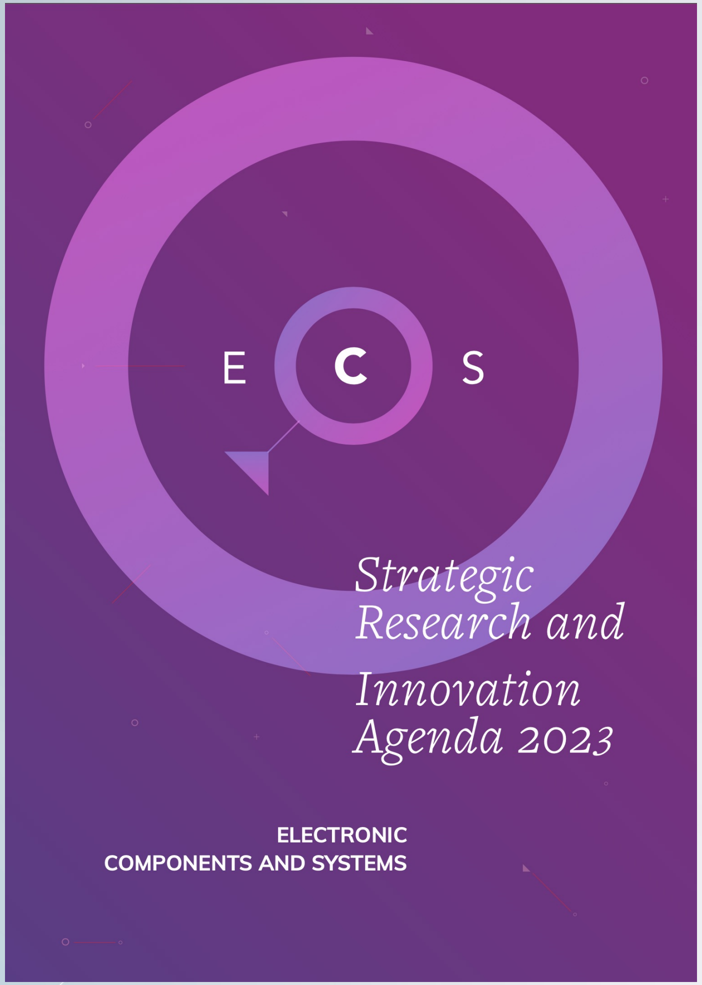

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Electronic Components and Systems

ECS-SRIA 2023

Final version

Paolo Azzoni, Chairman, Inside-IA

Patrick Cogez, Co-Chair, AENEAS

Nicolas Gouze, Co-Chair, EPoSS

Summary

- Introduction
- ECS-SRIA 2023 updates
- How to use the ECS-SRIA

ECS

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The ECS-SRIA

The SRIA for the ECS value chain

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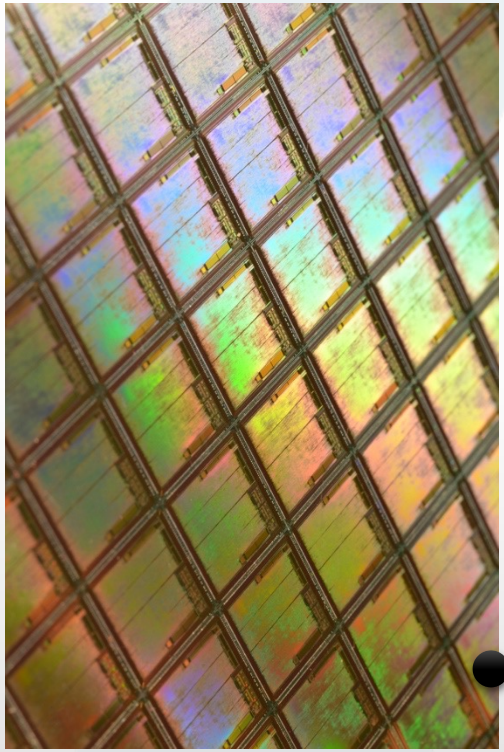
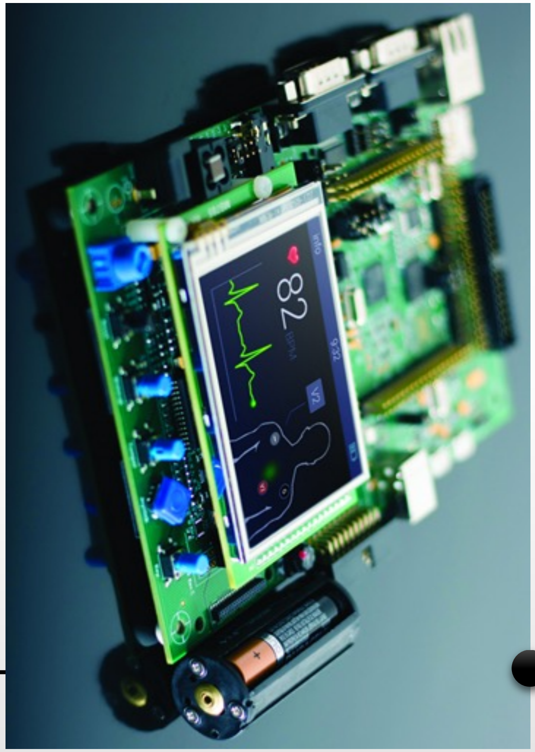
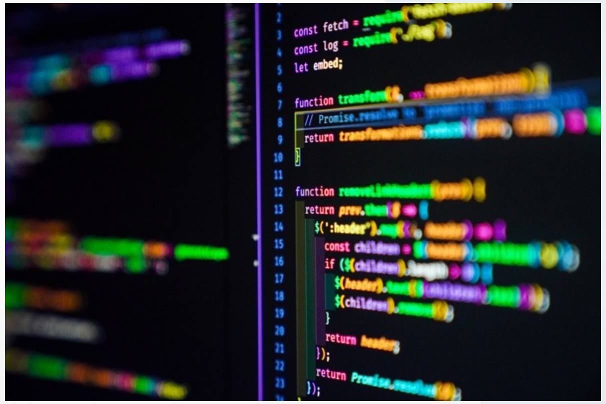


Materials, processes, semiconductors, micro & nano electronic components, ...



Smart sensors, integrated devices, edge AI, embedded SW, ...

Systems and applications, value creation, societal goals, ...



