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ECSEL means Innovation in - and by means of - Electronic Components and Systems. Electronics is central to virtually all innovations in business and society, and it is constantly pushing the limits of technology. And that is hard. From nano-scale semiconductor chips with features counted in atoms to the 100-million lines of software code in a modern car, the technology stretches the limits of our knowledge and creativity, yet it must always function perfectly (think "medical instrument" or "passenger airliner" and you’ll know what this means…).

To make this plethora of problems tractable, ECSEL’s strategy follows that of the European Electronic Components and Systems industries’ common Strategic Research Agenda. This leverages on Key Enabling Technologies as essential capabilities on the one hand, and on the other the key applications with important business and social impact. In this way, the common issues of technology development can be shared, while the specific needs of important applications are addressed. Together, these developments prepare the leap across the void between research and the creation of economic and societal added value. (In addition, each project shows its approximate total costs and the funding received at both national and EU level.)
ADACORSA targets to strengthen the European drone industry and increase public and regulatory acceptance of BVLOS (beyond visual line-of-sight) drones, by demonstrating technologies for safe, reliable and secure drone operation in all situations and flight phases.

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The project will drive research and development of components and systems for sensing, telecommunication and data processing along the electronics value-chain. Additionally, drone lead smart industries with high visibility and place for improvement will be developed which will pave the way for a higher public/industry acceptance of the drone technologies.

In particular, ADACORSA will deliver:

- On the component level, functionally redundant and fail-operational radar and LiDAR sensors as well as 3D cameras. In order to reduce risk, time and costs, the project aims to adapt technologies from the automotive sector to the drone market for these components.

- On the system level, hardware and software for reliable sensor fusion and data analytics as well as technologies for secure and reliable drone communication using multipath TCP and registration and identification by developing platforms based on eUICCs/eSIM.

- On an architecture level, fail-operational drone control and investigation a pre-operational Flight Information Management System (FIMS) the integration with COTS components for Unmanned Air Vehicle Traffic Management System (UTM).

- Within the project, 35 physical as well as virtual demonstrators of BVLOS, long-range drone flight shall pave the way toward certifiable systems for future integration of drone operations.

ADACORSA's innovations will leverage the expertise of a very strong consortium, comprising world renowned industrial (OEMs, Tier-1, Tier-2 and technology providers) and research partners along the complete aviation, semiconductor and also automotive value chains, providing Europe with a competitive edge in a growing drone and drone technologies market.
In Dec 2019, the European Commission presented a roadmap for making the EU’s economy sustainable, turning climate and environmental challenges into opportunities across all policy areas and making the transition just and inclusive for all. AI4CSM sets its foundations in this European Green Deal and directly contributes to Clean, Connected and Shared Mobility.

Growing urbanization needs novel mobility concepts, which can be achieved by digital technologies connecting traffic and resources through high autonomy and automatization of vehicles. Such new mobility platforms require alternative paradigms for resource efficiency and sustainable productivity, decoupling economic growth from the exploitation of resources and transforming itself towards a sustainable, circular economy.

AI4CSM will realize a novel architecture for ECS in electrical vehicles, needed when electro mobility becomes mainstream (i.e., more than 50% of vehicles are electrically driven), driving digitalisation to foster mobility as a service, and connected, shared operation.

The project will develop functional architectures for next-generation electric vehicles (EVs) based on ECS, embedded intelligence and functional virtualization for connected and shared mobility. This mission applies to different mobility sectors, including the automotive and semiconductor sectors as well as to wider society. AI4CSM results will enable future mobility solutions by providing new electronic components and systems for advanced perception, efficient propulsion and batteries, advanced connectivity, new integration platform concepts and intelligent components based on trustworthy AI.

**AI4CSM**

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<td>Duration</td>
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The industrial revolution we are witnessing is driven by increasing complexity, automation, more intelligence and continuous focus on optimization. Today, Artificial intelligence (AI) accelerates this transformation by remodelling industries with new processes and capabilities, enabling enhanced product control and development. Intelligent machines, better diagnostic tools, and robots can help observe, analyse, and learn from vast amounts of data, extending and supporting humans in complex environmental situations.

AI4DI's mission is bringing AI from the cloud to the edge and making Europe a leader in silicon-born AI by advancing Moore's law and accelerating edge processing adoption in different industries through reference demonstrators.

AI4DI objective is to research and develop AI technologies implemented to different industrial sector applications and deployed under conditions as close as possible to real-life. The project aims to enhance processes based on repetitive tasks, focusing on replacing process identification and validation methods with intelligent technologies across industries such as automotive, semiconductor, machinery, food and beverage, and transportation.

AI4DI is building a roadmap on AI-based technologies, exploitation studies, business cases that are supporting accelerating the adoption of AI hardware (HW) and software (SW) solutions by the European industry for approaching its most urgent priorities in digitisation and moving the intelligence to the edge and providing new distributed reference architectures that are aligned with the industrial requirements. Growing data factors cause the demand for high AI performance (e.g., data quality) and industrial factors (e.g., moving from linear to network-based manufacturing processes), AI4DI is developing industry-grade AI technologies, tailored to the European industry’s specific needs based on various industrial sectors' requirements and specifications.

AI4DI provides a high-level reference hybrid system architecture for the digitising industry and defines the different building blocks, functions, interactions, and workflows based on AI and IIoT solutions for seamless integration and scalability. The hybrid system architecture is applied to distributed and heterogeneous systems as reflected by the AI4DI applications in the different sectors.

The project’s ultimate goal is to provide AI-based technologies at the edge for digitising the industry by reducing costs, save time, optimising/improving processes/products/services, increasing quality by enhancing industrial processes, and built and sustain a dynamic AI technology ecosystem in Europe.
AIDOaRt focuses on AI-augmented automation supporting the continuous development of Cyber-Physical Systems (CPSs) in its phases, such as requirements, monitoring, modelling, coding, and testing. The growing complexity of CPS poses several challenges throughout all software development and analysis phases, but also during their service and maintenance life.

Many are envisaging tomorrow’s automation of to be brought about by Artificial Intelligence (AI) technology. While the number of companies that invest significant resources in software development is constantly increasing, the use of AI in design and development and is still immature.

AIDOaRt will develop a model-based framework to support teams during the automated continuous development of CPSs by means of integrated, AI-augmented solutions. The overall AIDOaRt infrastructure will work with existing data sources, including traditional IT monitoring, log events, along with software models and measurements. The infrastructure is intended to operate within the DevOps process, combining software development and information technology (IT) operations. Moreover, AI-based technological innovations must ensure that systems are designed responsibly and contribute to our trust in their behaviour (i.e., requiring both accountability and explainability).

AIDOaRt results are designed to impact organizations where continuous deployment and operations management are standard operating procedures. DevOps teams may use the AIDOaRt framework to analyse event streams in real-time and historical data, extract meaningful insights from events for continuous improvement, drive faster deployments and better collaboration, and reduce downtime with proactive detection.
In all lighting sectors, warranty and customisation are becoming key product differentiators. In addition, the integration of more electronics and sensors in lighting systems will change what we call ‘lighting’ today.

While the concepts of digitalisation and Industry 4.0 are progressing fast into the manufacturing world, front-end product design in the lighting industry still uses traditional simulation techniques, while the back-end struggles to use all the data generated by sensors. An innovative approach is to couple digital twins with Artificial Intelligence to offer unlimited possibilities to the “first build and then tweak” approach.

AI-TWILIGHT will merge the virtual and physical worlds to pave the way for innovations in fields where the European lighting industry is likely to be competitive. Self-learning digital twins of lighting systems (LED source, the driver of a lighting application) using AI and analytics techniques will be created and used as input for predicting performance and lifetime of autonomous product and infrastructure design and management. Tests will be carried out in selected application domains e.g., automotive, horticulture, general and street-lighting.

Translated to business goals, AI-TWILIGHT will result in 20% increase in the introduction of more customised and connected products while reducing the time to market by 30% and reducing by 25% the total cost of ownership of an AI-TWILIGHT powered system. The project will also promote extensive energy savings (of around 30-40%, depending on domain) by enabling optimally designed luminaires with higher efficacy and longer foreseen useful lifetime, as well as through intelligent control of lighting.

Start date         1 June 2021
Duration                                                                  36 months
€M Total costs / EU / National                    18 / 18.5 / 5.3
Number of participants                                                     24
The APPLAUSE project focuses on developing advanced packaging and assembly technologies for combined electronics, optics and photonics, targeting high-volume, low-cost manufacturability. New methods, processes, and tools will be developed for automated high-volume manufacturing for this type of advanced packaging – addressing current limitations for optics and photonics.

