E C S

Electronic Components and Systems

KDT Workshops

Inputs derived for the Long-Term Vision (LTV) Chapter of the ECS SRIA, ed. 2022

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KDT WORKSHOPS

ECS-SRIA Workshops for KDT Work Programme Preparation

Electronic Components and Systems

May 04:	SW in ECS based Digitisation
May 18:	AI, IoT, Advanced Control and Edge Computing
May 20:	Multifunctional Integration incl. Integrated Photonics and Flexible Electronics
May 27:	Micro-Nano-Electronics Challenges in KDT
June 01:	Green ECS and Decarbonisation

Primary Target: Prioritization of Research Topics to be addressed by the KDT calls in 2021 and 2022

Workshop:
SW in ECS based Digitisation

Priorities: https://ecscollaborationtool.eu/publication/download/slides-proposals-for-priority.pdf

Electronic Components and Systems

Horizontal Priorities

- Embedded Intelligence – IoT & intelligent edge, SoS support, HW/SW co-design for reconfigurable IoT, solutions for engineering process automation.
- Integration & orchestration platforms for IoT and SoS.
- Ensure/improve SW dependability, interoperability, virtualisation, scalability, standardisation & certification (more of a generic characteristic).
- Promote open-source SW in the ECS and digitisation value network.
- End-to-end trustworthiness (supported by engineering tools incl. frameworks, methods & tools for analysis, testing & V&V for ECS, especially for those that (a) have a high level of automation up to autonomy, (b) are supposed to cooperate with humans and/or other ECS within a network, cloud, etc., and (c) employ AI. Includes automation and low code/no code, non-functional properties.
- Engineering automation & lifecycle support: SW/HW hybrid modelling; Management of complexity, dynamics & uncertainty of KDT applications & SoS; SW upgrades (over-the-air); Autonomous SW for the verification, validation & testing of IoT & edge computing.
- Swarm computing & neuromorphic solutions.
- Ensure support for legacy SW and systems.

Workshop:
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Vertical Priorities

Application-specific priorities (mobility, health, industry, energy, agrifood, society), including functional-safety aspects, application-specific engineering tools, environmental aspects, energy efficiency, etc.

Synergistic Program Across Domains: European Ecosystem & Infrastructure

- Integrating a large number of the above elements.
- Moving from ‘cognitive CPS’ to ‘orchestrated, distributed & embedded intelligence’.

Workshop: AI, IoT, Advanced Control and Edge Computing

Priorities: https://ecscollaborationtool.eu/publication/download/slides-patrick-pype-priorities.pdf

Foundational & cross-technology priorities

- Embedded Intelligence & Advanced Control: 5 priorities
- Edge Computing: 6 Priorities (2 overlap with SW)
- System of Systems, Internet of Things: 8 Priorities (5 overlap with SW)
- Emerging & Lifecycle Support: 7 priorities (5 overlap with SW)

Application specific priorities

(3 to 5 priorities per application domain)

Mobility, Energy, Digital Industry, Health & Wellbeing, Agrifood & Natural Resources, Digital Society

Public Authorities

Trusted HW for AI , trusted chip design, self sufficient electronic systems, edge computing HW tailored to application

Workshop: AI, IoT, Advanced Control and Edge Computing

Electronic Components and Systems

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Industry (Bosch, Kalray, Infineon)

- IoT: IoT : Device connectivity, SW updates, device management, data driven continuous improvement in the AIoT Cycle
- Open (IoT) Platforms with OSS, Open HW/SW Ecosystems , Interoperability between edge layers, open layers from cloud to edge
- Heterogeneous real time processing with many core processors incl. smart data fabrics and high speed i/f's
- Accelerated fusion of embedded SW&HW, meta learning & hybrid modelling, blockchain & AI, new AI processing elements / memories
- Trust and explainability , Safe AI , learning and re learning at the edge, functional safety, security & adversarial attacks
- Tools and libraries

Research (IMEC)

Seamless AI, AI acceleration, specialized compute units, flexible integration, increased power efficiency, cross disciplinary integration

Workshop: Multifunctional Integration
incl. Integrated Photonics & Flexible Electronics

Electronic Components and Systems

Priorities: https://ecscollaborationtool.eu/publication/download/summary-w5.pdf

- **Novel devices, modules & systems with new or improved functionalities**: Advanced logic, Specific power and RF application technologies; Advanced interconnect, encapsulation, and packaging technologies; 3D integration technologies; Application-specific multifunctional integration incl. photonics and flexible; where industrial uptake is likely; also consider manufacturing aspects
- **Physical and functional integration** for new sensing, imaging and actuation solutions, communications, Energy and thermal management; incl. information processing; AI at the Edge;
- **Materials** : innovative, green, functional bulk and surface coating materials; Improved design and simulation capabilities (material data base);
- **Technologies, manufacturing and integration processes**: Integration for complexity: Embedding of components into several types of substrate; Fluidics, photonics, flexible electronics;
- **Decarbonisation and recyclability**: Develop technology platforms offering re-usable modules
- Enhance and ensure **reliability, robustness and sustainability of ECS**;
- Further **integration of SMEs and startups**: access to production capacities; platforms;