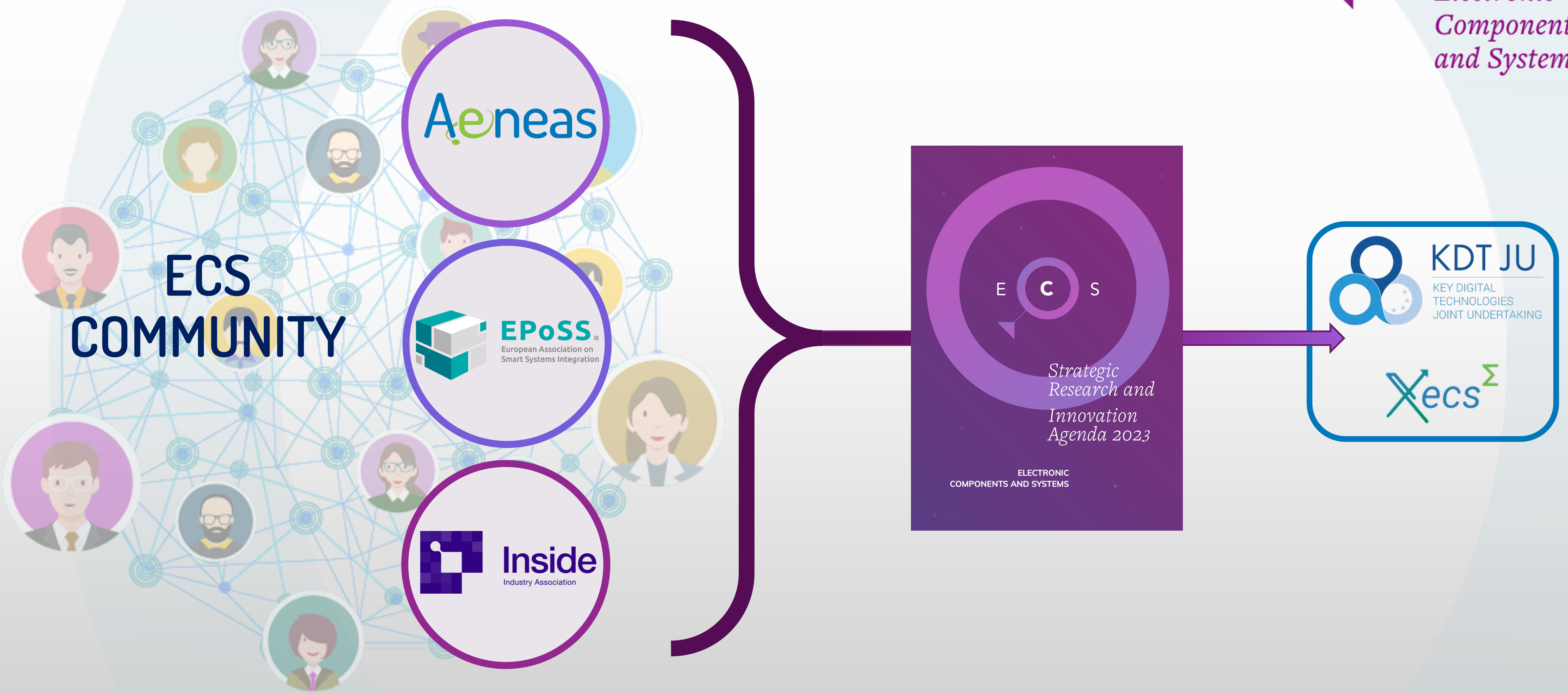
ECS engineering tools

https://ecssria.eu/ECS-SRIA 2023.pdf

The ECS-SRIA 2023

Basis for KDT Calls 2023

Electronic Components and Systems



The ECS-SRIA Team 2023

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Paolo Azzoni
Inside IA
Chairman

Patrick Cogez
AENEAS
Co-chairman

Nicolas Gouze
EPOSS
Co-chairman

Core Team

- Arco Krijgsman - ASML
- Christophe Wyon - CEA
- Jerker Delsing - LTU
- Juergen Niehaus - Safetrans
- Patrick Pype - NXP
- Sven Rzepka - Fraunhofer
- Wolfgang Dettmann - Infineon

More than 300 European experts

ECS-SRIA structure

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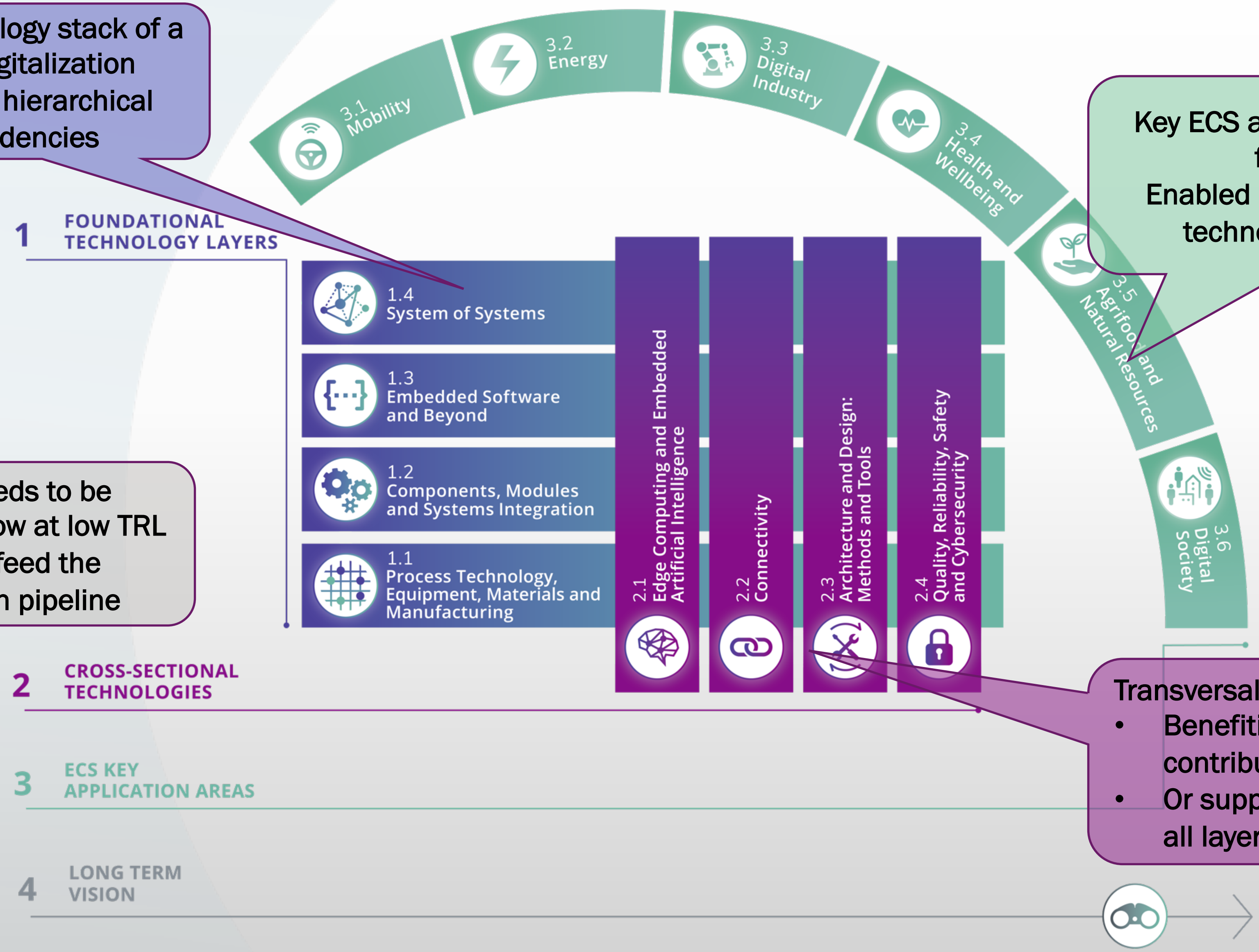
Basic technology stack of a typical digitalization solution & hierarchical dependencies

Key ECS application domains for Europe
Enabled by and driving ECS technology roadmaps

What needs to be addressed now at low TRL level to feed the innovation pipeline



Transversal areas

- Benefiting from interdisciplinary contribution of the foundational layers
- Or supporting technology stack across all layers

ECS-SRIA 2023 Updates

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ECS-SRIA 2023 Updates

Electronic Components and Systems

The ECS-SRIA website

Updates focused on societal benefits

Intro update with focus on climate & energy

Open Source HW and RISC-V new Appendix

4 “Main Objectives” confirmed

Structural updates

Research and market trends

New market figures

Timelines

Highlight interdisciplinarity

References to recent reports and studies

Improved chapters integration & synergies

Updates focused on technology

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Part 1 Foundational Technology Layers

