E C S

Electronic Components and Systems

ECS - SRIA
OVERVIEW

SIE 2021

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What is the ECS-SRIA?

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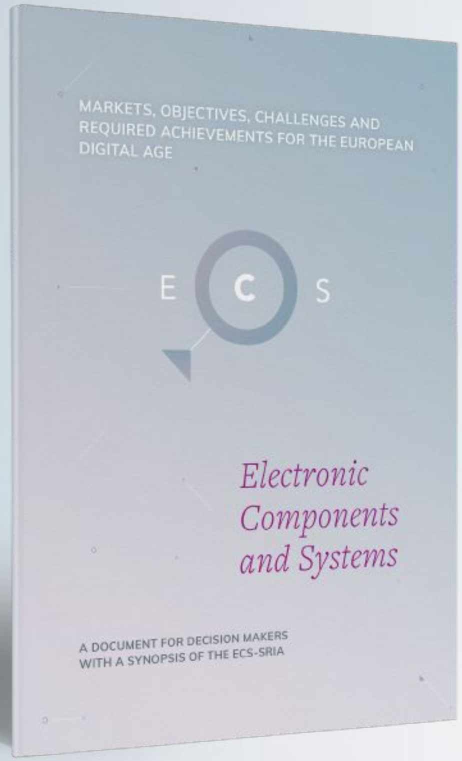
https://artemis-ia.eu/publication/download/ecs-sria-2021-final.pdf

- The ECS Strategic Research and Innovation Agenda (ECS-SRIA):
  - describes the major challenges,
  - and the necessary R&D&I efforts to tackle them,
  - in the area of the electronics components and systems, and systems of systems.
- Joint effort of the ECS community and 3A
  - AENEAS, ARTEMIS-IA and EPOSS,
  - more than 300 experts involved.
- Funding-programme agnostic document looking 15 years ahead.
- Reference document for:
  - the KDT SRIA 2021 (and previously ECSEL),
  - EUREKA Clusters (PENTA, Euripides, …).

The ECS-SRIA Synopsis



https://artemis-ia.eu/publication/download/ecs-sria-part-a.pdf

- The ECS-SRIA is a technical and very detailed document, conceived for a technical audience.
- We decided to published an ECS-SRIA synopsis:
  - a brief executive summary explaining the ECS SRIA purpose, the main ECS objectives, the European ECS Roadmap, and the related challenges and opportunities
  - intended for decision makers
  - to provide a consolidated insight into the markets, objectives, and required achievements for Europe's Digital Decade
  - trying to promote more investments and close collaboration along the ECS value chains and between countries

ECS-SRIA 2021: What is new?