Workshop: Micro-Nano-Electronics Challenges

E C S
Electronic Components and Systems

Priorities: https://ecscollaborationtool.eu/publication/download/slides-patrick-cogez-conclusions.pdf

- **Semiconductor device architecture, process integration and manufacturing**
  - Advanced computing, memory and in memory computing concepts
  - Novel devices and circuits that enable advanced functionality
  - Enable flexible, sustainable, agile and competitive high volume semiconductor manufacturing
- **Design tools and methodologies, IP**
  - Software becoming a core competence
  - HW/SW co design and simulation from device to system level
  - Increased testability, reliability, durability and sustainability
  - Rethink the semiconductor value chain
- **Equipment**
  - Expand Moore's law to 3 axes of innovation
  - Equipment & manufacturing technologies for integrated photonics & quantum computing
- **Materials and substrates make a difference**
  - For power devices, communications, (ultra) low power computing
  - Ever increasing variety
  - Essential element of supply chain (SiC)

Workshop:
Green ECS and Decarbonisation

Electronic Components and Systems

Priorities: https://ecscollaborationtool.eu/publication/download/slides-gereon-meyer.pdf

Target: Green ECS

- **Energy efficient co-design** and on-demand operation of ECS soft- and hardware
- Low energy consumption by adding **sleep modes** or partial shut down modes
- Energy efficient sensors to measure environmental parameters
- Rebound effects of energy harvesting with new materials
- **Green life cycle approach**, including functional integration and modularization
- Repairing and recycling of composites
- New fabrication sites for GaN/SiC power electronics
- **Predictive and condition based maintenance**
- Standardize environmental impact for chips, boards, systems
- Identifying and analyzing the links of the ECS value chain in terms of CO2 footprint
- Develop a **LCA-database for ECS**
- **Trustworthy** and high quality production in Europe

Workshop:
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Electronic Components and Systems

Target: G

- **Energy ef**
- Low energ
- Energy eff
- Rebound
- **Green life**
- Repairing
- New fabric
- **Predictive**
- Standardiz
- Identifying
- Develop a
- **Trustwort**

Target: Decarbonization

- Energy efficiency of **electric vehicles** allowing range extension, also by automation
- Performance gains and **sustainable manufacturing** of power electronics for electrification
- Adaptive management of renewable energy sources, storages and chargers in **smart grids**
- **Sector coupling**: Heat and Electricity
- **Energy harvesting** as a power source
- **Energy storage technologies**:
  Production, Transportation, Storage, Distribution, Consumption, and Energy conversion systems
- Green and **Zero-emissions buildings** and constructions
- Secure, resilient communication, **smart edge computing** and AI for autonomous energy control
- Comprehensive **assessment of product CO_2 emissions** based on analysis of components
- Verification & validation of lower carbon footprint solutions
- Development of reference instruments to measure accurate energy flow/consumption in EV
- Smart monitoring of the environment and bio resources
- Active **Carbon Capturing** Methods and Technologies

Findings for the ECS LTV Chapter

Electronic Components and Systems

The ECS SRIA defines the short, medium, and long-term priorities in industrial-driven applied research and innovation

The Long-term Vision chapter of the ECS SRIA highlights the fields of fundamental research needed as enabling base

These fields are inspired by visions of new applications and driven by the global goals. Digitalization and decarbonisation mark the most dominating directions in technology development

Technology Fields

Quantum Technologies:
Q-Sensing, Q-Computing, Q-Communication

AI Technologies:
Hierarchical Architecture (AI at the edge … SoS), Trustable / Certifiable, Digital Twins (full-scale … very compact)

Autonomous Systems:
Multifunctional Integration and Functional Electronics, Trust-worthiness (Reliability, Safety, Self-X, Security, Robustness)

Materials: Highly performant, Efficient fabrication, Inherently green, Hazard-free, Recyclable, Bio-based, Lifecycle optimized

Application Fields

Electronic Components and Systems

Mobility: Electrical, connected & autonomous vehicles

Energy: Multimodal bidirectional sustainable generation, distribution and use – across Europe

Digital Industry: Industry 4.0, Collaborative Robots

Agrifood: Fully autonomous systems for smart farming, biodegradable materials, sustainable farming, animal welfare

Health & Wellbeing: Individualized / personalized medicine & care for inclusive self-determined life without dependence

Digital Society: Comprehensive services with full privacy

Electronic Components and Systems

Let's compile a great LTV roadmap

to make these visions come true

by highly innovative ECS technologies and products

made in Europe.