1.1 - Process technology, equipment, materials and manufacturing

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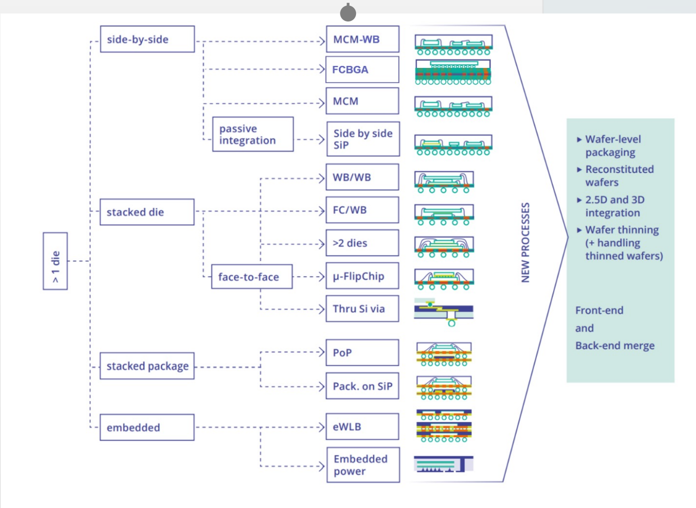
MC 1 Advanced computing, memory and in-memory computing

- 2.5D integration technology
- More details about chiplets, interposers
- 3D interconnect & “monolithic” 3D integration

MC 3 Heterogeneous integration & packaging

- Flip Chip Ball Grid Array Substrates
- New materials for wafer level bonding and chip integration
- New SiP combination diagram, merging front-end and back-end



MC 4 World-leading and sustainable semiconductor manufacturing equipment and technologies

- Sustainable manufacturing of chips to reduce CO_2 & H_2O footprint & chemicals impact
- New figures about water and energy consumption, CO_2, gas and chemicals use

H_2O/CO_2 footprint “scopes”

H_2O consumption & CO_2 emissions:

- due to operations in wafer fab
- purchased energy to run fabs
- other steps of the supply chain

1.2 Components, modules & systems integration

Review of societal benefits and application breakthrough

- Different technologies integration
- Embedded intelligence
- Energy consumption optimisation
- EU positioning in microelectronic for reliability, security & safety
- Role of low level SW enabling higher levels of the stack
- Sustainability through miniaturisation, modularity and HW/SW efficient engineering

Clarified development goals and needs both from technology & functional perspectives

Major challenges re-structured to improve clarity

MC 1: Enabling new functionalities in components with More-than-Moore technologies.
MC 2: Integration Technologies, manufacturing and processes.
MC 3: Decarbonization and recyclability.

1.3 - Embedded SW & beyond

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Embedded SW technologies

- Parallelization
- integrability for distributed computing
- SoS and microservice-based architectural paradigms
- SW support for new computing paradigms
- SW support for heterogeneous accelerators
- SW engineering tools (Compilers, code generators, and frameworks for optimal use of heterogeneous computing platforms
- Co-simulation platforms
- Tools, middleware and (open) hardware with permissible open-source licenses

Heterogeneous computing architectures

SW supporting several types of accelerators to meet power consumption, performance requirements, safety, and real-time requirements

Evolvability of embedded SW

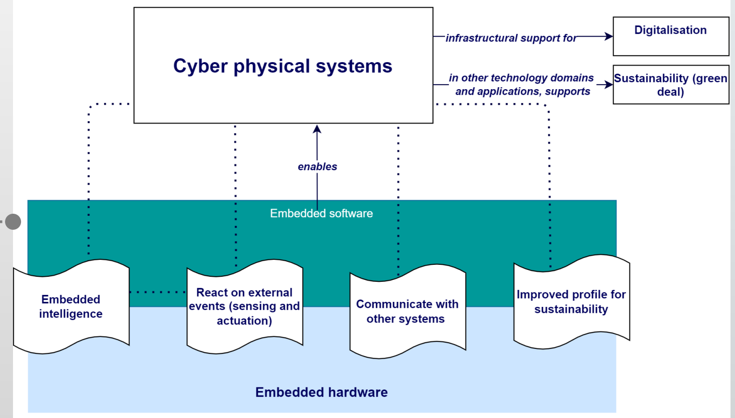
- Engineering automation, integration & orchestration platforms, to keep systems maintainable, adaptable and sustainable
- Embedded SW architectures to enable SoS

Open source SW

As defined by 4 freedoms:
- the freedom to run as you wish
- to study and change the source code
- to redistribute copies and
- to distribute copies of your modified versions

Embedded intelligence

Reviewed the concept of EI as the ability of a system or component to reflect on its own state (e.g. operational performance, usage load, environment)



Embedded intelligence is the ability of a system or component to reflect on its own state (e.g. operational performance, usage load, environment).

1.4 System of systems

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SoS integration along the life cycle

- Shift from system of systems engineering to SoS integration along the life cycle.
- Update MC4: integration and engineering methodologies, tools, tool chains and tool interoperability are fundamental to enable the implementation of SoS solutions using SoS architectures and platform technologies, supporting the whole lifecycle.

AI support to ”Trustable” SoS

- New methodology and tools for risk and vulnerability assessment and threat modelling based on AI/ML and ontology/semantic to improve knowledge, decision-making, predictions of SoS evolution.
- AI simplifies the assessment of cross sectorial requirements like e.g. security, safety, evolution, maintenance, etc.

Alignment of all the major challenges with the new concepts

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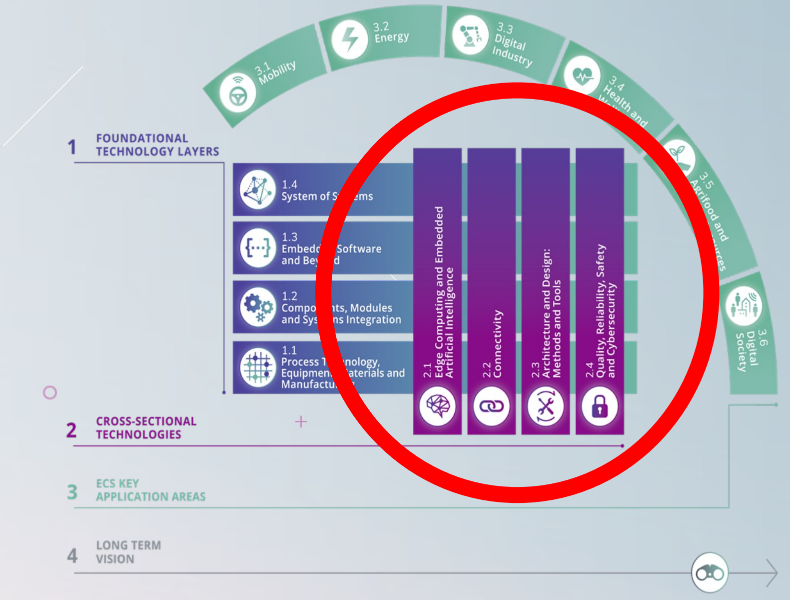
Part 2

Cross Sectional Technologies



Chapters 2.1 & 2.2

2.1 - Edge computing & embedded AI

New market figures and trends

- Reduction of computing and storage required by AI algorithms
- Energy for computing and data movement
- Size of DL networks
- Landscape of AI chips
- Positioning of EU semiconductors industries

New technology challenges

- Support of recent new deep neural networks models, such as Transformers, architectures for SOTA neural networks algorithms.
- “Automatic” adaptation of complex networks in embedded systems, with a minimum loss of performances
- Certifiable AI (and paths towards explicability and interpretability)

2.2 - Connectivity

Alignment with SNS on 6G

- MC 1 - Strengthening the EU connectivity technology portfolio to maintain leadership
- MC 2 - Investigate innovative connectivity technology

Update of major challenge 5

MC5: Network virtualisation enabling run-time and evolvable integration, deployment and management of edge and cloud network architectures

- Virtual connectivity architecture supporting multiple technology platforms, including 5G, B5G and 6G AI
- Reference implementation of virtual connectivity architecture
- Engineering, integration and management frameworks

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Chapters 2.3 & 2.4

2.3 - Architecture and design: methods and tools

Virtual verification & validation

- MC 1 - Key Focus Areas "Virtual Engineering"
- MC 2 - Key Focus Areas "Modelling"
- Objective: enable usage of virtual V&V for certification, increasing simulators accuracy and faithfulness, model accuracy and faithfulness, increasing environment modelling, etc.