APPLAUSE consists of 12 large enterprises, 11 small and medium-sized enterprises (SMEs) and eight research and technology organisations from 11 countries. The consortium comprises a number of leading European expert organisations from electronics packaging companies and research organisations representing different value chain levels related to advanced packaging and smart system integration. The parties have complementary expertise in concept creation, design, packaging, testing and manufacturing of electronic components, as well as understanding from a wide range of markets and needs of end users. The unique European ecosystem established within the APPLAUSE consortium represents the competitive, leading edge of the technologies available and will increase Europe’s resilience and expertise in the sector.

The expected technology innovations include ultra-thin wafer and die handling, high precision photonic packaging, bonding technologies for sensitive optics components, medical and biocompatible photonic packaging, molding and 3D integration for optical component manufacturing, metrology methods and tools for advanced packaging as well as development of test concepts, test equipment platforms and failure analysis to combine the reduced device size and the tightening alignment specifications.

This newly developed technology will be piloted in six industrial use cases, taking the technology towards manufacturability, and ensuring short time-to-market. These use cases are: a substantially smaller 3D integrated ambient light sensor for mobile and wearable applications (ams AG, Austria); a high performance, low cost, uncooled thermal IR sensor for automotive and surveillance applications (IDEAS, Norway); high speed datacom transceivers with reduced manufacturing costs (DustPhotonics, Israel); a flexible cardiac monitoring patch (Precordior, Finland); miniaturized cardiac implants with advanced monitoring capabilities (Cardiacs, Norway); and an optical humidity measurement module with cost-effective packaging of components (Vaisala, Finland).

Through the APPLAUSE project, European industry will build on the European expertise in advanced packaging and assembly to develop new processes and related process equipment, process control equipment, and simulation and test methods for high volume manufacturing of advanced packages combining semiconductors, optics and photonics.

APPLAUSE

Start date         1 May 2019
Duration                                                                  36 months
€M Total costs / EU / National                   34.5 / 8.6 / 5.3
Number of participants                                                      31
Vehicle automation is emerging in many forms and has many social implications. In order to take full advantage of emerging technologies, the electric, connected and automated (ECA) vehicles need to be trustworthy. People must feel safe and want to use and buy new services that ECAs open up to them. Consequently, there is a strong need for an independent and reproducible validation of automated vehicles even though it have to dial with non-deterministic elements.

The vision of ArchitectECA2030 is to provide a harmonized pan-European validation framework enabling mission-oriented validation of electronic components and systems (ECS) for electric, connected and automated (ECA) SAE L3 to L5 vehicles to improve reliability, robustness, safety and traceability.

The ArchitectECA2030 is working on several goals:

- To manage failure modes, uncertainties, and failure probabilities, propagating through the entire ECA vehicle stack consisting of on-board HW, on-board SW, off-board SW and data, development and validation methodologies, to support hazard identification, risk analysis, and sufficient risk mitigation.

- To develop a widely agreed homologation framework, comprised of harmonized methods, tools, and processes able to handle dynamic requirements (e.g. new scenarios, untested events, online traffic data etc.), provided by the in-vehicle monitoring device, to ultimately design safe, secure, and reliable ECA vehicle with a well-defined, quantified and acceptable residual risk across all ECS levels. The residual risk relies on the failure risks of each single semiconductor, electronic component, subsystem, and system used to build ECA vehicles.

- To propose, align and develop a concept, for an in-vehicle monitoring device, which is able to indicate and measure the health status and possible degradations of the functional electronics and electronic systems enabling predictive diagnosis, maintenance, and re-configuration of embedded SW.

- To bring together the representative stakeholders from ECS industry, standardization and certification bodies (Europe, US, Asia), governments, test field operators, and academia in tight interaction with the lighthouse initiative Mobility.E and its LIASE group to influence emerging standards, validation and homologation procedures for ECA vehicles and contributing to the emerging UL 4600 which is based on ISO 26262 and ISO/PAS 21448 (SOTIF).
The road to industrial digitalisation is still long and winding, mainly due to the unpredictable cost and utilisation efficiency of various architectural choices. Arrowhead Tools is a very ambitious project which will bring innovative digitalisation and automation solutions for European industry, closing the gaps that hinder IT/OT integration. By introducing new technologies in an open source platform for design and run-time engineering, Arrowhead Tools renders the efficient development of IoT and System of Systems tractable.

These gaps will be addressed by four major components of the Arrowhead Tools concept:

- Provision of a mature service integration platform providing extensive interoperability between IoT services and legacy technology, together with management capabilities for dynamic configuration and orchestration of System of Systems solutions.
- Provision of efficient procedures, tools and integrated tool chains for engineering, of service platform-based digitalisation and automation solutions in both design time and run time.
- Provision of training material (HW and SW) for upgrading of industry personnel.
- Feasibility verification of the above procedures, technologies and materials through demonstrators in a wide range of applications use cases, each with clearly identified exploitation potential.

A successful execution of the Arrowhead Tools concept and approach is expected to significantly reduce the overall engineering cost for digitalisation and automation solutions. Such solutions will impact our society in a way where our society is increasingly and seamlessly sharing information for benefit of e.g. production efficiency, energy efficiency, transportation efficiency, and environmental footprint. To a large extent, Software technology supporting System of Systems integration is the enables for the emerging SoS market. The total SoS market growth from 2016-2025 from 500B€ to estimated 3.900B€-11.100B€ it is expected that Arrowhead Tools will positively impact both the global growth rate and the European competitive position.
BEYOND5 will build a completely European supply chain for Radio-Frequency Electronics enabling new RF domains for sensing, communication, 5G radio infrastructure and beyond. It is a technology project gathering most significant European actors covering the entire value chain from materials, semiconductor technologies, designs and components up to the systems.

The project strives to bring together mobile broadband (5G), the Internet of Things (IoT) and automation connectivity for self-driving cars in a single technology platform based on the most advanced SOI technologies manufactured in Europe, namely RFSOI and FDSOI.

BEYOND5 aims to manufacture SOI components in Europe (three pilot lines in two European countries), to aggregate the value chain to demonstrate added-value of the technology at the user level (six demonstrators) and to reinforce a design ecosystem in Europe using these platforms. The project covers the whole RF SoI value chain. The substrate and IC manufacturers closely cooperate with designers, chipset and system providers, test instrument suppliers and end users to enable high performance and low cost RF components in proper time and volume and accelerate the Time-to-Market.

BEYOND5 will drive industrial roadmaps in More than Moore (MtM) in adding connectivity features on existing CMOS Technology. The ambition is to accomplish sustainable Radio Frequency SOI platforms to cover the frequency range from 0.7GHz to more than 100GHz, and to demonstrate the technical advantage of SOI, which allows combining large scale integration, low power consumption, cost competitiveness and higher reliability; thus, resulting in high volume production of trusted components with low environmental impact in Europe.

**BEYOND5**

**Start date** 1 June 2020  
**Duration** 36 months  
**€M Total costs / EU / National** 97.5 / 25 / 10.4  
**Number of participants** 40

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By lowering the barriers for utilizing edge computing for artificial intelligence applications, BRAINE will open the door for European SMEs to leverage state of the art technologies, driving their development and growth as industry leaders in their sectors. The BRAINE project's overall aim is to boost the development of the Edge framework and, specifically, energy efficient hardware and AI empowered software systems, capable of processing Big Data at the Edge, supporting security, data privacy and sovereignty. BRAINE's overall aim will be reached by targeting five fine-grained goals:

- Devising an EC infrastructure that offers control, computing, acceleration, storage, and 5G networking at the Edge and excels in scalability, agility, security, data privacy, and data sovereignty in Big Data and AI for low latency and mission-critical applications.
- Developing a future-proof Edge security framework and associated infrastructure, based on the latest software and hardware security technologies.
- Developing a distributed and partly-autonomous system that takes data privacy and sovereignty into account on each and every decision regarding workload placement, data transfer, and computation, while guaranteeing interoperability with the environment.
- Developing a heterogeneous, energy efficient Edge MicroDataCenter, suitable for stationed, mobile, and embedded autonomous applications, that goes beyond the current hardware and software architectures and offers Big Data processing and AI capabilities at the Edge.
- Testing and demonstrating the effectiveness and generality of the BRAINE approach by evaluating multiple real-world use cases and scenarios that exhibit the required scalability, security, efficiency, agility, and flexibility concerns.

