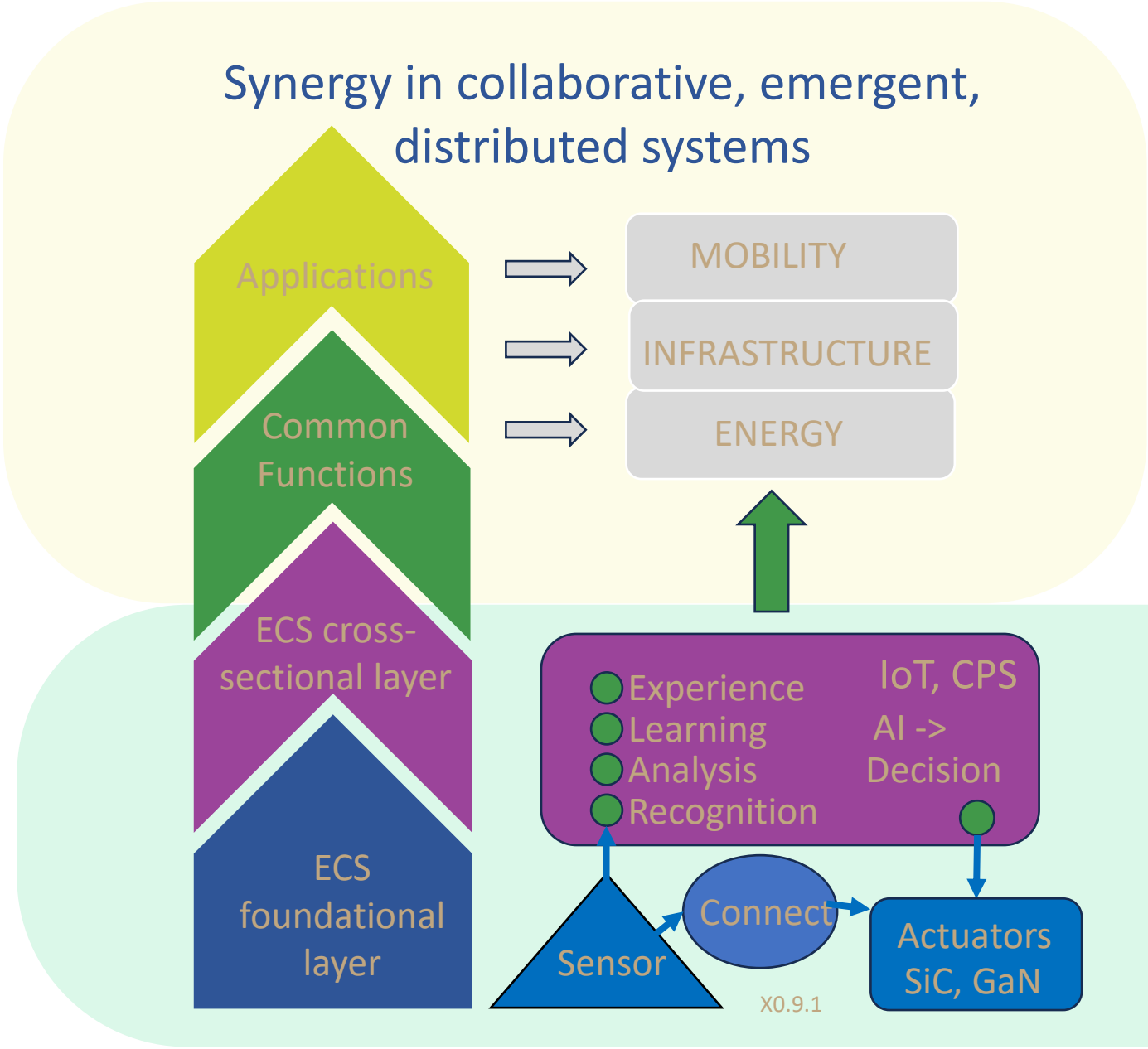
Industry 5.0 and Society 5.0: fair use of resources in the sense of a social optimum for the needs of all people in the society.