Verification/Validation of AI based systems

AI-based systems: systems in which at least one (optionally: safety critical) functionality is based on AI

- Objective: enable V&V of AI-based functions for certification, extending safety case arguments, new architectural solutions, or extending existing systems engineering methods
- Focus is on Systems Engineering methods, which need to be integrated with extensions in AI (i.e., increase of ‚explainability', ‚introspectation', etc.), in Chapter 2.1

2.4 - Quality, reliability, safety and cybersecurity

General improvement & focus on 5G/6G

- Improved MC1, focused on quality and reliability
- Improved MC3, analysing the impact of 5G/6G on cybersecurity, certifications, impact of methods and tools on sustainability

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Part 3
ECS Key Application Areas

3.1 - Mobility

Key market trends, industry objectives and societal benefits

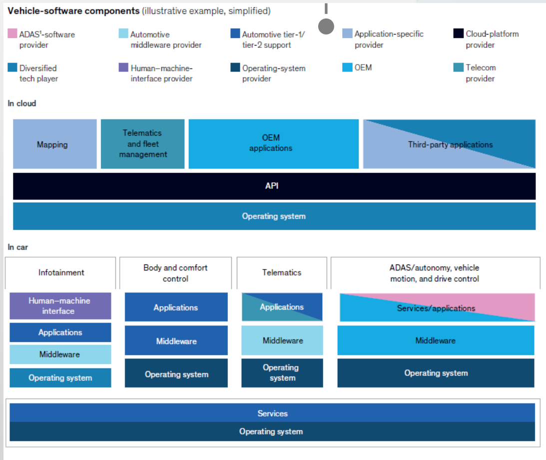
- CO_2 neutral mobility & resource optimized mobility
- inclusive & fatality free mobility
- Protect strong position of European automotive industry
- Digitalization in maritime, aerospace and rail industries
- Close collaboration with semiconductor and embedded software leaders in Europe
- 5 megatrends: electrification, autonomy, connectivity, shared mobility and SDV

Towards carbon neutrality

- Mobility is in a phase of fundamental changes, with a great potential to reduce global warming through CO_2 neutrality.
- MC1 and MC2 merged in a new MC: "Enable CO2-neutral mobility and required energy transformation"
- Includes electrified or sustainable alternative fuels based, and every category of vehicle

Software Defined Vehicle

- SDV is a vehicle where features and functions are primarily enabled through software
- E2E software platform (HW abstraction layer + OS + middleware with standardized interfaces for the application) to manage the rising SW complexity effectively and efficiently
- New MC3: Modular, scalable, re-usable, flexible, cloud-based, safe & secure end-to-end software platform (operating system and middleware) able to manage software-defined mobility of the future, sometimes labelled as "CAR-OS"



[1] Advanced driver-assistance system.

3.2 Energy

Evolution pace & supply needs

- Speed-up of energy transition is urgently needed
- Geopolitical tensions urge for action to obtain self-sufficient and secure energy systems

Consumer involvement

Educate the consumer and create incentives for environmentally-friendly behavioural changes.

New affordable technologies

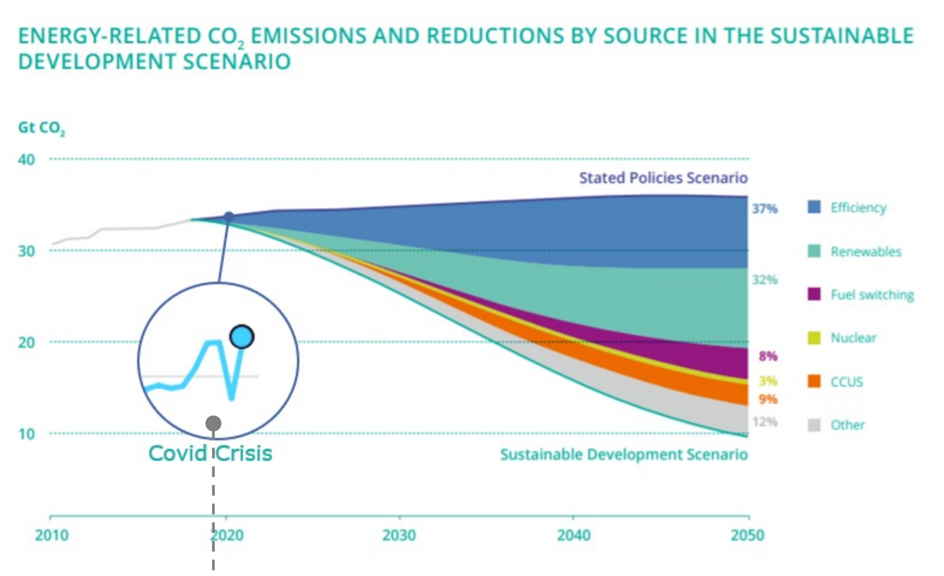
- Scheduling for cost-efficient energy consumption
- Solutions for grid stability

Industrial transformation

- Stronger focus on replacement of CO_2 emitting processes by low-carbon technologies
- Faster shift to renewables
- Sustainable manufacturing of ECS

Post-pandemic

- Update in COVID-19 developments from last year
- More awareness, but fast return to the old consumption level



3.5 Agrifood & natural resources

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Climate change

- Impact of climate change on agriculture and natural resources
- Benefits from ECS technologies to improve these areas

Connectivity

- New means to address communication coverage issues affecting remote farms (e.g. nanosat, microsat, smallsat)
- Coverage of IoT connectivity services in rural areas

Digital twins and block-chain

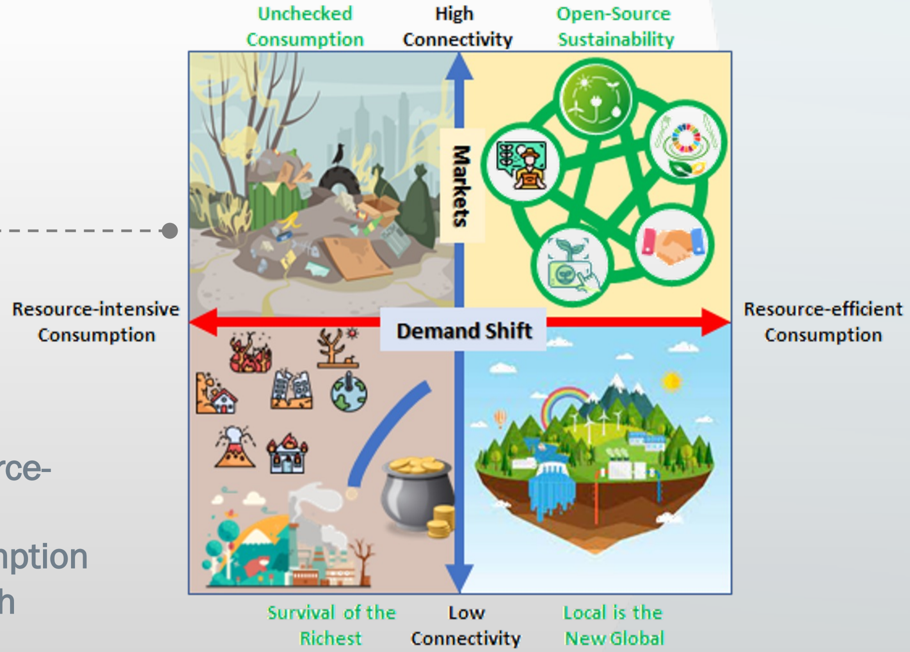
- Take the farming and food industry to the next level in terms of productivity and sustainability
- E.g. precision farming: DT is used to simulate different treatments for a specific plague

Farming as a service

Guarantee all sizes of farms, including small and medium sized, have access to digital solutions, in a cost-effective and easily exploitable way.