BRAINE provides a new vision for utilizing edge resources by providing novel network-edge workload distribution schemes. Predicting resource availability and workload demand, identifying trends, and taking proactive actions are all aspects of the novel workload distribution. The workload distribution technology developed in the context of BRAINE can be transferred to many other edge/fog computing environments to achieve different goals. Last but not least, BRAINE will have an important positive impact on the environment. Through BRAINE, edge computing can reduce this projected energy consumption by offloading many of the AI functions next to the end-users.

### BRAINE

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<td>€M Total costs / EU / National</td>
<td>16 / 5 / 4.8</td>
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Start date: 1 May 2020
Duration: 36 months
€M Total costs / EU / National: 16 / 5 / 4.8
Number of participants: 28
Digitalization has been identified as one of the key enablers for renewal and competitiveness of European manufacturing industries. However, grasping the digitalization and IoT-related opportunities can be limited by the harsh environmental conditions of the manufacturing processes and end use environments. The ECSEL JU project CHARM aims to contribute to solving this problem by developing ECS technologies that tolerate harsh industrial environments. The project centres around real industrial challenges from different types of end use industries. The synergies and impacts arise from similarities in technology solutions serving different applications and industry sectors.

The CHARM Use Cases include six different industry sectors, majority of them presented by innovative cutting-edge large enterprises that belong to the worldwide market leaders of their own sectors - while most of them being new to the ECSEL ecosystem: mining, paper mills, machining, solar panel manufacturing lines, nuclear power plants maintenance and decommissioning, and professional digital printing. The planned demonstrators engage these big actors within European ECS value chains and showcase capabilities that serve manufacturing industries’ needs at large. The new technologies which will be developed within this new project include novel multi-gas sensors, robust high temperature and pressure sensors, flexible sensors for paper machine rolls, wireless power transfer systems, connectivity solutions for rotating parts, advanced vision systems, and enablers for autonomous driving. These will be packaged with beyond the state-of-the-art packaging technologies to withstand the harsh conditions and demonstrated in Use Cases.

The project consortium includes 12 SMEs, 14 LEs and 12 RTOs, and covers the industrial value chains from simulations, sensors and components to packaging, integration and reliability as well as connectivity, cloud and cyber security solutions.

The planned activities go beyond the state of the art, contributing to the leadership of European ECS ecosystem, fostering it not only by the new knowledge and competitiveness, but also by providing new business opportunities and value chains within European markets. Simultaneously, CHARM fosters the manufacturing industries by enabling new digitalization capabilities as well as new contacts to European ECS community that can deliver the needed solutions.


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### CHARM

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Drones can perform air operations that manned aircraft struggle with, and their use brings significant economic savings and environmental benefits whilst reducing the risk to human life. Drone-based service and product innovation, driven by increased levels of connectivity and automation, is limited by the growing dependence on poorly interoperable, proprietary technologies, and the risks posed to people, to other vehicles and to property.

This issue has a high impact on European innovation, which demands R&D investments and incentives for the convergence of shared technologies and markets as a remedy. Actions creating globally harmonized, commercially exploitable yet widely accessible R&D ecosystems should be publicly performed.

Complementing existing European efforts, COMP4DRONES is an ECSEL JU project coordinated by Indra that brings together a consortium of 50 partners, with the aim of providing a framework of key enabling technologies for safe and autonomous drones. In particular, COMP4DRONES will leverage composability and modularity for customizable and trusted autonomous drones for civilian services. The project takes into account recent regulation developments in this area from EASA. The project will also consider the SESAR-JU studies concerning civilian drones, and will adhere to the U-space approach and protocols when available. COMP4DRONES will carry a holistically designed ecosystem ranging from electronic components to application, realised as a tightly integrated, multi-vendor and compositional drone architecture, complemented by a tool chain addressing the compositional architecture principles. The ecosystem aims at:

- supporting efficient customization and incremental assurance of drone embedded platforms,
- safe autonomous decision-making concerning individual or cooperative missions,
- trustworthy drone-to-drone and drone-to-ground communications, even in presence of malicious attackers and under the intrinsic platform constraints, and
- agile and cost-effective compositional design and assurance of drone modules and systems.

COMP4DRONES will also build an open, sustainable ecosystem around public, royalty-free and goal-driven software platform standards that will ease the development of new drone functionalities for multiple application domains, driving ecosystem development and benchmarking on the fields of transport, inspection, logistic, precision agriculture, parcel delivery.
In recent years, Cyber Physical Systems (CPS) technologies have become a game changer in strategic sectors where Europe is a world leader, such as Automotive, Energy and Industry Automation. In fact, CPS is a key driver for the innovation capacity of European industries, large and small, generating economic growth and supporting meaningful jobs for citizens.

In parallel to the product performance improvement linked to the implementation of the CPS, the technical complexity of the systems developments has significantly increased. Additional constraints related to safety, security, or GDPR, have also impacted the Research And Development Efforts and the Time To Market for these new products.

CPS4EU aims to arm Europe with an extensive value chain across key sectors by strengthening CPS Technology providers - mainly European SMEs - to increase their market share and their competitiveness to become world leaders. The project will improve design efficiency and productivity as well as secure certification. It will also enable the creation of innovative European CPS® products that will strengthen the leadership and competitiveness of Europe by both large groups and SMEs.

To achieve these goals, CPS4EU will develop 5 key enabling technologies: Computing, Connectivity, Sensing, Industrial Edge Computing, and Cooperative Systems. These CPS modules will be incorporated through pre-integrated architectures (PIARCH) and design tools. The project will instantiate these pre-integrated architectures in dedicated use-cases from strategic applications: automotive, smart grid and industrial automation, and improve CPS awareness and usage for all industry sectors.

CPS4EU gathers major large companies in the industry, a large set of innovative SMEs and research centres. This world-class consortium will significantly reduce the development time and certification efforts through pan-European collaboration, knowledge exchange and access to the strong value chain in strategic markets. CPS4EU builds on a strong foundation in both European and national initiatives, enabling European industry to lead strategic markets thanks to high-level sharing of CPS technologies across sectors along the value chain.
The use of artificial intelligence in edge computing, based on ubiquitous small and connected devices, is entering a new era. The results of the first era do not bode well for Europe; though often based on European inventions, the standards are set and most components are produced in other regions. DAIS will strengthen Europe’s position by putting European values at the core of the ECS components, that will shape this new era - self-organization, privacy by design and low use of energy - and delivering the technology needed to protect these values.

DAIS focuses on very early pan-European cooperation to ramp up the capabilities needed to deliver these new components. In order to complement huge IT leaders, cooperation from a very early stage is key. All partners in the project participate in delivering key parts of these new ECS components. The project will demonstrate the use of these components in three key industrial areas for Europe, providing the early examples needed to unlock corporate and external funding and deliver on the promise of this very exciting and challenging project.

The DAIS project will research, promote and deliver distributed artificial intelligence systems, as well as respective architectures, solving the problems of running existing algorithms on these vastly distributed edge devices. DAIS is organized around eight different supply chains, five focus on delivering the hardware and software that is needed to run industrial grade AI on different type of networking topologies, while three others will demonstrate how known AI challenges, from different functional areas, are met by this pan European effort.

With forty-seven parties from eleven different countries, DAIS fosters cooperation between large and leading industrial players from different domains, several highly innovative SMEs, and cutting-edge research organisations and universities from all over Europe. Each of the supply chains, in which the partners collaborate, delivers its findings for broader dissemination through a special work package to directly influence industrial standards. To address the take up of digital transformations and digital innovations it will be paramount to use open, international and public available standards. This will also support the SME industry with services to adopt new technology to increase interoperability of information technology, common enterprise-wide views of information, obsolescence of information technology and freedom from vendor lock-in.

