ECSEL JU
BOOK OF PROJECTS
volume two
CALLS 2016 & 2017
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I mentioned above some early successes, so we can indeed show some cautious examples of "yes" answers to that question. But these successes need nurturing if they are to deliver their full potential. And I am happy to see that ECEL JU has launched some initiatives – "Lighthouse Initiatives", in fact - that reach out beyond individual projects. These Initiatives, of which there are three at the time of writing (Industry4.E, Mobility.E and Health.E), as set to establish a completely new élan in electronics innovation that goes well beyond the confines of singles projects and even of the ECEL JU instrument.

With all these projects and all these results stemming from our collaborative approach, we are steadily improving our position in Europe, through the motto - what we do together, we do better together. Let us continue in this way!

the Chair of the ECEL JU Governing Board
In this second volume of the Book of Projects, I am happy to present now the 26 projects from the third and fourth ECSEL calls: consolidating even further on the initial program approaches. I am sure you will enjoy reading these summaries, and you can go deeper in each of the projects’ details via our website.

Executive Director of ECSEL Joint Undertaking
Bert de Colvenaer
In 2016 and 2017 the amount of funding increased and resulted in an impressive set of new projects. Impressive in size but most importantly also in scope. The portfolio of ECSEL is evolving; new topics come in, others diminish in importance. Some trends can be underlined.

Safety and security were always present as a subtopic in projects. But, some new projects now tackle various aspects of safety and security as main topic. Those projects then deliver results applicable across sectors to, for example, the mobility sector and healthcare.

The development of next generation power devices for mobile and power grid applications by several European players underscores the European dominance in this sector. This is matched by smart grid projects that deliver results in platforms for such grids. Both ultimately, developments in both components and grids ultimately will potentially result in large potential energy savings.

On another track, developing electronic components and systems tools for the digitization of the European Industry is supported by several projects; one of them having the largest consortium in ECSEL and in H2020 (collaborative projects).

The MASP is collaboratively defined by the stakeholders in the ECSEL JU programme. Its primary source is the Private Members of the JU, who compile the complete description of what needs to be done technically, and keep it up to date. The JU Office compiles the MASP and an Annual Work Plan based on this technical input, checking it against the financial considerations of the JU, and presents it all to the Governing Board for adoption. In this way, the needs of industry (which, in our world, clearly embraces the academic partners) are matched with the strategic considerations of the EU and the Participating States.

During 2017, the AENEAS Association, ARTEMIS Industry Association and EPOSS Association – members of the ECSEL JU representing the private partners – undertook a major action to produce a unified roadmap for Electronic Components and Systems, contributed to by leading companies and institutes in electronics and the industries is serves.

The outcome is a document of unprecedented importance for the ECS sector: a roadmap for technological development, referencing the important application domains that will benefit society while being independent of any particular funding programme or sector-specific grouping. It is now offered to various organisations as a common reference for European business and technology developers, and is referred to, for example, by funding programmes under Eureka, the EU’s Framework Programme (Horizon2020), as well as by ECSEL JU for their future MASP revisions (as of 2018).
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.)
The fifth generation (5G) communications technologies will provide internet access to a wide range of applications: from billions of low data rate sensors to high resolution video streaming. The 5G network is designed to scale across these different use cases and will use different radio access technologies for each one.

To support very high data rates, 5G will use wide bandwidth spectrum allocation at mm-wave frequencies. The offered bandwidth at these frequencies (above 24 GHz) is more than 10 times as large as that in the lower bands (sub 6 GHz). However, the move to mm-waves comes at a cost – increased path loss, which makes it extremely challenging to provide coverage.

A partial remedy is to use beamforming to direct the radio energy to a specific user by means of special active antennas. For some deployment scenarios, beamforming is not enough and the output power must also be increased. A major challenge is to bring affordable, high-performance mm-wave active antenna arrays into production. There is a definite market pull for these systems but there is presently a capability gap.

5G_GaN2 project will substantially lower the cost and power consumption, and increase the output power of mm-wave active antenna systems. The maximum output power and energy efficiency results will be possible thanks to the use of Advanced Gallium Nitride (GaN) technology. In addition, low-cost packaging techniques for digital applications will be further developed to reach the cost and integration targets.

Capabilities of the developed technologies will be shown in a set of demonstrators. The application demonstrators will be used to guide the technology development towards maximum impact and exploitation in the post-project phase. The consortium spans the complete value chain: from wafer suppliers, semiconductor fabrication to system integrators.