Challenges

- Demand shift from resource-intensive consumption to resource-efficient consumption
- Markets shift towards high connectivity



Chapters 3.3, 3.4 & 3.6

3.3 Digital industry

General review, new links to RISC-V, AI, energy, new references to recent publications

3.4 Health and wellbeing

- Align with final recommendations Health.E Lighthouse Initiative
- Synergies with Innovative Health Initiative (IHI) Joint Undertaking

3.6 Digital society

General review, minor changes

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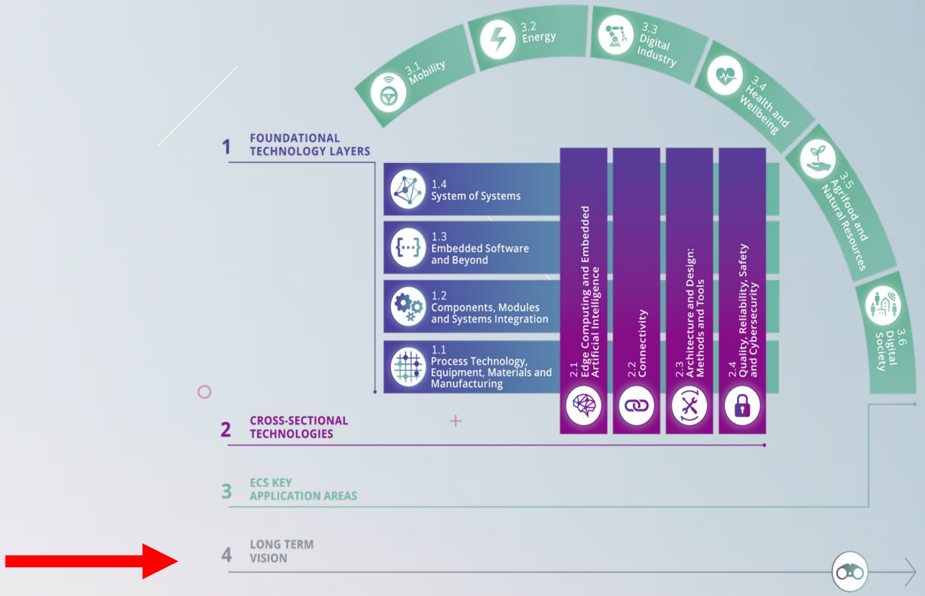
Part 4
Long Term Vision



4 - Long-Term Vision

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Green Deal & sustainability objectives

Sustainable chips production

Chips production will generate more environmental waste and energy and water consumption, CO_2 and GHG emission will increase:

- Chips will require more metal layers and lithography steps
- Chips production will increase significantly

Objective: new ways to recycle, reduce, recover and reuse water; use renewable energies; gas recycling and reuse; new R&D processes; more cooperation along the value chain

ECS repair, reuse and recycle

- Tackle the lack of circular economy and business model preventing recycling
- Non invasive electronics for single-use or disposable devices
- ECS reuse across domains and for linear and functional scalability
- Solutions include materials, processes, computing models, etc.

Next generation computing devices

Physics to make computation poses new challenges in integration and development:

- New modes of coding information besides bits (e.g. qbit)
- Encoding in time like for neuromorphic architectures
- Massively parallel computation using biological technology (based on proteins, DNA construction, etc.)

4 - Long-Term Vision (2)

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New frontiers in Edge AI

Distributed & coordinated AI

New computing models distribute functionalities from edge to cloud, across different domains:

- Distributed & coordinated intelligence and federated learning become increasingly important.
- Need of multidisciplinary in Advanced AI, like composite AI.

Social acceptance of AI

To ensure social acceptance and wide adoption of AI, significant effort needs to be spent on certifiable and explainable AI

Explosion of diversity of ECS

AI supports engineering with automatic design space exploration, design of SoCs, code generation, integration and orchestration of ECS

Integrity of the ECS and ECS application supply chain

- Many cybersecurity incidents originate from exploited vulnerabilities in the supply chain
- E.g. hardware trojans at fabrication plants and implanting malicious hardware components in systems
- New HW/SW validation solutions are needed

Increased heterogeneity of SoS

Heterogeneity (due to emerging computational models including accelerators, AI/ML subsystems, approximate computing, organic systems, etc.) poses new challenges:

- Interoperability and adaptation to diverse physical interfaces and communicated data
- Solutions to manage heterogeneity at all levels, including dynamic instantiation of computing resources and auto-configuration of distributed resources (locally or globally) to satisfy application functional and non-functional requirements.
- Lack of standardization for HW/SW functions and scalability specifications

How to use the ECS-SRIA

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ECS SRIA and KDT calls 2023

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<u>Basis for KDT calls 2023</u>

Open Call:

- Includes all Major Challenges of the SRIA (from CHP 1.1 to 3.6)
- Refer directly to the ECS-SRIA for both RIA and IA

Focus Topics:

- Refer to call text
- ECS-SRIA is aligned with focus topics
- Represents a complementary source of information to:
  - position the focus topics in the ECS value chain
  - identify synergies/dependencies with other technology areas (interdisciplinarity)