The DAIS project aims to tilt in Europe’s favour the global competitive scale in this key ECS domain in Europe’s favour. The outcome will help European industry stay at the global forefront with many of its developed and manufactured components, including distributed AI enabling ones, proudly showing “Made in Europe” logos.
The complementary capabilities of different consortium partners will secure R&D results that lead to a higher competitiveness of them all. By 2030, the project is expected to generate an increased turnover of 700 M€, increased market share and/or market leadership for 20 partners, 100+ new collaborations, 200+ new jobs and 10+ M€ of additional investments. The consortium, half of who are SMEs, forms a squad of challengers, agile and hungry to grasp the huge business opportunities that emerge in the convergence of the two sectors, supported by large companies fostering the immediate business volume, and carefully selected RTOs. The consortium nucleates a new ecosystem of strongly interlinked value networks, the impact towards European competitiveness, growth and innovation capabilities ranging far beyond 2030.
Looking more like modern art than geometric shapes produced by mathematical algorithms, fractals are patterns in which similar repetitions exist at progressively smaller or larger scales. One could draw parallels between these and consciousness or cognition, which too emerges from different levels of organisation from subcellular to system level. In fact, fractals have numerous applications in natural and artificial systems. The value of complex fractal networks lies largely in the complexity they represent with unique simplicity, retaining the main features of the system via nodes and the interactions among them.

The EU-funded FRACTAL project is developing a computing node on which to base a cognitive fractal network capable of learning from and responding to its environment. It will support seamless, fast and reliable interaction between the physical world and the cloud for applications ranging from self-driving cars to remote medical procedures.

The objective of this research activity is to create a reliable computing node that will create a Cognitive Edge under industry standards. This computing node will be the building block of scalable Internet of Things (from Low Computing to High Computing Edge Nodes). The cognitive skill will be given by an internal and external architecture that allows to forecast its internal performance and the state of the surrounding world. Hence, this node will have the capability of learning how to improve its performance against the uncertainty of the environment.

As a result of the integration of these cognitive systems into a fractal network, there will be another, intrinsic crucial advantage, emergency and adaptability, new functions will flourish through the created space of possibilities of our cognitive Systems. This complex network will transfer all those cognitive advantages to the Edge, a computing paradigm that lay down between the physical world and the cloud.

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GaN4AP will make GaN-based electronics one of the main technology for active devices in all power conversion systems in Europe. A pervasive use of GaN electronics will allow the possibility of developing close-to-zero energy loss power electronic systems, an objective in line with the Energy Efficiency Directive of the European Commission.

In summary, the GaN4AP project will reach the following ambitious results:

- Development of innovative Power Electronic Systems for power conversion and management with advanced architecture and circuit topology, based on state-of-the-art GaN-based High Electron Mobility Transistors (HEMTs) available in a new concept high-frequency package that can achieve the requested 99% power conversion efficiency.

- Development of an innovative material (Aluminium Scandium Nitride, AlScN) which, combined with advanced growth and process solutions, can provide outstanding physical properties for highly efficient power transistors. Therefore, a new HEMT device architecture will be fabricated with much higher current (2x) and power density (2x) than existing transistors.

- Development of a new generation of vertical power GaN-based devices on MOSFET (Metal-Oxide Semiconductor Field-Effect Transistor) architecture with vertical p-GaN inversion channel for safe power switching up to 1200 V.

- Development of new, intelligent and integrated GaN solutions (SiICGaN) both in System in Package (SiP) and Monolithic variances, that will allow the design of novel E-Mobility power converters.

The development of new device technologies and innovative power circuits, employing the GaN-based devices is a crucial factor for the world-wide competitiveness of EU industries. This project will establish a strong European leadership in GaN-based devices technology. It will be able to strongly support the European industry in their research and development activities for increasing the reliability and yield of production processes for GaN on Si power devices, the exploitation of methods for advanced metrology and novel devices architecture, and at the simultaneous evaluation of the envisioned applications by the building of challenging demonstrators.
The new ways of smart driving and using a vehicle demand reliable and affordable versatile perception systems. These systems need to be accurate and trustworthy both for what can happen inside of the vehicle, as well as the outside of it. The driver and passenger monitoring, as well as the environment surrounding monitoring, must be improved to be failure-proof in all light and weather conditions.

For both of these topics, the extension of current perception systems (mainly based on visible imaging, Lidar and Radar detection) to the thermal sensing is a priority. Thermal sensing, especially in the LWIR (6 to 14 μm) bandwidth, provides valuable additional information and has to be considered as a must for the next generation of L4 ("Eyes off") and L5 ("Mind off") autonomous driving. In this context, the HELIAUS project aims to deliver breakthrough perception systems for in-cabin passengers monitoring, as well as for the car surrounding by developing smart thermal perception systems that extend the current systems to the LWIR bandwidth.

The main objectives of the HELIAUS are four-fold:

- developing cutting-edge and cost effective technologies leading to low cost, high performance LWIR module,
- specifying, developing, testing and validating the thermal perception systems first prototypes for in-cabin and out-of-cabin application,
- quantifying the valuable addition of the thermal sensing into the current systems and future systems,
- and promoting the benefit of such systems in the future autonomous vehicles, and for smart mobility in general.

HELIAUS is a first and essential step to the creation of a future industrialized affordable thermal perception systems. The project will largely contribute to the global competitiveness of the European transport and smart mobility industry.
The European Green Deal strives for sustainable mobility and efficient use of resources. HiEFFICIENT will work towards these goals to develop the next generation of wide-bandgap semiconductors (WBG) for smart mobility.

Today, the applicability of WBG semiconductors in electrified vehicles has been demonstrated but only few manufacturers are making use of these devices, using Silicon Carbide (SiC) but as yet not Gallium Nitride (GaN). To boost this development and the market introduction in automotive applications, HiEFFICIENT partners have set ambitious goals to gain higher acceptance and achieve the maximum benefit in using WBG semiconductors.

To accomplish these goals, the project partners will work on industrial use cases to demonstrate the key achievements and the progress that goes beyond state of the art. This includes, amongst others, modular inverters with different voltage levels (such as 48 V and 400 V), flexible on- and multi-use off-board chargers for different voltage levels, multi-purpose DC/DC converters and test systems for power electronics’ lifetime testing. These use cases are led by OEMs and other industrial partners, who define requirements and specifications for the envisioned systems. The project work starts at component-level, developing highly integrated GaN and SiC devices and is followed by multi-objective design optimization and virtual prototyping. High integration means big challenges in thermal management, which will be addressed by the development of advance cooling concepts, and modularity for the sake of maintainability and flexibility for future applications. Finally, the demonstrators are integrated in relevant environments to prove the concepts and the applicability for future use.

HiEFFICIENT will introduce highly advanced, integrated, and reliable WBG technologies to the automotive market, fulfilling the highest reliability and performance requirements the automotive industry is used to. Therefore, the complete value chain – from the semiconductor manufacturers to the module integrators and system suppliers, and the OEM’s themselves – collaborate within this project to tackle the challenges in a comprehensive manner. The project results will have a significant impact on all levels along the value chain. It will strengthen Europe’s semiconductor industry due to innovative devices, such as the first GaN-based SoC half-bridge for 650 V. It will also impact Europe’s automotive industry by introducing highly energy-efficient and reliable power electronics to all types of electrified vehicles and charging infrastructure. And lastly, it will also help strengthening Europe’s universities and RTOs by significantly extending their knowledge and expertise in power electronics integration and advanced cooling concepts.
ID2PPAC pursues the objective to demonstrate that Performance Power Area and Cost (PPAC) requirements for the 2nm node generation of leading-edge logic technology can be achieved. It consolidates and integrates 2nm technology solutions which have been identified and evaluated in its predecessor IT2.

To continue the Moore’s law trajectory to the 2nm node, while meeting PPAC requirements, the combination of further advancements in EUV lithography & masks, 3D device structures, materials and metrology is required. The strength of the project pivots on the focused engagement of leading expert partners in these key interlocking areas and a shared pilot line.

The ID2PPAC project is expected to enable IC-fabs to do EUV-based, single-print, High Volume Manufacturing for the 2nm node by 2025. This technology evolution is driven by the growing demand for compute power, which increases more than exponentially with time. This has made the world migrate from 1 billion interconnected devices in the “PC era” to 10 billion in the “Mobile + cloud era” to the future “Intelligence era”, in which there will be over 100 billion intelligent connected devices. To enable this growth, the semiconductor industry is continuously pursuing technology innovations to realize this progress, as has been predicted by Moore’s Law, and will continue to do so.

Nowadays, next to pure geometric scaling of 2D features, additional approaches in which new devices, materials, 3D and system architecture aspects are combined to increase the compute power density. In the ID2PPAC project, in addition to advancing Lithographic, Metrology, Process and Mask equipment, these advanced semiconductor Process technology developments are covered concurrently to provide the relevant equipment demonstrators to enable 2nm node process technology.