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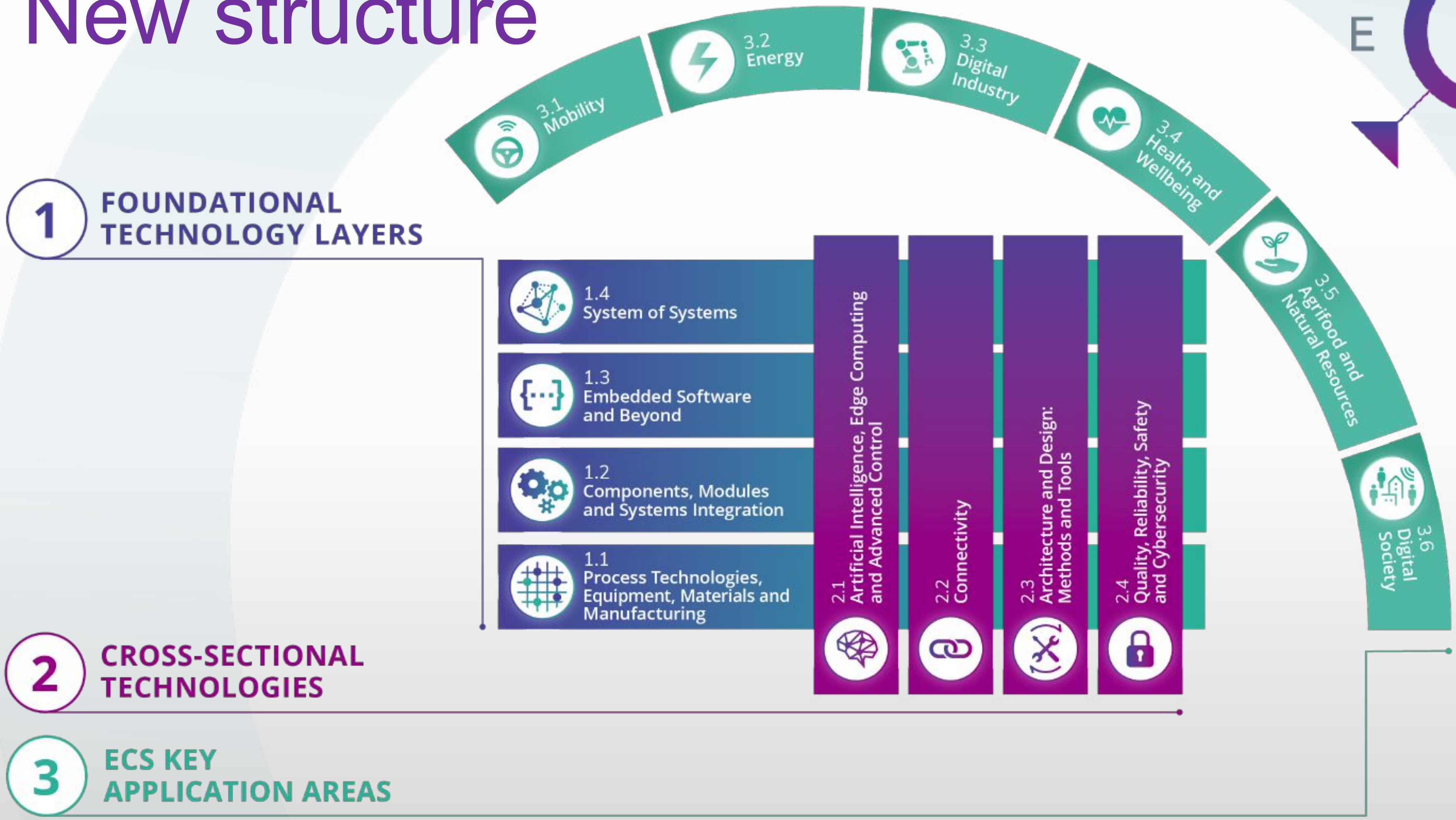
- New Structure
- Analysis of all Major Challenges = 4 Main Objectives +1
- Global Timelines (short term, mid term and long term)
- Broadened Scope (Integrated photonics; flexible electronics topics; Higher layers of software)
- Introduction, that guide the reader through the SRIA
- Updated Long Term Vision Chapter
- Common Glossary (SRIA definitions of specific terms)

New structure



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Foundational technologies

- The Foundational Technology Layers and their technical challenges cover the technology stack of a typical digitalization solution based on ECS.
- These foundational layers are characterized by hierarchical dependencies due to the inherent nature of ECS and the way they compose and integrate in complex entities.
- Advances in all Foundational Technology Layers will be essential for creating new electronic chips, components, modules, systems and Systems of Systems along the value chain.
- The foundational layers represent a very fertile ground where new interdisciplinary technologies, products and solutions can grow.

Cross sectional technologies

Foundational layers are complemented by the four Cross-Sectional Technology sections that focus on transversal areas of scientific research and engineering, where innovative results emerge from the joint contribution of the foundational layers.

For example, embedded intelligence on the edge will require

- new integrated circuits
- to develop innovative electronic components
- that can be used to develop smarter and more connected components, modules and entire systems,
- running smart software that will offer new functionalities and capabilities
- that will allow these systems to interact, cooperate and merge in larger Systems of Systems.

The innovation generated by these cross-sectional technologies will be applied across foundational layer and amplify the effect of innovation.