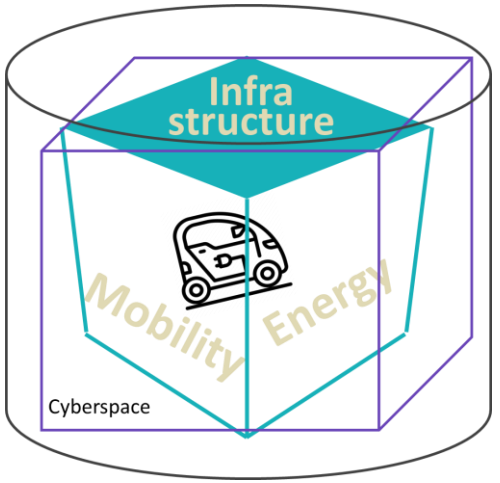
Franz Zieher, Reiner John

Abstraction

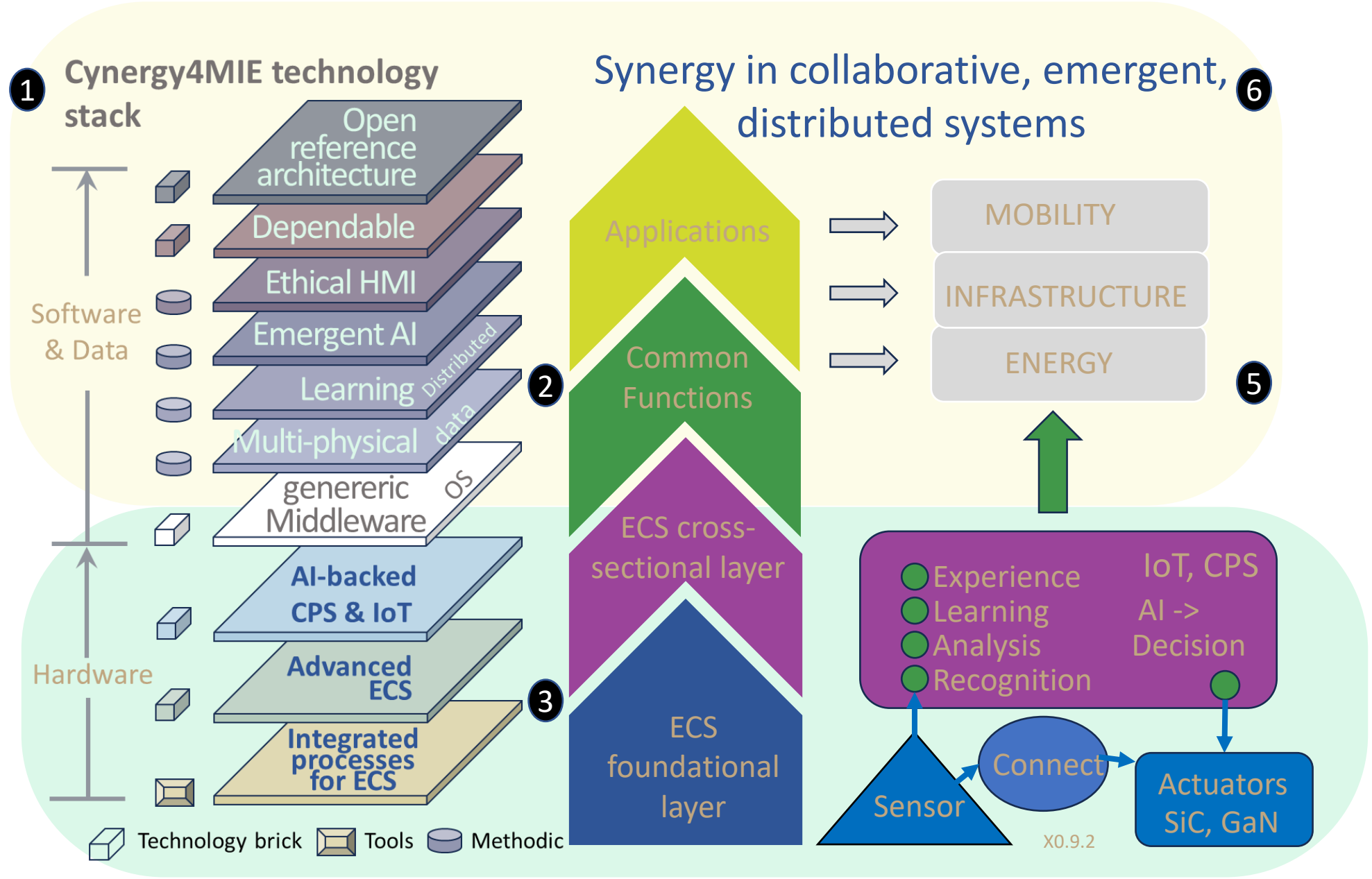


Semantics


Synergy in collaborative, emergent, distributed systems
Applications
Common Functions
ECS cross-sectional layer
ECS foundational layer
MOBILITY
INFRASTRUCTURE
ENERGY
Experience
Learning
Analysis
Recognition
IoT, CPS