ECS-SRIA Outline

Electronic Components and Systems

Chapter scopes at a glance

Chapters Synergies

CROSS-SECTIONAL TECHNOLOGIES

FOUNDATIONAL TECHNOLOGY LAYERS

		2.1 - EDGE COMPUTING AND EMBEDDED ARTIFICIAL INTELLIGENCE	2.2 - CONNECTIVITY	2.3 - ARCHITECTURE AND DESIGN: METHODS AND TOOLS	2.4 - QUALITY, RELIABILITY, SAFETY AND CYBERSECURITY
		Hardware architectures and their implementation (Systems of Chips, Embedded architectures), for edge and "near the user" devices. Generic technologies for compute, storage and communication (generic embedded architectures) and technologies that are more focused towards edge computing. Technologies for devices using Artificial Intelligence at the edge.	The connectivity and interoperability technology is focused on enabling the projected commercial and societal benefits that are related to the OSI model layers 1, 5 and 6.	Innovations, advancements and extensions in architectures, design processes and methods, and in corresponding tools and frameworks, that are enabling engineers to design and build innovative ECS-based applications with the desired quality properties, efficiently and cost effectively.	Ensure quality, reliability, safety, dependability, privacy and security of ECS as a part of the Design, Implementation, and Validation/ Testing process of complex, heterogeneous and intelligent ECS, including human-systems interaction.
1.4 - SYSTEM OF SYSTEMS	System of Systems (SoS) enable the cooperation, orchestration, management, control and evolution of an entire system composed of embedded and cyber-physical systems (ECPS). This layer covers SoS architecture, technologies to securely and safely compose ECPS in SoS, ECPS and SoS interoperability, advanced control, and open, secure and interoperable SoS platforms, supported by SoS full lifecycle automated engineering.	Artificial intelligence to automatically manage the composition of ECPS in SoS and control their evolution. Artificial intelligence to improve/ automate interoperability. Distributed artificial intelligence to provide the level of automation required to monitor, to support decision making and to control the complexity of SoS.	Connectivity is a key enabler for SoS which, by definition, are composed of connected and distributed ECPS. Connectivity channels and their interfaces are at the base of the composition process from which SoS originate.	Engineering methodologies, tool chains and tools interoperability are fundamental to enable the definition of SoS architectures, the implementation of SoS platform and SoS management across their lifecycle. The heterogeneity of SoS requires automated engineering processes and toolchains, integrated between multiple stakeholders, brands and technologies, supporting efficiency, quality and sustainability.	End-to-end trust (security, privacy, reliability, etc.) covering the entire edge to cloud continuum (trust continuum) is a key factor for SoS. Trust must be preserved during the composition of ECPS in SoS and must be ensured during their evolution. Security, privacy, reliability, etc. must scale following the complexity of SoS, which requires automation to efficiently manage trust.
1.3 - EMBEDDED SOFTWARE AND BEYOND	Facilitate engineering of embedded and cyber physical systems (ECPS), enabling digitalisation through the feasible and economically accountable building of larger software-enabled systems with desired quality . This layer covers new applications of ECPS, continuous integration and deployment, ECPS engineering and management across their lifecycle, including sustainability aspects. Starting from integrated hardware systems, this layer provide the embedded software (OS, libraries, virtualisation, middleware, etc.) required to produce fully functioning embedded and cyber physical systems.	Embedded software represents one of the key enablers of embedded intelligence. Embedding data analytics and artificial intelligence in devices allow to process data on the edge, take decision on the edge, optimise operations, dynamically adapt and improve the cooperation between ECPS and sustainability. This layer provides also software support for AI-specific hardware, machine learning and federated intelligence on the edge.	ECPS are, for the vast majority, connected and this layer provides them with all the elements required to ensure field connectivity, inter-system communications and the capability to interact with cloud platforms. These elements are key to enable the composition of ECPS in SoS, and also for the inclusion of legacy systems.	Software engineering is exceeding the human scale, meaning it can no longer be overseen by a human without supporting tools: current and future ECPS, due to their complexity, require continuous hardware-software integration, both at component and system level. Continuous and automated engineering extends also to ECPS deployment and to their entire lifecycle. These necessities increase when considering embedded AI and new computing paradigms (e.g. neuromorphic).	Trust represents one the strongest barriers for the acceptance of ECPS and it must be ensured in embedded software, in particular for embedded AI. Trust should be ensured by design, and by ensuring it becomes an interdisciplinary solution because, at this level, many technology aspects converge in a single system: hardware, different layers of software, connectivity, development tools, etc. The quality of embedded software also plays a key role in ECPS.
1.2 - COMPONENTS, MODULES AND SYSTEMS INTEGRATION	Multidomain engineering for physical and functional heterogeneous integration of several functionalities into new physical entities at components, modules and system levels. Heterogeneous integration spans SoC, System-in-Package and larger modules and systems, including flexible electronics and photonics solutions. This layer generates hardware integrated systems including low level software (e.g. firmware and operating system drivers).	Smart components, modules and systems are the hardware key enablers for the embedded intelligence. The focus is on integrating machine learning and artificial intelligence on the sensor, module and systems level. New advanced, efficient and specialized processing architectures (based on CPU, embedded GPU, accelerators, neuromorphic computing, FPGA and ASICs) to increase the edge computing performances and reduce power consumption. Low level software support to enable AI-based data analytics is provided.	Connectivity solutions (communication modules & interfaces) that are needed in networked embedded and cyber physical systems (ECPS). Focus is on providing real-time, low-latency, low-power for edge and IoT devices, photonics communications, high-speed 5G and beyond 5G/6G connectivity, and quantum technology preparing the path towards the quantum internet.	Design and simulation methods that enable and support multi-physics and multimodal design, simulation, manufacturing and testing must be addressed (e.g. modelling and design tools for thermal, mechanical and electrical characteristics in small 3D packages). Focus cover also lifecycle engineering for optimized use for materials, for components, modules and systems condition monitoring, predictive maintenance, and to improve their recyclability.	Growing complexity of smart components, modules and systems represents a reliability challenge which requires the continuous improvement of existing methods (e.g. design for reliability) and development of new techniques (e.g. prognostic health management) for reliable ECS. The area also focuses on solutions for ensuring secure integration of systems, sensor level hardware and software security, privacy and data trustworthiness and AI Hardware safety.
1.1 - PROCESS TECHNOLOGY, EQUIPMENT, MATERIALS AND MANUFACTURIN	Semiconductor process technology, equipment, materials and manufacturing form the base of the ECS value chain and, from Single chip (e.g. Si, more Moore), more than Moore technologies (photonics, MEMS/Sens, Bio, etc.) and System on a Chip, they produce the chips (Packaged Single Chip, System in a Package, Packaged SoC) and packaged chip-level building blocks (SoC and Single Chip, Packaged Devices in Board) for all digital applications.	AI adoption covers both the electronic components and their manufacturing process. Add intelligence close to the sensors (Intelligence at the edge) and/or to the data sources (IoT), and integrate the components in a form factor that perfectly suits their applications. Use AI in the operation of semiconductor fabrication, to master complexity, increase reliability, shorten time to stable yield, improve quality, productivity, sustainability, resource saving volume production of semiconductors	Provide process technologies and electronic components required for ECS hyper-connectivity, including 5G/6G communications, advanced RF and photonics communication technologies to interface between semiconductors components, subsystems and systems.	Electronic design and automation methods and tools required to support the use of nanomaterials and metamaterials, the design and manufacturing process of future nano-scale semiconductors and electronic components, including assembly and packaging of electronics on flexible substrates. Production tools for heterogeneous integration and to support flexible, sustainable, agile and competitive high-volume high- quality semiconductor manufacturing are also considered.	End to end security starts from semiconductors. New technologies to address security at silicon level are considered, including application-specific logic, heterogeneous SoC, security by design, etc. Quality and reliability in the semiconductor production are also considered, focusing on maximising quality KPIs, monitor the process with AI, early detect yield/reliability issues, qualify the parameters that influence HW reliability, adopt design for reliability, prognostics health management of ECS etc.

KEY APPLICATION AREAS

3.1 - MOBILITY

Mobility is a basic human need and Europe's mobility industry is a key contributor to it, with a significant share in the global market in all mobility sectors (automotive, aerospace, maritime and rail). ECS take a fundamental role in mobility innovation for the final user, the society, the ecosystem and for European companies. The Green Deal and digitalisation are significantly influencing mobility, oriented to the reduction of CO_2 and other emissions (with electrification, alternative fuels but also more energy- and cost-efficient electronic and optoelectronic components, interconnected intelligent systems and AI-based embedded software), and to ensure an inclusive safe and secure mobility (e.g. with smart perception, affordable, safe and environmentally neutral light mobility, automated on- and off-road vehicles, and smart mobile machinery). The mobility market is increasing integration of automation functions, to evolve towards connected, cooperative and automated mobility, where ECS are essential building blocks, bringing to partial or fully automated vehicles: the focus is on affordable, automated and connected mobility for passengers and freight on road, rail, air and water, on tools and methods for validation and certification of safety, security and comfort of embedded intelligence in mobility, and on real-time data handling for multimodal mobility and related services.

3.2 - ENERGY

The Energy chapter focuses on the challenges of a society and industry more and more based on electrical energy, addressing energy generation, supply, conversion, and use, aiming at developing highly efficient, reliable and secure solutions to achieve a carbon neutral society by 2050. The chapters cover smart and efficient solutions to manage energy generation, conversion, and storage systems, solutions for the energy management from on-site to distribution systems, for future transmission grids, for a clean, efficient and resilient local energy supply and for energy systems monitoring and control. ECS play a central role for these solutions and, in conjunction with 5G, IoT, AI, and cloud-edge computing, will strengthen the position of leading European companies in smart energy related markets (e.g. for electrical drives, grid technologies, and decentralised renewable energy sources). ECS increase also sustainability, improving the smooth implementation, integration and use of renewable energy resources and lowering the costs through new materials and semiconductors, new device architectures, innovative new circuit topologies, architectures, and algorithms, the total system cost can be lowered. ECS ensure a competitive, self-sufficient and efficient energy transmission and consumption in the EU, supporting decentralized intermittent energy sources, bi-directional grid and storage systems, and distributed AC/DC network and grid technologies.