Application chapters and LTV

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Six Application sections describe the challenges arising from specific ECS application domains that are key for Europe and identify the R&D&I efforts required by these application domains.

Finally, the Long-Term Vision chapter illustrates our vision of the ECS beyond the time horizon covered by the other chapters:

- it seeks to identify the research subjects that must be addressed at low TRL levels
- and help the research programmes in the continuous improvement of European digital technology

EU Main Objectives taken up by SRIA

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- Boost industrial competitiveness through interdisciplinary technology innovations

- Ensure European digital autonomy through secure, safe and reliable ECS supporting key European application domains

- Establish and strengthen sustainable and resilient ECS value chains supporting the Green Deal

- Unleash the full potential of intelligent and autonomous ECS-based systems for the European Digital Age

- Ensure engineering support across the entire lifecycle of complex ECS-based systems

EU Main Objectives in SRIA Chapters

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EC Strat. Targets	Industrial Competitiveness	EU Sovereignty	Sustainability and Green Deal	Digital Age (AI, NGC)
ECS R&I Object-ives	**Boost industrial competitiveness through interdisciplinary technology innovations**	**Ensure EU sovereignty through secure, safe and reliable ECS supporting key European application domains**	**Establish and strengthen sustainable and resilient ECS value chains supporting the Green Deal**	**Unleash the full potential of intelligent and autonomous ECS-based systems for the European Digital Era**
Major Challenges in ECS Research and Innovation	1.1.1 Advanced compute, memory and compute-in-memory concepts	1.4.2 SoS interoperability	1.1.4 World-leading and sustainable semiconductor equipment and manufacturing technologies	1.1.1 Advanced compute, memory and compute-in-memory concepts
	1.1.2 Novel devices and circuits that enable advanced functionality	1.4.3 Composability of embedded and cyber-physical systems in SoS	1.2.4 Decarbonisation and Recyclability	1.1.2 Novel devices and circuits that enable advanced functionality
	1.1.3 Advanced heterogeneous integration and packaging solutions	2.2.1 Strengthening EU connectivity technology portfolio in order to maintain leadership, secure sovereignty and offer an independent supply chain	1.3.5 Green Deal and Embedded Software	1.3.4 Embedding Data Analytics and Artificial Intelligence
	1.1.4 World-leading and sustainable semiconductor equipment and manufacturing technologies	2.2.4 Architectures and reference implementations of interoperable, secure, scalable, smart and evolvable IoT and SoS connectivity	1.4.2 SoS interoperability	2.1.1 Increasing the energy efficiency of computing systems
	1.2.2 Materials	2.4.1 Ensuring HW quality and reliability	2.1.1 Increasing the energy efficiency of computing systems	2.1.3 Supporting the increasing lifespan of devices and systems
	1.2.3 Technologies, Manufacturing and Integration Processes	2.4.2 Ensuring dependability in connected software	2.1.3 Supporting the increasing lifespan of devices and systems	2.1.4 Ensuring European sustainability in AI, edge computing and advanced control
	1.4.2 SoS interoperability	3.1.1 Challenge 1 (climate and energy): Enable electrification & sustainable alternative fuels for CO2 neutral mobility	2.1.4 Ensuring European sustainability in AI, edge computing and advanced control	2.2.3 Autonomous interoperability translation for communication protocol, data encoding, compression, security and information semantics
	1.4.5 Open "system of embedded and cyber-physical systems" platforms	3.1.2 Challenge 2 (safety): Enable affordable safe and environment neutral light Mobility (Bikes, tricycles, wheelchairs, small drones, …) and mobile machinery (as smart farming)	2.2.1 Strengthening EU connectivity technology portfolio in order to maintain leadership, secure sovereignty and offer an independent supply chain	2.2.4 Architectures and reference implementations of interoperable, secure, scalable, smart and evolvable IoT and SoS connectivity
	2.1.1 Increasing the energy efficiency of computing systems	3.1.5 Challenge 5 (real-time data handling): Achieve real-time data handling for multimodal mobility and related services.	2.2.4 Architectures and reference implementations of interoperable, secure, scalable, smart and evolvable IoT and SoS connectivity	3.1.3 Challenge 3 (automation): Enable affordable, automated and connected mobility for passengers and freight on road, rail, air and water
	2.2.1 Strengthening EU connectivity technology portfolio in order to maintain leadership, secure sovereignty and offer an independent supply chain	3.2.2 Energy Management from On-Site to Distribution & Transmission Systems	2.4.4 Ensuring of safety and resilience	3.1.5 Challenge 5 (real-time data handling): Achieve real-time data handling for multimodal mobility and related services.
	2.2.2 Investigate innovative connectivity technology (new spectrum or medium) and new approach to improve existing one in order to maintain EU long term leadership	3.2.3 Achieving Clean, Efficient & Resilient Urban/ Regional Energy Supply	3.1.1 Challenge 1 (climate and energy): Enable electrification & sustainable alternative fuels for CO2 neutral mobility	3.2.1 Smart & Efficient - Managing Energy Generation, Conversion, and Storage Systems