AI -> Decision
Sensor
Connect
Actuators SiC, GaN
X0.9.1


Infra structure
Mobility
Energy
Cyberspace

Technology stack

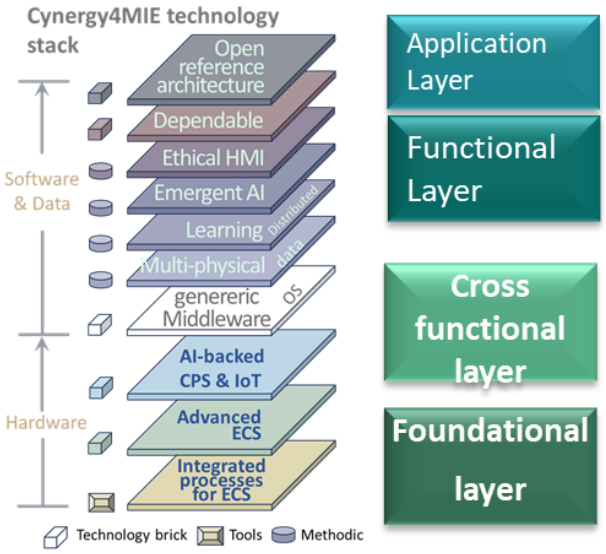


Where to go?

Software defined systems

Advanced Hardware

Evolution of software defined goods and services

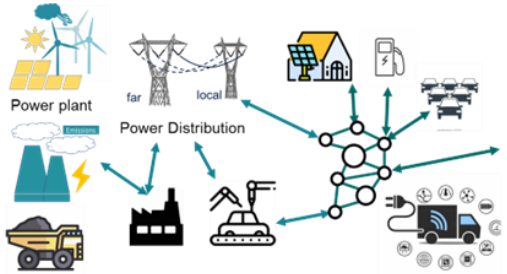
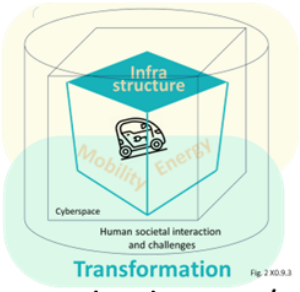