The impact of ID2PPAC is expected to be huge, as the work will enable the semiconductor industry to keep pace with Moore’s law, meeting the PPAC requirements for 2nm technology. The project will also help to expand Europe’s technological capacity to act in this field, which is crucial for digitization, (edge) AI and for solving national, European, and global societal challenges, and will strengthen the consortium of leading European companies and institutes active in this sector. Moreover, the results of the ID2PPAC project are crucial to further extend the technological leadership of the consortium of leading European companies and institutes, and to maintain Europe’s sovereignty in the Semiconductor Equipment industry in a worldwide and highly competitive landscape.
IMOCO4.E provides vertically distributed, edge-to-cloud intelligence for machines, robots and other human-in-the-loop automation systems having actively controlled moving elements. They face ever-growing requirements on long-term energy efficiency, size, motion speed, precision, adaptability, self-diagnostic, secure connectivity, or new human-cognitive features.

The project develops a way to understand complex machines and robots through two main pillars: digital twins and AI principles (machine learning/deep learning). These pillars build on a completed ECSEL JU project, I-MECH, and uses its reference framework and methodology by adding new tools to layer 3 that deliver an intelligible view on the system, from the initial design throughout its entire life cycle. For effective employment, completely new demands are created on the Edge layers (Layer 1) of the motion control systems (including variable speed drives and smart sensors) which cannot be routinely handled via available commercial products.

This project brings adequate edge intelligence into the Instrumentation and Control Layers, to analyse and process machine data at the appropriate levels and to synchronise the digital twins with either the simulated or the real-time physical world. At all levels, AI techniques are employable.

IMOCO4.E will deliver a reference platform consisting of AI and digital twin toolchains, and a set of mating building blocks for resilient manufacturing applications. Optimal energy-efficient performance and easy (re) configurability, traceability and cyber-security are crucial. The IMOCO4.E reference platform benefits will be directly verified in applications for semiconductor, packaging, industrial robotics, and healthcare, and additionally in other generic motion-control-centred domains. The project outputs will affect the entire value chain of the production automation and application markets. By further evolving the I-MECH methodology, it creates new, sustainable propositions such as “digital twins as a service” or “(generative) machine design as a service”, for the ongoing smartification of industries.
Artificial Intelligence of Things (AIoT) is the natural evolution for both Artificial Intelligence (AI) and Internet of Things (IoT) because they are mutually beneficial. AI increases the value of the IoT through machine learning by transforming the data into useful information, while the IoT increases the value of AI through connectivity and data exchange. The ECSEL JU project InSecTT – Intelligent Secure Trustable Things, a pan-European effort with 54 key partners from 12 countries, will provide intelligent, secure and trustworthy systems for industrial applications to provide comprehensive cost-efficient solutions of intelligent, end-to-end secure, trustworthy connectivity and interoperability to bring the Internet of Things and Artificial Intelligence together. InSecTT aims at creating trust in AI-based intelligent systems and solutions as a major part of the AIoT.

InSecTT will enable cooperation between big industrial players from various domains, a number of highly innovative SMEs distributed all over Europa and cutting-edge research organisations and university. The project features a big variety of industry-driven use cases embedded into various application domains where Europe is in a leading position, i.e. smart infrastructure, building, manufacturing, automotive, aeronautics, railway, urban public transport, maritime as well as health. The demonstration of InSecTT solutions in well-known real-world environments like airports, trains, ports, and the health sector will generate huge impact on both high and broad level, going from citizens up to European stakeholders. InSecTT will bring intelligent solutions into the market by conclusive showcases all over Europe, hence strengthening Europe’s industry and once more make European solutions a frontrunner in cutting-edge technology.

InSecTT will open up new market opportunities for the European industry, will significantly reduce time to market and decrease costs for trustable AIoT solutions on the market, in particular by using new designs and technical building blocks. InSecTT is aiming to achieve the full potential of the “Artificial Intelligence of Things” - it will establish the EU as a center of intelligent, secure and trustworthy systems for industrial applications enabled by a strong industry with a strong reputation and an informed society, in order to enable products and services based on AI compliant to European values and “Made in Europe”.
iRel40 has the ultimate goal of improving reliability for electronic components and systems by reducing failure rates along the entire value chain. Trend for system integration, especially for heterogeneous integration, is miniaturization. Thus, reliability becomes an increasing challenge on device and system level and faces exceptional requirements for future complex applications. Applications require customer acceptance and satisfaction at acceptable cost. Reliability must be guaranteed when using systems in new and critical environments.

In iRel40, 79 partners from 14 countries collaborate in 6 technical work packages along the value chain. WP1 focuses on specifications and requirements. WP2 and WP3 focus on modelling, simulation, materials and interfaces based on test vehicles. WP4 applies the test vehicle knowledge to industrial pilots related to production. WP5 applies the knowledge to testing. WP6 focuses on application use cases applying the industrial pilots. We assess and validate the iRel40 results. Reliable electronic components and systems are developed faster and new processes are transferred to production with higher speed. Crucial insight gained by Physics of Failure and AI methods will push overall quality levels and reliability.

iRel40 results will strengthen production along the value chain and support sustainable success of Electronic Components and Systems investment in Europe. By collaboration between academy, industry and knowledge institutes on this challenging topic of reliability, the project secures more than 25,000 jobs in the 25 participating production and testing sites in Europe. The project supports new applications and reliable chips push applications in energy efficiency, e-mobility, autonomous driving and IoT. This unique project brings, for the first time ever, world-leading reliability experts and European manufacturing expertise together to generate a sustainable pan-European reliability community.
IT2

Start date         1 June 2020
Duration                                                                  36 months
€M Total costs / EU / National               91.3 / 20.8 / 17.2
Number of participants                                                      32

Semiconductor research and development continuously focuses on surpassing present state-of-the-art Micro-Chips manufacturing technology to accommodate the exponential increase in demand for more processing power. To increase the number of transistors per chip, the IT2 project develops next generation extreme UV lithography and explores novel 3D structures. Much like building an apartment complex rather than a single-family home on the same real estate. The project will enable future chips that will be at the core of AI, Big Data, Mobile/5G communication and other elements of Europe’s digitisation. In this way, the project develops knowledge and infrastructure to give Europe’s semiconductor manufacturing equipment industry global leadership in 2nm CMOS technology and supports Europe to obtain a sovereign position in the electronics value-chain.

IT2 will explore, develop and demonstrate technology options that are needed to realize 2nm CMOS logic technology extending the scaled Semiconductor technology roadmap to the next node in accordance to Moore’s law. These activities cover creation of Lithography equipment, new Processes & Modules and Metrology tools capable to create and deal with new 2nm node 3D structures, defect analysis, overlay and features.

Within the Lithography part of the project, the specific objectives are:

- To realize a 2nm node Multi-Patterning EUV scanner module ready for High Volume Manufacturing.
- To improve productivity levels by 30% and/or to mitigate stochastic (random) errors compared to the current state of the art while simultaneously reducing the On-Product Overlay performance.

The key objective related to Process & Module Exploration is the assessment of existing and innovative technology, solutions that allow industry to keep pace with Moore’s scaling law and meet the performance, power, area and cost specifications for the 2nm node.

The objective for the metrology activities is to further develop metrology, characterization and inspection capabilities with sufficient sensitivity, accuracy and precision to study 2nm node process windows and to establish correlations between process parameters and process results at wafer level for the 2nm node.

The potential impact of the IT2 project for the Semiconductors Industry is large, because of the strong market pull for ever smaller IC-nodes. In addition, the chance of a social impact is close to 100%, because advanced Electronic Components and Systems are crucial for the products and infrastructure required for solving national, European and global societal challenges.
MADEin4

MADEin4 project is a comprehensive Industry 4.0 electronic components and systems equipment and manufacturing framework that aims at developing next ECS generation metrology tools, machine learning methods and applications to support Industry 4.0 high volume manufacturing (HVM) of both the Semiconductors and Automotive industries.

The metrology role in the ECS integrated circuit (IC) fabs is of the most challenging form, as it measures on silicon wafers down to a nanometric scale 2D and 3D features with angstrom levels precision and accuracy. In addition, the metrology role is continuously increasing for other highly complex industrial sectors as automotive.

MADEin4 will address these challenges by concentrating on developing next generation metrology tools for the ECS IC industry which will focus on higher productivity and connectedness to its environment (Cyber Physical Systems (CPS)), and developing new tools and methods to combine in an intelligent way, for both ECS and Automotive industries, the large amount of metrology data which are or will become available, with design, process and tools data to both enhance productivity as well as predictability of the production processes.