	2.3.2 Managing new functionality in safe, secure, and trustable systems	3.4.1 Enable digital health platforms based upon P4 healthcare	3.1.2 Challenge 2 (safety): Enable affordable safe and environment neutral light Mobility (Bikes, tricycles, wheelchairs, small drones, …) and mobile machinery (as smart farming)	3.3.1 Responsive and smart production
	2.3.4 Managing Diversity	3.4.2 Enable the shift to value-based healthcare, enhancing access to 4Ps game changing technologies	3.1.3 Challenge 3 (automation): Enable affordable, automated and connected mobility for passengers and freight on road, rail, air and water	3.3.3 Artificial Intelligence in Digital Industry
	3.1.5 Challenge 5 (real-time data handling): Achieve real-time data handling for multimodal mobility and related services.	3.4.3 Support the development of home as the central location of the patient, building a more integrated care delivery system	3.2.1 Smart & Efficient - Managing Energy Generation, Conversion, and Storage Systems	3.3.6 Autonomous systems, robotics
	3.2.2 Energy Management from On-Site to Distribution & Transmission Systems	3.4.5 Ensure more healthy life years for an ageing population	3.2.3 Achieving Clean, Efficient & Resilient Urban/ Regional Energy Supply	3.4.2 Enable the shift to value-based healthcare, enhancing access to 4Ps game changing technologies
	3.2.4 Cross-Sectional Tasks for Energy System Monitoring & Control	3.5.1 Food Security	3.3.1 Responsive and smart production	3.4.4 Enhance access to personalized and participative treatments for chronic and lifestyle related diseases
	3.4.1 Enable digital health platforms based upon P4 healthcare	3.5.2 Food Safety	3.3.2 Sustainable production	3.4.5 Ensure more healthy life years for an ageing population
	3.4.2 Enable the shift to value-based healthcare, enhancing access to 4Ps game changing technologies	3.6.3 Facilitate inclusion and collective safety	3.4.1 Enable digital health platforms based upon P4 healthcare	3.5.1 Food Security
	3.4.3 Support the development of home as the central location of the patient, building a more integrated care delivery system		3.4.2 Enable the shift to value-based healthcare, enhancing access to 4Ps game changing technologies	3.5.3 Environmental protection and sustainable production
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	3.5.4 Water resource management		3.4.4 Enhance access to personalized and participative treatments for chronic and lifestyle related diseases	
	3.5.5 Biodiversity restoration for Ecosystems Resilience, Conservation and Preservation		3.4.5 Ensure more healthy life years for an ageing population	
	3.6.1 Facilitate individual self-fulfilment		3.5.3 Environmental protection and sustainable production	
	3.6.2 Facilitate empowerment and resilience		3.5.4 Water resource management	
	3.6.3 Facilitate inclusion and collective safety		3.5.5 Biodiversity restoration for Ecosystems Resilience, Conservation and Preservation	
	3.6.4 Facilitate supportive infrastructure and a sustainable environment		3.6.2 Facilitate empowerment and resilience	
			3.6.4 Facilitate supportive infrastructure and a sustainable environment	
	Ensure engineering support across the entire lifecycle of complex ECS-based systems			
Major Challenges in ECS Research and Innovation	1.2.1 Physical and Functional Integration	1.3.2 Continuous Integration of Embedded Software	1.3.1 Efficient Engineering of Embedded Software	2.1.2 Managing the increasing complexity of systems
	1.3.1 Efficient Engineering of Embedded Software	1.3.3 Life Cycle management of Embedded Software	1.3.2 Continuous Integration of Embedded Software	2.3.1 Extending Development Processes and Frameworks (to handle connected, intelligent, autonomous, evolvable systems)
	1.3.2 Continuous Integration of Embedded Software	1.4.1 Architectures	1.4.5 Open "system of embedded and cyber-physical systems" platforms	2.3.3 Managing Complexity
	1.3.3 Life Cycle management of Embedded Software	1.4.4 Systems of embedded and cyber-physical systems engineering	2.1.2 Managing the increasing complexity of systems	3.1.4 Challenge 4 (validation): Provide tools and methods for validation & certification of safety, security and comfort of embedded intelligence in mobility
	1.4.1 Architectures	1.4.5 Open "system of embedded and cyber-physical systems" platforms	2.3.3 Managing Complexity	3.3.4 Industrial service business, life-cycles, remote operations, and teleoperation
	1.4.3 Composability of embedded and cyber-physical systems in SoS	2.1.2 Managing the increasing complexity of systems	2.3.4 Managing Diversity	3.3.5 Digital twins, mixed or augmented reality, telepresence
	1.4.4 Systems of embedded and cyber-physical systems engineering	2.3.2 Managing new functionality in safe, secure, and trustable systems	2.4.5 Human Systems Integration	
	2.1.2 Managing the increasing complexity of systems	2.3.3 Managing Complexity	3.3.4 Industrial service business, life-cycles, remote operations, and teleoperation	
	2.4.5 Human Systems Integration	2.3.4 Managing Diversity		
	3.3.5 Digital twins, mixed or augmented reality, telepresence	2.4.3 Ensuring cyber-security and privacy		
		3.1.4 Challenge 4 (validation): Provide tools and methods for validation & certification of safety, security and comfort of embedded intelligence in mobility		
		3.3.4 Industrial service business, life-cycles, remote operations, and teleoperation		