Application Layer

Functional Layer

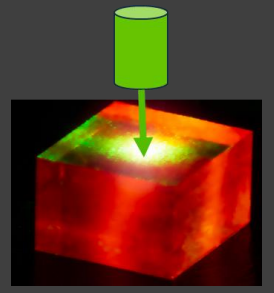
Cross functional layer

Foundational layer

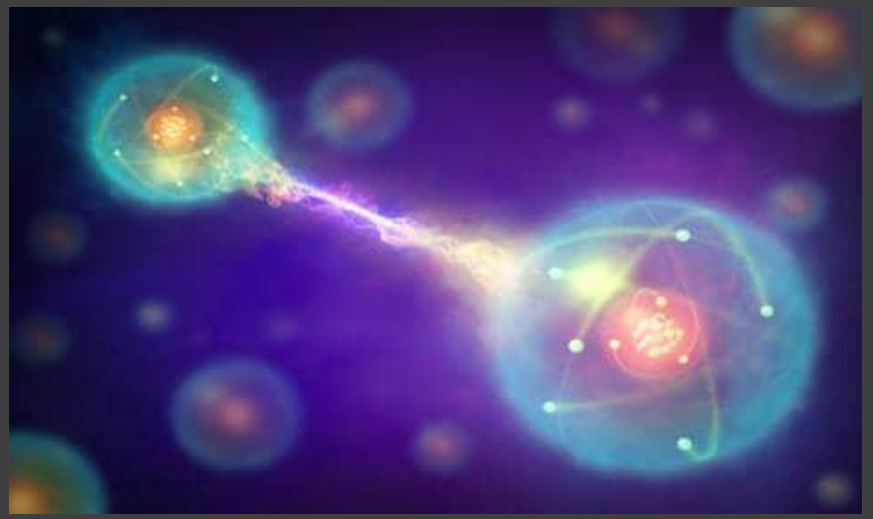
	Today Domain related	**Tomorrow** Domain convergence	**Future** Human/ domain collaborative
	centralized	 Distributed, multi domain	 Emergent, multi-domain/ virtual
	Collaborative-AI	Cognitive-AI	Synergetic-AI
	Cyber Physical systems	Cognitive Cyber Physical systems	Synergetic/emergent Cyber Physical systems
Technology	80-100ECUs Multiple CAN, LIN, Ethernet Flexray,	4-5 high-performance distributed multi/manycore IoT/CPS Zonal communication Ethernet backbone	- Cluster distributed AI/signal processing - Noninvasive/QuantumSensor - Backbone
Characteristics	Distributed control Many nodes Intercommunication via central gateway	Dedicated domains Consolidation of functions Routing handled by advanced gateways	Virtualized functions executed in "HPC" Zone depended IoT/CPS Routing handled by advanced gateways

- Products and services become more human centric
- Ethical behavior from human Machine interaction
- Stack oriented Design and adaption make them affordable and flexible to build

A-IQ Ready



Quantum correlations and advantages



X0.2

Entanglement // Verschränkung

Zina zina@teraglobus.lt

AI-READY: enabling different application through quantum sensor technology (1/4)

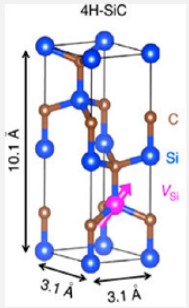
The proposal is to **connect SC3, SC4 and SC6** by **leveraging on the quantum sensor technology**.

In fact **the same QS technology** will be **integrated** into **different processing platforms** thus enabling **different applications** in **different SCs**

Quantum-sensors

highest precision & sensitivity for multi-physical characterisation to optimize systems on the edge

Quantum Sensor for multi modal, multi-physical, multi-scale measurements

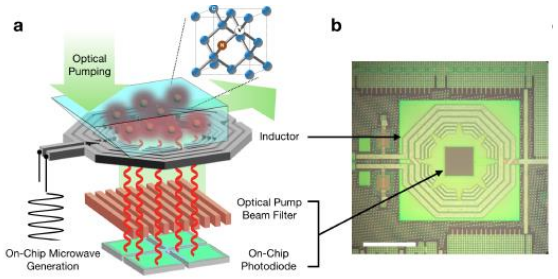


- Temperature (T)
- el. Current (I)
- el. Voltage (V)
- magn. Field (H)
- mech. Tensioning

Multi feature extraction for models

SC6

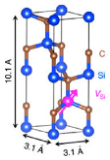
Development of the QS, HW interface and toolbox



FAU, EDI, I&M

SC3

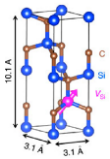
QS for detection of magnetic field orientation on UGV



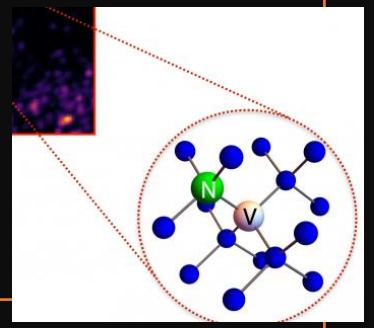
VIF, MUL, FAU, AIT, OTH, EDI I&M, UNIMORE