MADEin4 is expected to strengthen the EU’s ECS and Automotive industries and will have a significant positive impact on the EU zone economy.
C MOS-based digital computing has given rise to ever-greater computational performance, big-data based business models, and the accelerating digital transformation of modern economies. However, the increasingly larger amounts of data to be handled and the continuously growing complexity of today's tasks for high-performance computing (HPC) are becoming unmanageable, as data-handling and energy consumption of high-performance computers, server farms, and cloud services are reaching unsustainable levels. New concepts and technologies for high-performance computing (HPC) are necessary.

One such HPC technology is Quantum Computing (QC). QC utilizes "quantum bits" (qubits) to perform complex calculations fundamentally much faster than conventional digital-bit computing can. First demonstrators and quantum computer prototypes have been created using various types of quantum bits. Superconducting Josephson junctions (SJJs) have been shown to be extremely promising qbit candidates to achieve a significant, nonlinear increase of computational power with the number of qbits in a quantum computer. Industrial market-introduction of novel materials, devices, and characterization represents a great challenge yet opportunity for Europe to create a complete value chain for Josephson junction technology and QCs. Such a complete value chain will be a significant contribution to Europe's technology sovereignty.

The MATQu project will validate technology options to produce SJJs on industrial 300 mm silicon-based process flows. The project addresses substrate technology, superconducting metals, resonator technology, through-wafer-via holes, 3D integration, and variability characterization. The substrate, process, and test-compatibility will be assessed with respect to integration practices for qbits. Core substrate and process technologies with high quality factors, improved material deposition on large substrates, and increased critical temperature for superconducting operation, will be developed and validated. Concerning substrate technology, process technology and tools, MATQu brings together major European actors in the field, including four large RTOs. The MATQu partners complement each other in an optimal manner across the value chain to create a substantial competitive advantage, e.g., faster time-to-market and roll-out of technologies and materials for better Josephson junctions for quantum computing.
Compared to the pace of innovation in electronic consumer products, the pace of innovation for medical devices is lagging behind. It is the overarching objective of Moore4Medical to accelerate innovation in electronic medical devices.

The project addresses emerging medical applications and technologies that offer significant new opportunities for patients as well as for industry including: bioelectronic medicines, organ-on-chip, drug adherence monitoring, smart ultrasound, radiation free interventions and continuous monitoring. The new technologies will help fighting the increasing cost of healthcare by reducing the need for hospitalisation, helping to develop personalized therapies, and realising intelligent point-of-care diagnostic tools.

Moore4Medical brings together 66 selected companies, universities and institutes from 12 countries who will develop open technology platforms for these emerging fields to help them bridge “the Valley of Death” in shorter time and at lower cost. Open technology platforms used by multiple users for multiple applications with the prospect of medium to high volume markets are an attractive proposition for the European industry.

The combination of typical MedTech and Pharma applications with an open platform approach will enhance the competitiveness for the emerging medical domains addressed in Moore4Medical. With value and IP moving from the technology level towards applications and solutions, defragmentation and open technology platforms will be key in acquiring and maintaining a premier position for Europe in the forefront of affordable healthcare.
NewControl

Start date         1 April 2019
Duration                                                                  45 months
€M Total costs / EU / National                     37.8 / 11 / 0.3
Number of participants                                                      43

NewControl will develop virtualized platforms for vehicle subsystems that are essential to highly automated driving (such as perception, cognition and control), so as to enable mobility-as-a-service for next generation highly automated vehicles. It will provide an industrially calibrated trajectory towards increased user-acceptance of automated control functions, through an approach that is centred on the premise of safety by design.

The project will deliver a fail-operational platform for robust, holistic perception through a combination of Lidar, Radar, and sensor fusion. The project will also develop a generalised virtual platform for stable and efficient control of propulsion systems, on top of cost- and power-efficient, high-performance embedded compute-platforms for in-vehicle perception, cognition, and control. Robust approaches for implementing, verifying, and certifying automated control for safety-critical applications will be one of the main results of this ambitious project.

Eleven (11) demonstrators will be built to showcase the project’s findings and their capability to facilitate perception, cognition and control of next generation highly automated vehicles. The developments in NewControl will enable significant cost reduction for essential modules of future automated vehicles. These developments will improve the safety and reliability of automated systems to the levels necessary for mass-market deployment. These innovations will leverage the expertise of industrial (OEMs, Tier-1, Tier-2 and technology providers) and research partners along the complete semiconductor, automotive, and aviation value chains, providing Europe with a competitive edge in a growing market. Importantly, NewControl’s innovations will improve the market penetration of safety-centric automation systems, contributing directly to the European goal of zero road fatalities by 2050.
NextPerception

Start date 1 April 2019
Duration 36 months
€M Total costs / EU / National 28.7/ 8.7/ 30.7
Number of participants 43

Next generation smart perception sensors and distributed intelligence for proactive human monitoring in health, wellbeing, and automotive systems.

Smart complex systems have become of great significance particularly in healthcare and autonomous driving domains. The precision and timeliness of the decisions depend on the systems’ capacity to accurately understand individuals and their environment. The EU-funded NextPerception project will advance perception sensing technologies such as radar, LiDAR and time-of-flight cameras, improving and allowing them to better detect human conduct and physiological parameters. The project will develop next-generation smart perception sensors and improve the distributed intelligence model, aiming to establish adaptable, safe, reliable and dynamic human monitoring solutions for the health, well-being and automotive sectors. The new distributed intelligent model will be supported by specific instruments based on the advantages of edge and cloud computing.

The objectives of the project are:

- An accurate and unobtrusive sensing of human behaviour and physiological parameters by means of innovative perception and complementary sensors;
- Supporting a proactive decision-making ensuring Health, Wellbeing, and Traffic Safety by means of predictive analytics and explainable AI;
- Providing a reference platform to support the design, implementation and management of distributed sensing and intelligence solutions;
- Demonstration and validation of proactive monitoring solutions in Health and Wellbeing and Automotive domains, including cross-sector applications.
PIN3S will discover, develop and demonstrate lithography, metrology, mask repair technology, devices and process modules, which will enable the micro-electronics industry to migrate to the 3nm node technology. The innovations proposed in this project will ensure that the European semiconductor equipment sector and ecosystem can capitalize on the exponential growth expected in this sector, create sustainable job growth and stay ahead of the curve in terms of worldwide technological leadership.

PIN3S is about “Pilot Integration of 3nm Semiconductor Technology”. This covers Process Integration, creation of Lithography Equipment, EUV Mask Repair Equipment and Metrology tools capable of dealing with 3D structures, defects analysis, overlay and feature size evaluation. Each of these objectives will be achieved by close cooperation between key European equipment developers and suppliers; ASML, Zeiss, Thermom Fisher, Applied Materials (Belgium and Israel), Nova, KLA Israel, Coventor (Lam Research), Recifi, Peefler, VDL ETG, Prodrive Sioux-CCM, Berliner Glas, IBS, Solmates, scia Sytems together with the involvement of a strong knowledge network based on Universities in Romania, the University POLITEHNICA of Bucharest and in the Netherlands, the Technical University of Delft and the University of Twente, complemented with key Technology Institutes such as imec in Belgium and Fraunhofer in Germany.

PIN3S drives the ambition of the European Semiconductor Equipment industry for advanced semiconductor technologies to lead the world in miniaturization by supplying new equipment and materials approximately two years ahead of introduction of volume production of advanced semiconductor manufacturers. With the results of the PIN3S project, the consortium builds on facilitating IC manufacturers’ migration to the 3nm Technology node, which itself enables a class of new products with more functionality, more performance and are more power efficient. As such, it will form the basis for innovations yet to come, enabling solutions that address the societal challenges in communication, mobility, health care, security, energy and safety & security.
Power2Power

Start date 1 June 2019
Duration 36 months
€M Total costs / EU / National 74.3 / 17 / 89.9
Number of participants 43

Power2Power is fostering a holistic, digitized pilot line approach by accelerating the transition of ideas to innovations in the Power Electronic Components and Systems domain. In the course of the project, the international leadership of the European industry will be strengthened by means of a digitized pilot line approach along the supply chain located entirely in Europe; working together with multiple organizations, combining different disciplines and knowledge areas in the heterogeneous power-ECS environment.