An example

3.1.4.1 Electrification & sustainable alternative fuels
3.1.4.2 Affordable safe and environmentally neutral light mobility
3.1.4.3 Affordable, automated and connected mobility

2030	-37.5 % CO2 reduction vs. 2021
2040	Zero emission in cities
2050	Zero net emission

3.3.4.1 Responsive and smart production
3.3.4.2 Sustainable production

3.4.4.1 Digital health platform based upon P4 healthcare
3.4.4.2 Shift to value-based healthcare
3.4.4.3 Home as the central location of the patient
3.4.4.4 Personalised & participative treatments
3.4.4.5 Ensure more healthy life years for an ageing population

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Timeline

MILESTONES TO BE REACHED VIA COLLABORATIVE RESEARCH PROJECTS ACROSS EUROPE

Industrial competitiveness

SHORT TERM (2021–2025)	MEDIUM TERM (2026–2030)	LONG TERM (2031 AND BEYOND)
Additive manufacturing, rapid prototyping Modular multi-application architecture supporting AI and advanced sensing and control Remote engineering and operations, telepresence	Advanced human-machine joint intelligence Time-critical functions moved to the cloud Cost- and effort-effective, continuous virtual ECS development and validation processes	Zero defect design and manufacturing and circular economy for ECS Certified trusted hardware and embedded software for autonomous systems

EU sovereignty

SHORT TERM (2021–2025)	MEDIUM TERM (2026–2030)	LONG TERM (2031 AND BEYOND)
EU devices enabling 5G connectivity Leveraging open source or alternatives to develop advanced European AI edge solutions	6G connectivity RF and photonics devices End-to-end AI-based security New self-learning methods to ensure safe operations of complex systems 1 nm node semiconductor equipment	EU ecosystems for dependable SW Trustable AI-based IoT systems Quantum and other novel paradigm technologies for computing, communication and sensing

