# ECS R&D&I Timelines

Concertation and Consultation on Computing Continuum - 10-11/05/2023 - Brussels

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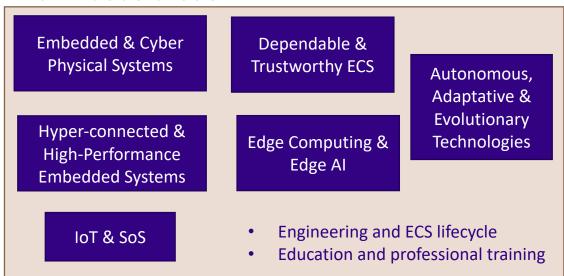




## **INSIDE Industry Association**

INSIDE is the European Technology Platform for research, design and innovation on Intelligent Digital Systems and their applications.

#### Main focus areas:



INSIDE is part of KDT JU, the largest tripartite industry oriented PPP ever, supporting the digital transformation of all economic and societal sectors and the Green Deal. KDT covers the continuum, excluding cloud.

The KDT will evolve in the Chips Act.

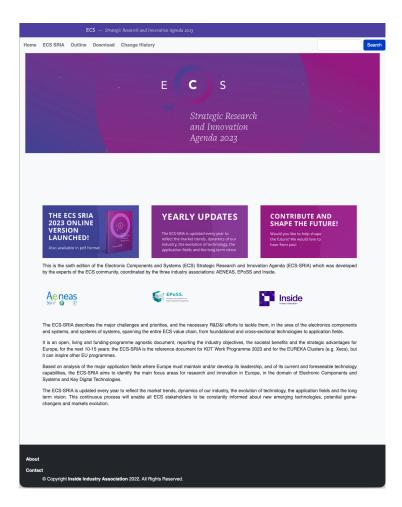


Tri-partite organisation (PPP)





## ECS Strategic Research & Innovation Agenda



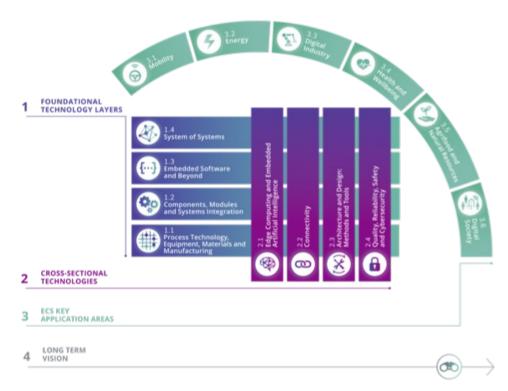
- Identifies the major technological challenges, priorities and required R&D&I efforts in the next decade, covering the entire ECS value chain
- Live, open and funding programme agnostic
- Edited every year by the ECS community, with more than 300 European experts
- Extensive and detailed report, serving as a basis for collaborative research

The ECS-SRIA is the reference document for the KDT (and Chips Act) calls for proposals.

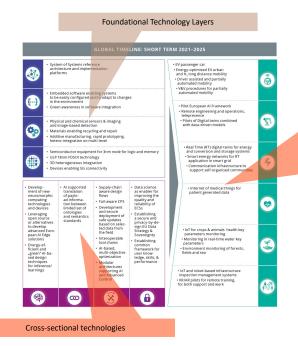


https://ecssria.eu/

## **ECS-SRIA Structure & Timelines**



Global and detailed (per chapter) timelines identify the main milestones foreseen in the next 10 years at TRL 8–9 (prototype or early commercialization)



#### **ECS-SRIA** structure:

- Foundational layers: cover the technology stack of a typical digitalization solution based on ECS
- Cross-sectional technologies: focus on transversal areas, where innovation emerges from the interdisciplinary contribution at the different levels of the foundational layers
- Key application areas for Europe, having a push/pull relation with foundational/cross-section chapters
- Long term vision, illustrating the vision beyond the time horizon covered by the other chapters

#### **Timelines periods:**

- **Short term** (2023–2027): the industry has a precise idea of what must be achieved during that timeframe
- Medium term (2028–2032): reasonably good knowledge of what can possibly be achieved
- Long term (2033 and beyond): expected achievements are more of a prospective nature

# Short term priorities (2023–2027):

- Improving features and computing capabilities on the edge
- Increase the autonomy of systems on the edge (AI)
- The continuum from the SoS perspective (e2e monitoring, orchestration & control)
- Towards circular economy in the continuum
- The engineering continuum
- Key applications based on the computing continuum



 System of Systems reference architecture and implementation platforms



- Embedded software enabling systems to be easily configured and to adapt to changes in the environment
- · Green awareness in software integration



- Physical and chemical sensors and imaging and image-based detection
- Materials enabling recycling and repair
- Additive manufacturing, rapid prototyping, heterogeneous integration in multiple levels



- Semiconductor equipment for 2nm node for logic and memory
- ULP 18nm FDSOI technology
- · 3D heterogeneous integration
- Devices enabling 5G connectivity

Al supported

translation of

information

limited set of

and semantics

payload

between

ontologies

standards

- Development of technologies and scalable devices for new Al paradigms
- Leveraging
  open source or
  alternatives to
  develop advanced & efficient
  European Al
  Edge solutions
- Energy-efficient and sustainable Albased design techniques for edge Al

- Supply-chain aware design flows
- Fall-aware CPS
- Development and secure deployment of safe updates based on selected data from the field
- Interoperable tool chains
- Al-based, multi-objective optimization
- Modular architectures supporting Al and Advanced Control