3.3 - DIGITAL INDUSTRY

The Industry 4.0 have a profound impact on how factories, construction zones and processes are managed and operated. Powerful networked digital solutions are needed to support discrete manufacturing (e.g. manufacturing of automobiles, trains, airplanes, satellites, white goods, furniture, toys and smartphones), process industries (e.g. chemical, petrochemical, food, pharmaceuticals, pulp and paper, and steel), provisioning, and also production services, connected machines and robots. Emphasis is also given to any type of factories, productive plants and operating sites, value chains, supply chains and lifecycles. ECS and digitalisation represent a key enabler for the future success of European industry sector and this chapter focuses on their adoption for the development of responsive, smart and sustainable production, artificial intelligence in digital industry, industrial services, digital twins and autonomous systems and robotics. The objective is to increase the level of automation, digitisation and decision making, to support demand-driven and agile production, condition monitoring and maintenance, to improve sustainability through energy, waste, material, recycling optimisation, to improve production and supply chains resilience and responsivness, and to strengthen key European value chains with digital infrastructures and added value services based on ECS.

3.4 - HEALTH AND WELLBEING

The healthcare industry is facing a radical change, enabled by its current digital transformation in combination with a change towards a personalized medicine, the so called P4 healthcare (predictive, preventive, personalised, participatory). Related developments in healthcare electronics, healthcare data and healthcare technologies will progressively generate a new ecosystem positioning the "healthcare consumer" at the centre of the value chain. The ecosystem will rely on digital instruments, advanced electronic sensors and photonics, micro-electromechanical systems (MEMS), and the large volume, high-quality, low-cost production capabilities of the ECS industry. ECS will play a key role to enable the development of tools, data, platforms, technologies and processes for improved prediction, prevention, interception, diagnosis, treatment and management of diseases. The objectives include a better understanding of the determinants of health and priority disease areas, a reduction of the fragmentation of health R&I efforts bringing together health industry sectors and other stakeholders, the creation of people-centred digital health platforms based upon P4 healthcare, the exploitation of digitalisation and data exchange in health care, the development of the home as the central location of the patient, the development of a more integrated care delivery system and the creation of solutions to ensure more healthy life years for an ageing population.

3.5 - AGRIFOOD AND NATURAL RESOURCES

Electronic components and smart systems are vital for the sustainable production and consumption of safe and healthy food, for sustainable practices in agriculture, livestock, aquaculture, fisheries and forestry, access to clean water, fertile soil and healthy air for all, and also to preserve biodiversity and protect the planet's ecosystems. This chapter focuses on ECS-based technologies (e.g smart IoT solutions, traceability frameworks, robots, drones, AI) to ensure livestock and crop health, and also to farming systems and food supply chain assurance, food production and management. ECS are also at the base of soil health, air quality and environment smart integrated monitoring solutions, as well as of smart waste management systems and remediation methodologies. Moreover, the chapter focuses on the key role that IoT systems can play in water quality monitoring, manage and access to clean water, including the smart treatments of wastewater, rainwater and storms/floods. Finally, the chapter covers ECS-based solutions for biodiversity restoration and ecosystem resilience, conservation and preservation, to ensure the natural sustainability of healthy ecosystems and their resources (agriculture, aquaculture, fisheries and forestry). The objectives of the chapter are aligned with the key Horizon Europe missions and with the European Green Deal.

3.6 - DIGITAL SOCIETY

Digital Society chapter covers digital innovations that are essential to stimulate an inclusive and healthy society, contributing to solutions for European challenges in the fields of health, mobility, security, energy and the climate, and consequently to European economic prosperity. Europe needs digital solutions that support the individual, and at the collective level to empower society as a whole. These (smart) digital solutions will be driven by new technologies such as 5G, Artificial Intelligence with deep learning, virtual and augmented reality, brain–computer interfaces and robotics. They will shape new ways of how people use and interact with these technological solutions, with each other, and with society and the environment. Digital innovations should facilitate individual self-fulfilment, empowerment and resilience, collective "inclusion" and safety, as well as supportive infrastructure and sustainable environment. The ethical aspects of the digital transformation are also considered, trying to address societal concerns in a sustainable way, guaranteeing participation and reducing inequality. A human-centred approach is therefore a key aspect of the EU's approach to technology development. It is part of European social and ethical values, (social) inclusiveness, and the creation of sustainable, high-quality jobs through social innovation.

LONG TERM VISION

The Long Term Vision chapter addresses research subjects to enable and support effective development of European industry in about a decade from today. The chapter build upon the challenges identified by the ECS-SRIA and specify long-term industrial needs. These needs are the basis for research programs for effective research and development in appropriate technological and/or application domains, so that European technological strength increases continuously in time and at the appropriate pace. Since lead-time from a first scientific breakthrough (TRL1) to market presence of related products (TRL9) is about 10 years, the effective identification of the future industrial needs is a determining factor for the success and speed of innovation. The Long Term Vision is shaped by three main factors: technology, application domains and policies. Clearly, all factors are drivers of innovation, because (i) anticipated technological advances lead to innovative applications of these advances and (ii) user needs lead to technological innovations that enable these needs. At the same time, policies and politically established goals and processes lead technologies and applications towards common goals and targets such as the goals of the Green Deal and the European industrial competitiveness. It is apparent that, each of these factors motivates, shapes and initiates innovation efforts at many levels.

Chapters general structure

E C S
Electronic Components and Systems

- Scope
- Technology-enabled societal benefits
- Strategic advantage for EU
- Major challenges
  - Major challenge X.Y.Z
    - State of the Art
    - Vision & Expected Outcome
    - Key Focus Areas
- Timeline diagrams
- Synergies with other themes

What is the chapter covering?

What are the application breakthroughs enabled by technology advances?

What are the societal benefits?

Why is it strategic for EU? What are the market figures? And the impact on the industry sector?

What are the main challenges and key focus areas the projects should address?

MC are the key elements of open call and focus topics calls

MC can be derived from application-related requirements, or from societal / strategic needs (e.g., sustainability, sovereignty)