These comprehensive efforts will allow reaching a high-volume production of smart power electronics to change the market towards energy-efficient applications to meet the carbon dioxide reduction goals of the European Union. Consequently, economic growth and tackling grand societal challenges such as smart energy and mobility will lead to safeguarding meaningful jobs for European citizens. Silicon-based power solutions will outperform new materials (SiC, GaN) for many more years in terms of cost-to-performance-ratio and reliability. As a result, the Silicon-based power solutions will keep innovating and growing the upcoming years.

On a long run the project Power2Power will significantly impact the path to the industrial ambition of value creation by digitizing manufacturing and development in Europe. Smart energy utilization with highly efficient power semiconductor-based electronics is key in carefully utilizing the scarce resources. Energy generation, energy conversion and smart actors are these application domains where advanced high voltage power semiconductor components primarily impact the path toward winning innovations.
Progressus

The high-power requirements of ultra-fast charging stations give rise to special challenges when designing smart charging infrastructure. In support of Europe’s 2030 climate targets, the Progressus project aims to introduce a next-generation smart grid demonstrated by the application example of a smart charging infrastructure integrating seamlessly into current smart-grid architecture concepts. To do so, it will research new efficient high-power converters that support bidirectional power flow. New DC microgrid management strategies for energy efficiency and service provision that consider renewable energy sources, storage and flexible loads will be investigated. It will also explore novel sensor types, inexpensive high-bandwidth communication technologies and security measures based on hardware security modules and blockchain technology to protect communication and services. The project’s solution will promote a more environmentally friendly and efficient next-generation energy supply infrastructure.

Progressus supports the European climate targets for 2030 by proposing a next generation smart grid, demonstrated by the application example “smart charging infrastructure” that integrates seamlessly into the already existing concepts of smart-grid architectures keeping additional investments minimal. The expected high-power requirements for ultra fast charging stations lead to special challenges for designing and establishing an intelligent charge-infrastructure. As emission free traffic concepts are a nascent economic topic also the efficient use of charging infrastructure is still in its infancy. Thus, novel sensor types, hardware security modules, inexpensive high bandwidth technologies and block-chain technology as part of an independent, extendable charging energy-management and customer platform are researched for a charging-station energy-microgrid. Research of new efficient high-power voltage converters, which support bidirectional power flow and provide a new type of highly economical charging stations with connected storage and metering platform to locally monitor the grid state complements the activities. The stations are intended to exploit the grid infrastructure via broadband power-line as communication medium, removing the need for costly civil engineering activities and supplying information to the energy management solutions for utilization optimization. Smart-Contracts via block-chain offer a distributed framework for the proposed energy management and services platform. Furthermore hardware security hardens the concept against direct physical attacks such as infiltration of the network by gaining access to the encryption key material even when a charging station is compromised. Progressus solutions are estimated to enable a carbon dioxide saving of 800,000 tons per year for only Germany, will secure the competitiveness of European industry and research by extending the system know how and will thus safeguard employment and production in Europe.
The StorAlge project will develop and industrialize the FD-SOI 28nm and the next generation embedded Phase Change Memory (ePCM) world-class semiconductor technologies. This will allow prototyping of high performance, ultra-low power, secured & safe System on Chip (SoC) solutions enabling competitive Artificial Intelligence (AI) for Edge applications. The main challenge addressed by the project is to handle the complexity of sub-28nm 'more than Moore' technologies and to bring them up to a high level of maturity, while handling the design of complex SoCs for more intelligent, secure, flexible, low power and cost-effective consumption. The project targets chipsets and solutions with very efficient memories and high computing power.

The development of the most advanced automotive microcontrollers in 28nm FD-SOI ePCM will be the supporting technology to demonstrate the high performance as well as the robustness of the ePCM solution. The next generation of FD-SOI ePCM will be the main path for general purpose advanced microcontrollers, usable for large volume Edge AI applications in industrial and consumer markets, with the best compromise on three requirements: performance, low power, and adequate security. Furthermore, the project targets the development of hardware and software environments that will allow users to define architectures tailored to their specific needs. These architectures will support and make possible the introduction of artificial intelligence in a very large number of applications.

On top of the development and industrialization of silicon process lines and SoC design, StorAlge will also address new design methodologies and tools to facilitate the exploitation of these advanced technology nodes, particularly for high performance microcontrollers having AI capabilities. Work will be done to setup robust and adequate Security and Safety levels in the final applications, defining and implementing the good ‘mixture’ and trade-off between hardware and software solutions, to speed up adoption for large volume applications.
Massive adoption of computing in all aspects of human activity has led to unprecedented growth in the amount of data generated. Machine learning has been employed to classify and infer patterns from this abundance of raw data, at various levels of abstraction. Among the algorithms used, brain-inspired, or “neuromorphic”, computation provides a wide range of classification and/or prediction tools. Additionally, certain implementations come about with a significant promise of energy-efficiency; highly optimized Deep Learning engines, ranging up to the efficiency promise of exploratory Spiking Neural Networks (SNN). Given the slowdown of silicon-only scaling, it is important to extend the roadmap of neuromorphic implementations by leveraging relevant technology innovations.

TEMPO will sweep technology options, covering emerging memories and 3D integration, and attempt to pair them with contemporary Deep Learning (DL) and exploratory (SNN) neuromorphic computing paradigms. The process and design compatibility of each technology option will be assessed with respect to established integration practices. Core computational kernels of such DL/SNN algorithms (e.g. dot-product or integrate-and-fire engines) will be brought into practice in representative demonstrators. To address the needs of end-users’ application sectors (aviation, automotive, etc.), this ECSEL JU project has integrated the main European actors of each sector to participate in the specification of requirements’ data-set definitions. This allows TEMPO partners to complement each other in a near-optimal way to provide Europe with a substantial competitive advantage and a faster time-to-market opportunity in the roll-out of neuromorphic implementations throughout the different sectors involved.
Cyber-physical systems (CPS) are all around us, but due to today’s technical limitations and the possibility of human error, we cannot yet tap into their full potential. A more integrated and connected architecture for such systems, via edge and cloud technologies, could overcome these limitations.

The overarching goal of TRANSACT is therefore to develop a universal, distributed solution architecture for the transformation of safety-critical cyber-physical systems, from localised stand-alone systems into safe and secure distributed solutions.

To that end, TRANSACT will research distributed reference architectures for safety-critical CPS that rely on edge and cloud computing. These architectures will enable seamless mixing of on-device, edge and cloud services while assuring flexible yet safe and secure deployment of new applications, and independent releasing of edge and cloud-based components versus the on device parts. The distributed solutions will simplify CPS devices, reducing their software footprint, and consequently their Bill-of-Material (BoM) and Life Cycle Management (LCM) costs. A key element in the transformation of safety-critical CPS into distributed safety-critical CPS solutions (on-device, edge or cloud based) is that performance, safety, security, and privacy of data are guaranteed: the safeguarding of these properties gets due attention in the project.

Finally, by integrating AI based services into distributed CPS, TRANSACT will enable fast development of innovative value-based propositions and business models leading to faster market introduction in the various multi-billion euro markets targeted by the TRANSACT project.
Electrical energy is becoming the most important energy form on our way to a greener economy, and power electronics plays a dominant role in managing electricity to meet the fast-growing supply, transmission and end user demands. Silicon Carbide (SiC) based power electronics has the potential to use electrical energy significantly more efficient than current silicon-based semiconductors. TRANSFORM addresses the current and urgent needs for widespread adoption of SiC, while its ambitious goals are both of strategical and technical nature.

TRANSFORM will provide European downstream market players with a reliable source of these important electronic components and systems, based on an entirely European silicon carbide value chain, ranging from substrate wafers to energy converters. The technical excellence achieved by the project based on the foundation of former ECSEL projects like ‘WinSiC4AP’ or ‘R3-PowerUP’ and will significantly strengthen the competitive position of European technology in the global market. The project TRANSFORM will strongly improve current SiC technologies beyond the state-of-the-art to serve the large emerging markets for electric power conversion in renewable energies, mobility and industry. The project starts at the very beginning of the value-chain to bring radical innovation to the substrate manufacturing process, striving for nothing less than establishing a new global standard. Covering smart-cut technology as basis for a high scalability and reliability wafers, over bleeding edge processing technology, novel device concepts and reliable systems, in TRANSFORM substrate manufacturers, equipment manufacturers and technology providers cooperate to increase maturity of the new process from lab demonstration to pilot line availability.

On top of contributing to all European societal goals, the main goal behind this project is paving a way to a green economy. TRANSFORM contributing to a climate neutral mobility in Europe, is a key element for decarbonization of our economy and therefore supports the European Green Deal project. The technology developed in TRANSFORM will enable a significant increase of electrical energy efficiency. The result is a competitive, ready-to-industrialize technology and thereby strengthens Europe’s position in the world and its technological sovereignty in this critical field.