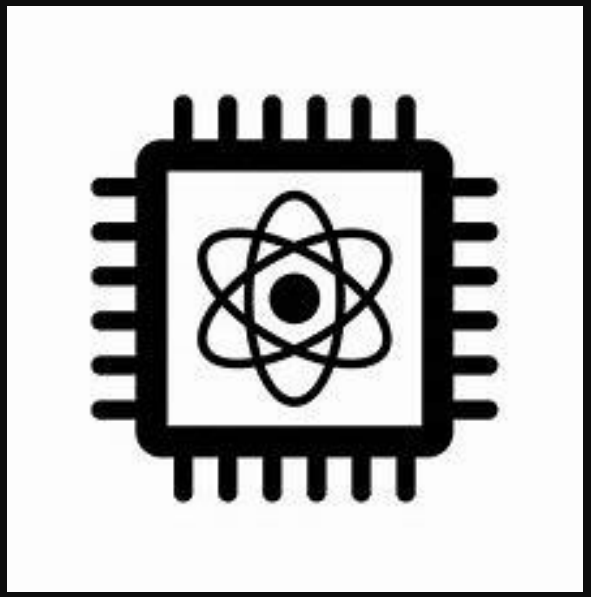
SC4

E-motor equipped with the quantum flux sensor



MBAG, HSO, AVL, BUT, I&M, UNIMORE





Quantum sensing

Quantum sensing makes use of the unique and counter-intuitive properties of matter and light when it is governed by quantum physics, such as quantization of energy levels, particle-wave duality, coherent superposition, and entanglement, to make precision sensors and measurements.

Applications of quantum sensors

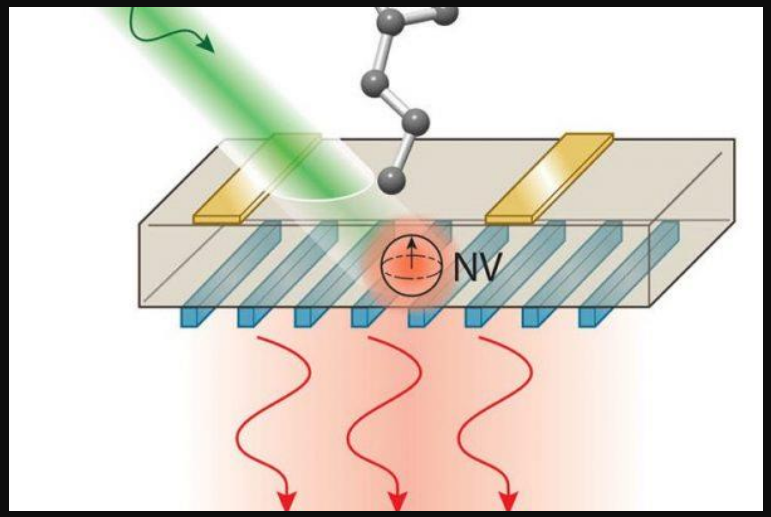
range from medicine to navigation, security, materials science, and even astrophysics.

Primary challenges

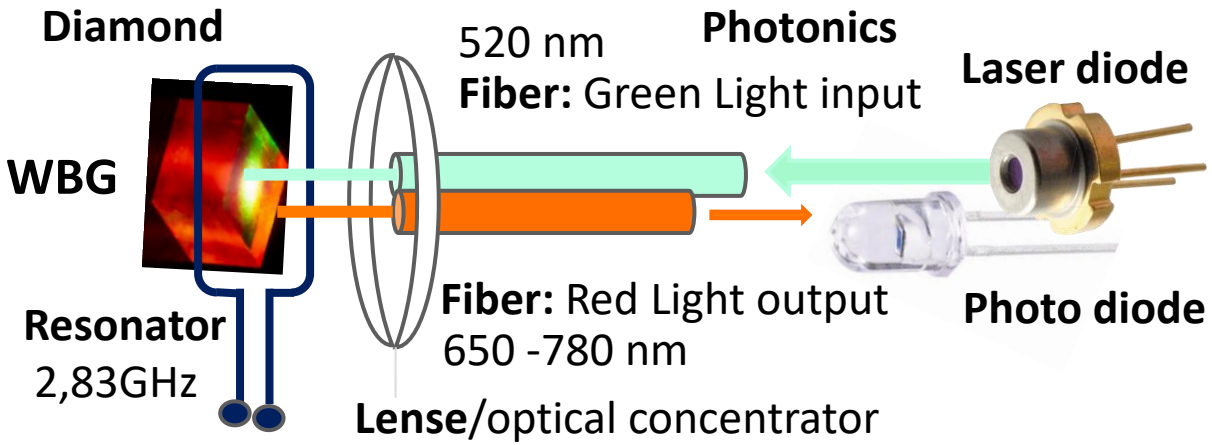
in quantum sensing is to protect the quantum system that is being used as a measurement device from the deleterious effects of interacting with its surrounding environment, while remaining sensitive to the target signal.