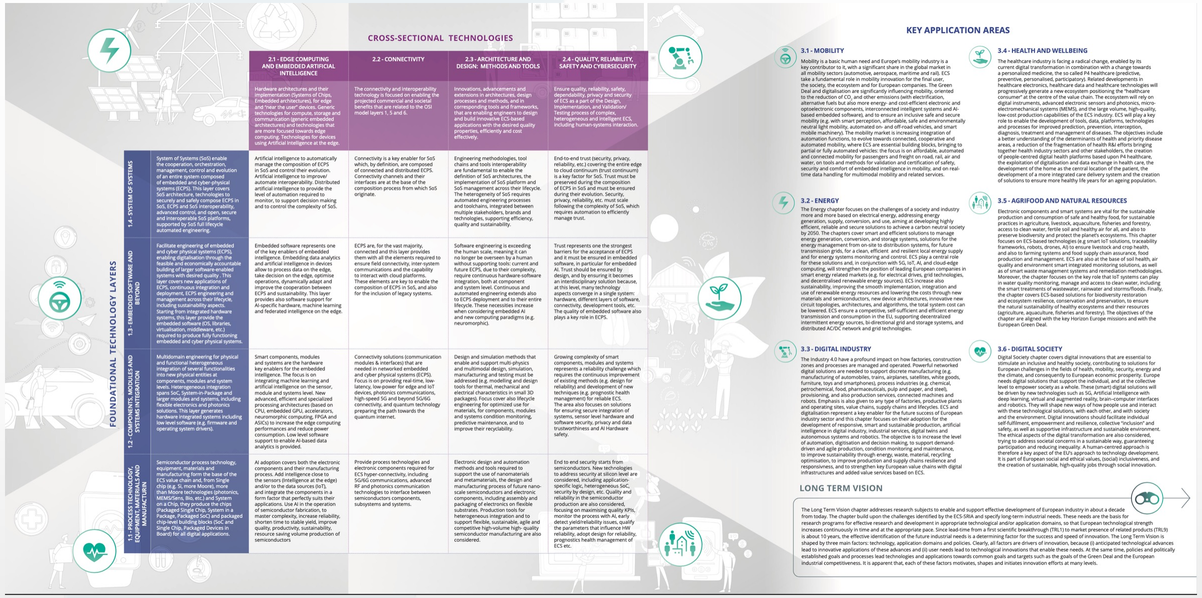
Temporal dimension & TRL information

Interdisciplinarity & technology dependencies

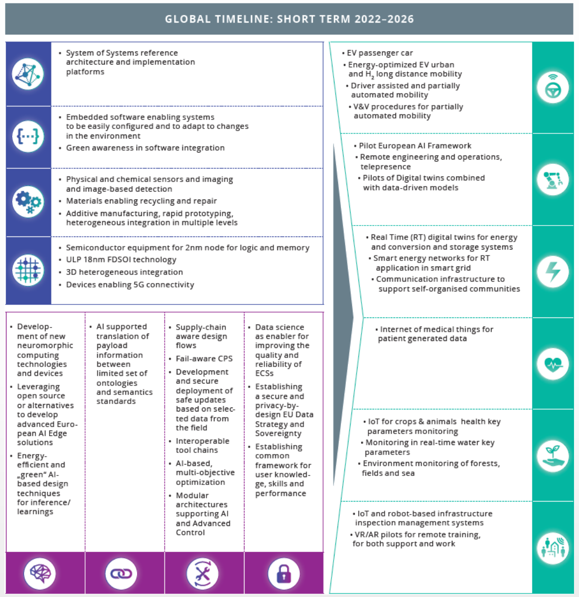
ECS-SRIA "Tools"

Electronic Components and Systems

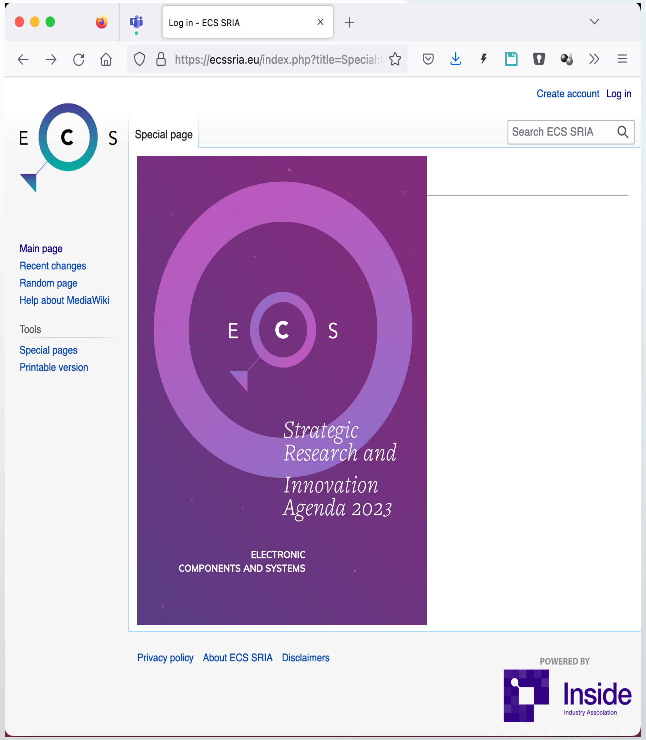
ECS-SRIA Outline



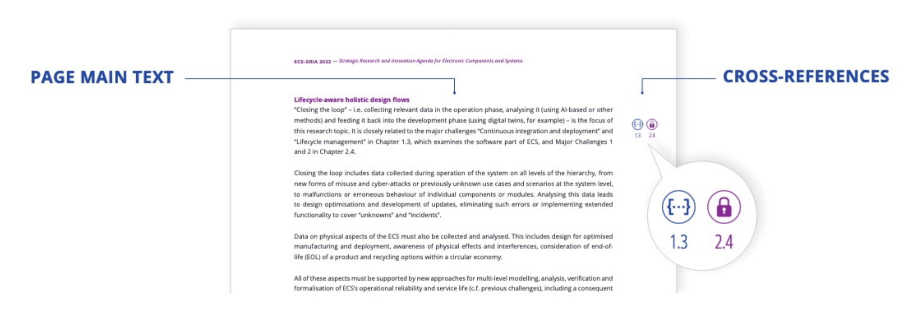
Global timelines



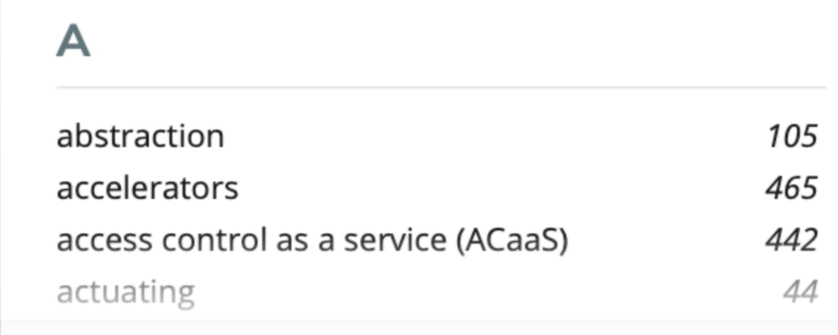
SRIA Web Site

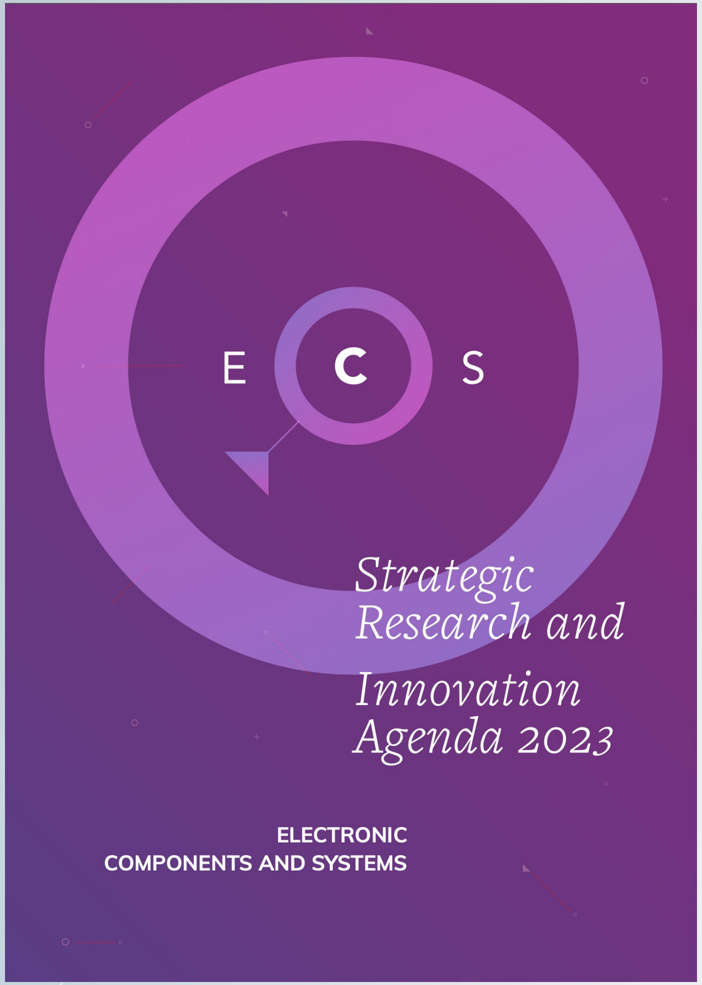


Cross-references



Keywords index





Thanks for the attention

E C S
Electronic Components and Systems