Last but not least, the silicon carbide market is just emerging. TRANSFORM can capture this market opportunity, obtain a competitive position and generate added value as well as highly qualified jobs in Europe.
UltimateGaN will safeguard Europe’s leading position in power semiconductors and high-performance RF applications by driving an innovative breakthrough with the next generation of Gallium Nitride (GaN) technologies. Several predecessor projects assured the availability of the first generation of European GaN-devices, also revealing that the challenges of these technologies have been heavily underestimated yet clarifying the high potential of GaN in overcoming the persistent threats of higher electric fields, current densities and power densities related to the necessity of device shrinkage.

A new concept - following a vertical approach to address research throughout the entire supply chain of technology, packaging, reliability and application - will significantly improve effectiveness that goes beyond the limits of silicon-based semiconductors in combination with packages that fully valorise the shrink-path of GaN power devices, but which are not yet ready.

UltimateGaN’s unique approach addresses, among others, the following innovative applications with the view to drive digitalisation and energy efficiency for 5G, Smart Grids and Smart Mobility that goes hand in hand with a significant reduction of the CO2 footprint:

- Extremely efficient server power supply enabling lower energy consumption in data centres
- Benchmark Photovoltaic inverters in terms of efficiency and size, to foster the use of renewable energies
- Affordable 5G-Amplifiers up to mm-wave, enabling a faster 5G rollout
- GaN-powered LIDAR application to enable autonomous driving
- Highest efficiency μ-Grid-converters and On-Board Chargers

The global state-of-the-art first generation GaN devices are mainly based on US and Asian suppliers. Only a cooperative project like UltimateGaN with European market leaders and world-class researchers can take on the challenges and bring Europe at the forefront of GaN-enabled opportunities.
Managers of automated systems and the manufacturers of the components used in these systems have been allocating an enormous amount of time and effort in the past years developing and conducting research on automated systems. The effort spent has resulted in the availability of prototypes demonstrating new capabilities as well as the introduction of such systems to the market within different domains. Manufacturers of these systems need to make sure that the systems function in the intended way and according to specifications which is not a trivial task as system complexity rises dramatically the more integrated and interconnected these systems become with the addition of automated functionality and features to them.

With rising complexity, unknown emerging properties of the system may come to the surface making it necessary to conduct thorough verification and validation (V&V) of these systems. VALU3S aims to design, implement and evaluate state-of-the-art V&V methods and tools in order to reduce the time and cost needed to verify and validate automated systems with respect to safety, cybersecurity and privacy (SCP) requirements. This will ensure that European manufacturers of automated systems remain competitive and that they remain world leaders. To this end, a multi-domain framework is designed and evaluated with the aim to create a clear structure around the components and elements needed to conduct V&V process through identification and classification of evaluation methods, tools, environments and concepts that are needed to verify and validate automated systems with respect to SCP requirements.

The implemented V&V methods as well as improved process workflows and tools will also be evaluated in the project using a comprehensive set of demonstrators built from 13 use cases with specific SCP requirements from 6 domains of automotive, industrial robotics, agriculture, Aerospace, railway and health.
VIZTA is developing innovative technologies for optical sensors and laser sources used in short to long-range 3D-imaging. The project demonstrates the value of these technologies in several key applications including automotive, security, smart buildings, mobile robotics for smart cities, and industry4.0.

The key differentiating Silicon sensing technologies developed during VIZTA are:

- Innovative Silicon single-photon avalanche diode technology, based on a dedicated 12-inch process and intended for direct Time-of-Flight applications;
- Pioneering lock-in pixel technology based on an advanced 12-inch CMOS process and intended for indirect Time-of-Flight applications;
- Ground-breaking and cost-effective 12-inch wafer level optics, including the development of Near Infa-Red (NIR) bandpass thin-film filters, no angle-shift NIR bandpass filters, RGB+Z on-chip filtering solution, micro-lenses solution for both depth sensing and RGB+Z;
- And complex RGB+Z pixel architectures for multimodal 2D/3D imaging.

VIZTA is a prime opportunity for placing Europe in a leadership position for advanced imaging sensors, laser sources, and systems. This will be achieved through the mastering of the complete value chain from silicon and III-V material technologies up to end-users. VIZTA will strengthen innovation capacity, competitiveness and sustainability of its consortium and positively impact European economy by enabling large volume imagining sensors and laser sources productions in Europe, and in consequence creating and maintaining employment. The project will also reinforce links between the large companies and the SMEs embedded in the project to explore new markets with early provision of state-of-the-art 3D sensors, and enable equipment suppliers to keep leadership and market share.
YESvGaN develops a new class of power transistors based on the wide band gap material gallium nitride (GaN), for efficient and affordable power conversion at voltages up to 1200 V and currents up to 100 A. This is enabled by an innovative membrane transistor approach, which allows fabricating vertical GaN transistors suitable for high voltage and high current operation while at the same time employing inexpensive semiconductor substrates. The target technology can replace current silicon-based insulated gate bipolar transistors (IGBTs) due to its comparable cost level while operating at the high efficiency of silicon carbide (SiC) field effect transistors (FETs), where the high substrate cost of the latter so far prevents IGBT replacement. This allows for a reduction of energy loss in a broad range of price-driven applications, from the electric vehicle powertrain over industrial motor drives to data-centre uninterruptable power supplies.

YESvGaN chose an ambitious set of objectives. Starting with the development of high-quality epitaxial growth of thick GaN layers on low-cost silicon substrates, allowing for high blocking voltages up to 1200 V. YESvGaN also paves the way to vertical GaN epitaxy on 300 mm silicon for maximum cost reduction. Regarding semiconductor process technology, multiple transistor channel concepts for highly efficient vertical GaN transistors with a specific on-state resistance below 4 mΩcm² at 1200 V rating are developed, together with key processes such as deep ion implantation, including the corresponding equipment. To access and electrically contact the backside of the residual micrometre-thin membrane transistor, specific bonding and debonding, substrate removal and backend processes compatible with the potentially fragile membrane transistors will be developed. Furthermore, assembly and interconnection technology for reliable, low-resistance and low-inductance contacting of membrane transistors to the outside circuitry is addressed, to finally apply and characterize membrane vertical GaN power transistors in prototype half-bridge power converter modules. Fabrication is complemented by reliability characterization along each process step to gain in-depth knowledge of the underlying performance-limitations, degradation and failure-mechanisms. The new transistor technology will be evaluated for pertinent applications on physical and simulation level setting up a comprehensive simulation framework and lab-scale demonstrators.

At the end of the project, fully functional membrane vertical GaN transistors suitable for 1200 V and 100 A operation will be available including their technical data sheet as well as lab-scale demonstrators showing the advantages in terms of system efficiency, power density and cost effectiveness for high power converter applications.
ECSEL JU is a public-private partnership set up in 2014 between the EU (via the Commission), 30 Participating States and three private-member Industry Associations. It brings leading European companies - large and small - world-class European research and technology organizations and academia together around a commonly agreed technical agenda for Electronic Components and Systems (ECS) technologies. ECSEL JU draws its funding from the European Union’s Horizon 2020 research scheme, as well as National - and in some cases Regional - funding authorities. ECSEL JU then coordinates and allocates the resources from these parties, together with Industry’s own contributions.

Why is it important? ECS are a Key Enabling Technology, impacting all industrial branches and almost all aspects of life. They provide the fabric on which the internet runs; they give life to portable phones and tablets; they drive driverless cars and trains, fly airliners, drones and satellites, make surgical robots possible... In modern times, no national economy can win in the global competition without mastering this technology. The ECSEL JU-funded projects contribute to the development of a strong and globally competitive electronics components and systems industry in the European Union.

How does it work? Industry and researcher institutes – via the Industry Associations who are members of the ECSEL Joint Undertaking, propose a technical programme, while the EU and participating countries define the budget which allows the ECSEL Office to run the calls, manage the contracts and support the participants. Together, they define a programme – and a corresponding set of projects with high impact - that best fits the needs of Industry (including academics) and National / European priorities, so offering real potential to shape the future of Europe.

1 At the time of writing, 26 EU Member States: Austria, Belgium, Bulgaria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and United Kingdom; and 4 associated countries with the EU’s Horizon 2020 programme: Israel, Norway, Switzerland and Turkey.

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