- Data science as enabler for improving the quality and reliability of
- Trustworthiness, secure and privacy-by-design EU Data Strategy & Sovereignty
- Establishing common framework for user knowledge, skills, & performance

- EV passenger car
- Energy-optimized EV urban and H, long distance mobility
- Driver assisted and partially automated mobility
- V&V procedures for partially automated mobility
- Pilot European AI Framework
- Remote engineering and operations, telepresence
- Pilots of Digital twins combined with data-driven models

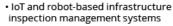


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- Real Time (RT) digital twins for energy and conversion and storage systems
- Smart energy networks for RT application in smart grid
- Communication infrastructure to support self-organised communities
- Secured supply chains
- Internet of medical things for patient generated data



- IoT for crops & animals health key parameters monitoring
- Monitoring in real-time water key parameters
- Environment monitoring of forests, fields and sea



 VR/AR pilots for remote training, for both support and work













### Medium term priorities (2028–2032):

- Improving features and computing capabilities on the edge
- Towards intrinsically interoperable continuum (AI)
- The evolutionary nature of the continuum (SoS level)
- Improved circular economy in the continuum
- The continuum in engineering
- Key applications based on the computing continuum



Evolvable, predictable and controllable composition of functional and extra-functional properties of System-of-systems.



- Interface management to prepare for System-of-systems
- Embedded software enabling systems to dynamically (re)-configure after updates or changes in the environment
- Maturity model for robustness of embedded software



**[:::]**)

- Energy management towards low/zero power
- · Heterogeneous integration for harsh environments
- Organic, compostable and biodegradable materials
- · In-memory computing
- PCRAM
- · 6G connectivity RF & photonics devices
- Smart GaN power devices

usage

- Equipment for 1 nm node nanowire, nanosheet-based logic and memory
- Holistic development environment and semi-automatic HW/SW codesign exploration flow and tools
- Decentralised, hybrid architectures and federated learning for high performance selected applications
- End-to-end Albased embedded systems trustability by design

- Interoperabi-Continuous lity: General development translation of processes incl. payload inforautomated damation enata-flow, based on digital twins bling application information and KI-based data analysis
  - Data-collection at run-time in fail-operational
  - Online V&V, safe and secure deployment, supported by modular and evolvable/ extendable reference architectures and

platforms

- Certification strategy under uncertain & dynamically changing environment
- New self-learning methods to ensure safe operations of complex systems
- SW & HW reliability metrics
- Digital twin as enabler to monitor ECS
- Ensuring personal data against cyber-attacks in the data-driven economy

- · Automated mobility in specific areas
- · Validation procedure for automated vehicles
- · Fuel cell passenger car and light-weight mobility
- · Energy-optimised rural mobility systems



- · Pilot of advanced human-machine joint intelligence
- Deeper integration of service-provider to end-user industrial processes



- · Further energy efficiency, security and reliability improvements
- Storage devices providing flexibility, stability and reliability in the grids
- · Local DC-coupling of various technologies for fast charging at home



- delivery systems part of the Internet of Medical Things
- Precision diagnosis to prevent hospital readmission



- · Food traceability over the whole value chain
- Improved electrochemical sensors for natural resources quality monitoring
- · Al for automatic decisions based on agro nomic models and algorithms



- Time-critical functions moved to cloud
- Multimodal and multi-sensory interfaces in serious gaming (beyond single games)











# Long term priorities (2033 & beyond):

- Improving features and computing capabilities on the edge
- Next generation of continuum connectivity
- Autonomous evolution of the continuum (SoS level)
- Full circular economy in the continuum
- The continuum in engineering
- Key applications based on the computing continuum



 Policy based autonomous System-of-systems engineering and evolution



- Programming languages to develop large scale applications for embedded System-of-systems
- Embedded software for trusted (secure and safe) autonomous systems



· Convergence of sensing principles

Autonomous

interopera-

bility: from

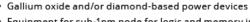
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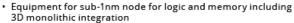
laver to instant

understanding

physical

- Integration methods for quantum computing, communication and sensing
- Zero defect manufacturing and circular economy for ECS







- Integration and orchestration of multiple computing paradigms into Al-based embedded systems
- Global and local reconfiguration of resources to satisfy functional and non-functional requirements
- · Certifiable and Explainable Al

- Certification at run-time (for known environments and for restricted classes of updates)
- Al-based design processes and tools
- Architectures and tools for new technologies, e.g. non von-Neumann, neuromorphic computing, quantum technologies

- EU ecosystems for dependable SW
- AI/ML enable to shorten development cycle & deploy PHM for the ECS's
- Liability & Safely manage human interactions in complex systems

- Fully automated mobility
- True multimodal mobility
- Approach to CO<sub>2</sub>-neutral (from cradle to grave) mobility



 Life cycle assessment as integral part of design-time and operative decision-making



- Close to zero emission (due 2050):
- Emission free cities with electrification, renewable energy sources and decentralised storages to improve reliability and efficiency (energy distribution, storage, and usage)



 Organ-on-a-chip developments addressing rare diseases



- Al-powered robots ensuring plant health care
- Water distribution mgt. based on advanced IoT
- Reduction of cumulated carbon and cropland footprint by 20% in the next 20 years



- Trustable Al-based IoT systems for increased situational awareness in surveillance and emergency response support
- No bandwidth and QoS limitation for video applications
- Real-time emotion sensing











# Thank you for watching