Sustainability and Green Deal

SHORT TERM (2021–2025)	MEDIUM TERM (2026–2030)	LONG TERM (2031 AND BEYOND)
Materials enabling recycling and repair Supply-chain aware design flows Energy-optimised EV urban mobility	New Power devices Energy management towards tow/zero power Energy-optimised H_2 long-distance mobility Food Traceability over the whole value chain Organic, compostable and biodegradable materials	Emission-free cities From cradle to grave CO_2-neutral mobility Reduction of cumulated carbon and cultivated land footprint by 20% in the next 20 years

Europe's Digital Age

SHORT TERM (2021–2025)	MEDIUM TERM (2026–2030)	LONG TERM (2031 AND BEYOND)
Communication infrastructure to support self-organised communities IoT-based health care solutions Sensing and processing for clean, connected and automated vehicles	Improved and new human-machine interfaces Validation and certification procedere for clean, connected and automated vehicles Next-generation (patch-like) drug delivery systems part of the Internet of Medical Things	Real-time emotion sensing Instant information understanding between systems Organ-on-a-chip developments addressing rare diseases

Global Timelines

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- Divided the timeframe in three periods
- Selected the milestones from a global and structured perspective:
  - Short term (2021–2025):
    The industry has a **precise idea** of what must be achieved during that timeframe.
  - Medium term (2026–2030):
    Reasonably good knowledge of what can possibly be achieved.
  - Long term (2031 and beyond):
    Expected achievements are more of a **prospective nature**.
- Described features expected to be available as ECS at TRL levels 8–9 (prototype or early commercialisation) within that timeframe
- Detailed timelines available in each technology or application section