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**5G_GaN2**

- **Start date**: 1 June 2018
- **Duration**: 36 months
- **€M Total costs / EU / National**: 20.6 / 6 / 5.6
- **Number of participants**: 17

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Farming is facing many economic challenges in terms of productivity and cost-effectiveness, as well as an increasing labour shortage partly due to depopulation of rural areas. Reliable detection, accurate identification and proper quantification of pathogens affecting both plant and animal health, must be kept under control to reduce unnecessary costs, trade disruptions and even human health risks.

AFarCloud addresses the urgent need for a holistic and systematic approach. It will provide a distributed platform for autonomous farming, which will allow the integration and cooperation of Cyber Physical Systems in real-time for increased agriculture efficiency, productivity, animal health, food quality and reduced farm labour costs. This platform will be integrated with farm management software and will support monitoring and decision-making, based on big data and real time data mining techniques.

AFarCloud also aims to make farming robots accessible to more users by enabling farming vehicles to work in a cooperative mesh, opening up new applications and ensuring re-usability, as various standard vehicles can combine their capabilities in order to boost farming efficiency.

The achievements from AFarCloud will be showcased in early laboratory trials and holistic demonstrators, including cropping and livestock management scenarios. Local demonstrators will test specific functionalities and validate project results in relevant environments located in different European regions.

AFarCloud outcomes will strengthen partners’ market position, boosting their innovation capacity and addressing industrial needs both at EU and international levels. The consortium represents the whole ICT-based farming solutions’ value chain, including all key actors needed for the development, demonstration and future market uptake of the precision farming framework targeted in the project.

AFarCloud
Start date: 1 September 2018
Duration: 36 months
€M Total costs / EU / National: 28.3 / 8.7 / 8.2
Number of participants: 60
The systems engineered in modern society are extremely complex and this makes it increasingly difficult to provide assurance for interrelated quality attributes including safety, security and performance. This is particularly the case for real-time systems where human life is at stake, such as in the transportation, aerospace, medical and industrial control domains.

Interacting, non-functional system properties are difficult to track and balance across and within all phases of the product lifecycle. Design trade-offs are normal, for instance when security mechanisms impact the performance of some subsystems, which in turn may be essential for system safety. Often, a balance found early in the lifecycle must later be changed during the detailed design phase. The problem is further compounded by the need to maintain safety-critical systems, which typically have a very long lifetime, often of decades.

It is of the outmost importance that the co-engineering principles are brought into mainstream practice. Achieving the associated advanced solutions will have many benefits, including:

- realising the capability to efficiently analyse the trade-offs between system quality attributes at all stages of the product lifecycle;
- design breakthroughs for architecting, thanks to an effective engineering support;
- providing a more effective ability to implement systems, reducing engineering cost for building and maintaining these systems.

Participating organisations in this endeavour will enjoy a decisive competitive advantage when dealing with standards for safe and secure pervasive systems, as well as meeting client performance requirements. In addition, it will enable easier access to supply chains or system integration, and improved design capability for Systems of Systems and Internet of Things.

Start date        1 May 2017
Duration                                                                  36 months
€M Total costs / EU / National                       15.5 / 4.6 / 3
Number of participants                                                      22
To make future mobility safer, more efficient, affordable, and end-user acceptable, AutoDrive will provide fail-aware, fail-safe, and fail-operational integrated electronic components, Electrical/Electronic architectures as well as (deeply) embedded software systems for highly and fully automated driving. This will require new levels of reliability and availability of components, new redundancy schemes and architectures, and methodologies that can balance complexity, cost, robustness, and flexibility.

AutoDrive has gathered 58 of Europe’s leading semiconductor companies, car manufacturers, suppliers, and renowned research institutes to create the next generation of fail-operational ECS for the automotive and the aviation domains.

Europe’s leading edge position in high tech products for highly dependable automated systems, such as for self-driving vehicle, will be further reinforced by Autodrive which will also significantly contribute to the grand societal challenges of increasing vehicle and road safety and job creation.

AutoDrive - key impacts as technology driver for EU industries and society:

- Strengthens European leadership in electronics and embedded computer systems, but also strengthens Europe’s role as a frontrunner for innovation and engineering quality in semiconductors and ECS for the automotive and aviation domains;
- Adds novel technology for fail-operational systems with high robustness and availability, based on novel semiconductors for functional integrated actuators, fail-aware sensor-systems and fail-operational control systems, and all at reasonable cost;
- Drives the standardization for fail-operational and redundancy levels, which are as yet not defined;
- Fosters the market introduction of this new and – especially for Europe’s industry - very important technology of automated systems;
- With the very strong consortium of 58 partners, covers the whole automotive, aviation and semiconductor value chain based on roughly 67 Mio€ budget giving the project significant critical mass;
- From the outset, engages certification bodies (EASA, Luftfahrtbundesamt) to facilitate the introduction of technologies, as well as insurance companies to cover the unavoidable residual risk and to get the license to drive the automated cars on public roads.
- Enables Europe to gather forces to take advantage of business and societal opportunities, and to maintain European leadership regarding trustworthy automated driving.
CONNECT provides novel electronic components and systems for energy management, power conversion and communication technologies to enable a competitive, secure and sustainable smart grid that saves energy, so reducing carbon emissions and the use of primary energy sources.