Quantum sensing research spans

from Chemistry, Physics, and Engineering science



First ever made integrated Q sensor magnetic field



Analog
MW-source, MW-amplifier
IQ-mixer, Photodetector
Lock-in amplifier, ADCs/DACs

CMOS Digital
Hardware control and timing
Signal processing
User interface

Figure 5 x0.9

More than Moore -> functionality

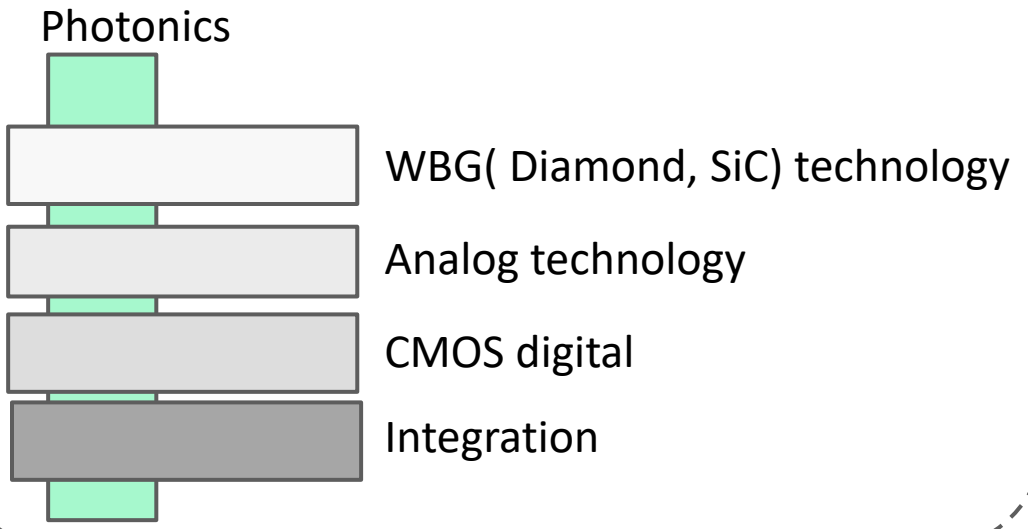
Use the strength of Europe's semiconductor technologies

Semiconductor content ->
new semiconductor are the key to the new world

SiC , GaN -> High innovation

More out top technologies

Integration of 5 Foundation layer (SRIA 1.1 – 1.3)



Example: Real-time torque sensing allows to monitor true power transfer, which is crucial for drive control systems, especially in terms of efficiency and safety improvement

mmWave sensor

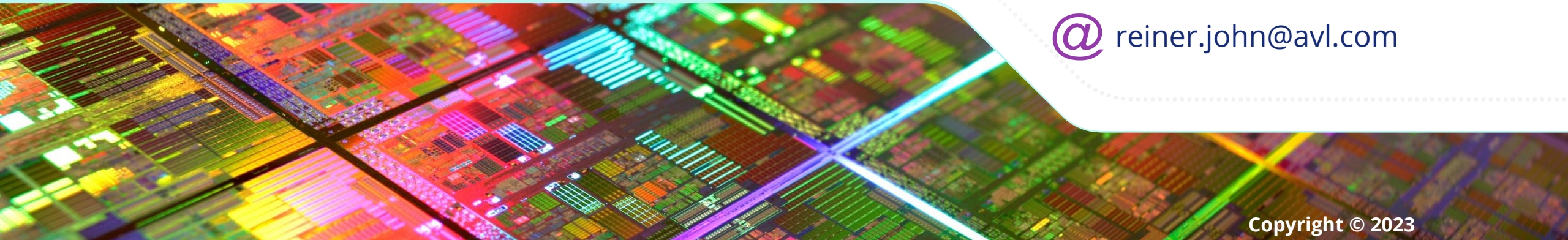
Current limitations:
Robustness against electromagnetic interferences, vibrations and limited installation space.

New:
New concept for torque measurement using tunable millimeter-wave metamaterials together with a continuous wave radar chip as read out.

EDGE AI

Thank You

For your attention



@ reiner.john@avl.com

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