Global Timelines
Short term example

Materials enabling recycling and repair

Components, Modules and System Integration

Foundational Technology

Advanced AI edge solutions leveraging open source or alternative strategies

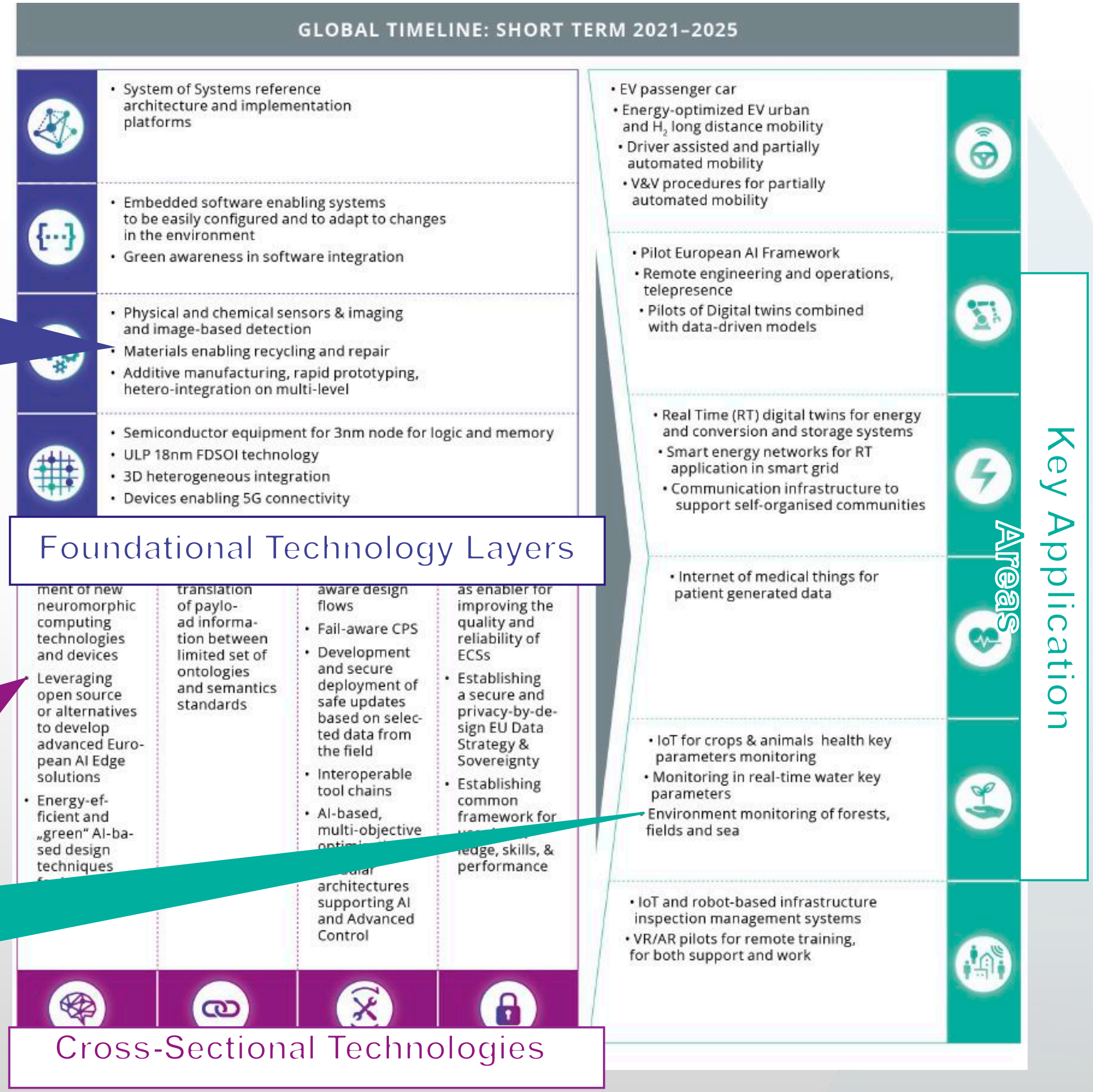
Artificial Intelligence, Edge Computing and Advanced Control

Cross-Sectional Technology

Widespread deployment of sensors to monitor forests, fields and oceans

Agrifood and Natural Resources

Key Application Area



Promoting Synergies

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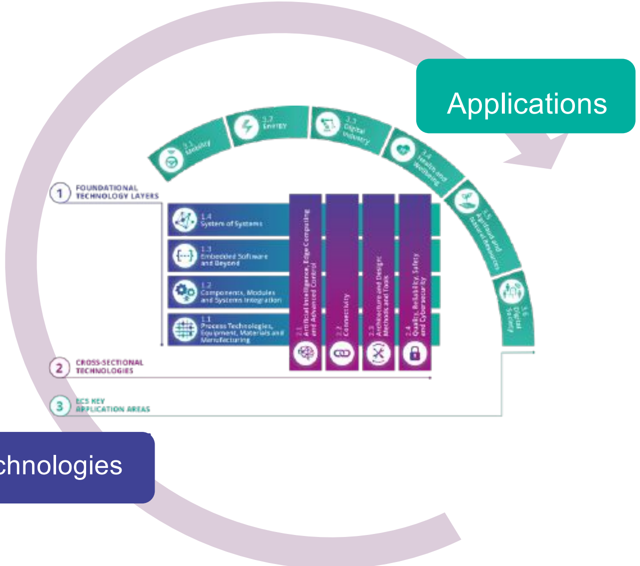
Within the SRIA

Potential new breakthroughs in applications



From application roadmaps to ECS technology requirements

ECS SRIA in the Global Landscape

And many others…

The ECS-SRIA 2022

- The preparation of the ECS-SRIA 2022 is ongoing.
- A preliminary version is planned for the end of September 2021.
- The updates interest the entire SRIA, at different levels,
  - to follow and guide the evolution of technologies,
  - to follow and influence the market trends along the ECS value chain.

We need more experts to further improve the ECS-SRIA 2022

If you are interested contact me or contact the industry associations (AENEAS, Artemis-IA, EPOSS).

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Thanks for the attention