Limitations of primary energy sources and carbon dioxide emissions are two of today’s most important societal challenges. Solving them requires a significant increase in the use of renewable energy sources, such as photovoltaics, and the introduction of local storage capacities.

CONNECT investigates concepts, technologies and components that support renewables and local storage in the supply grid, combined with intelligent management of the energy flow. It will also facilitate a decentralized energy infrastructure and allow reduction of demand for primary energy, as well as decreasing carbon emissions.

CONNECT provides new solutions for power conversion that will be specifically developed for bidirectional power exchange with the grid, through high efficiency, low-cost, low-weight, and compact high-power density converters with embedded communication capabilities for different application levels of the grid. Power quality optimization will also be explored, to avoid unnecessary energy flows in the grid.

CONNECT also addresses monitoring approaches and advanced energy management algorithms, which will take into account renewable energy sources, local storage and electric vehicles. This can reduce the peak power demand from the distribution grid and further optimise the use of local generation, consumption and storage.

Enhanced data transmission capacity of the smart grid communication infrastructure is needed to fully exploit these technologies. For this, CONNECT will develop solutions for highly interoperable, high data rate communication in the grid for local and wide area, which will feature enhanced security to protect this critical infrastructure. Particular effort is spent on minimising the power consumption of these solutions.

CONNECT will demonstrate key results in close-to-reallife scenarios. It is expected that they will contribute significantly to the reduction of losses. System level efficiency will be boosted by the reduction of peak power demand to the grid, and increased efficiency at the device and component level.

According to the recent research, more energy efficient, reliable power electronics alone have the potential to reduce the world’s electricity consumption by some 20-30% by 2025. CONNECT provides key technologies to make this happen.
Developed economies are facing up to a smart, digital revolution. The ECSEL Joint Undertaking will help make sure that the European Union keeps its place in the vanguard.

The ECSEL Joint Undertaking is a partnership between the private and the public sectors, designed to deliver three goals for Europe. Firstly, to establish and secure semiconductor and smart systems manufacturing, secondly, to provide access to the ideal infrastructure for innovating, designing and manufacturing of smart systems and finally, to develop the ecosystems and clusters that will encourage innovative SMEs to thrive.

Europe now finds itself in the midst of a revolution; a digital revolution. Inside a generation, the ways in which we organise our work, study and enjoy our leisure time have changed out of all recognition. We now rely on the connectivity of ‘Smart’ technology to shape virtually all aspects of what we do and how we do it.

So what makes this connectivity possible? Without exception, the technology that lets these ‘smart’ devices and systems communicate with each other relies on integrated semiconductor chips that are capable of running sophisticated embedded software.

**Embedding Europe in the connected economy**

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**Shaping the future**

This increasing reliance on smart technology is more than simply a lifestyle revolution. It also has massive implications for Europe’s future industrial strategy. Smart technology will drive the future of advanced economies around the world. If Europe is to play a leading role in this and embrace the fourth industrial revolution, then it needs to play a part in shaping the technology that makes it possible. It needs the capacity to design, develop and manufacture semiconductors, securing its own supply and maintaining a leading role in research. If not, it risks undermining its competitiveness in a pivotal area of innovation.

““The EU needs to carve out its own space in this ongoing shift to a digital economy. It should be central to its long-term commitment to research and innovation. The EU must be the master of its own destiny in Smart technology; a leading - and independent - ‘player’ in electronics and electronic systems,” explains Bert De Colvenaer, Executive Director of ECSEL JU.

“However, the approach needs to align EU and Member State efforts, making them efficient and avoiding duplicating efforts. This is a main component of ECSEL JU’s role; we bring the right stakeholders together at the right levels and help build the right connections. That’s our organisational challenge; executed effectively, ECSEL JU provides Europe with the strategic platform it needs to build long-term capabilities in this field.”
Creating compact, highly-focused environments

However, fulfilling this long term objective will only be effective if Europe has access to an ongoing stream of innovation. This is another of ECSEL JU’s key roles. Contrary to popular perception, innovation in smart applications is not the exclusive reserve of corporate technology giants; even household names such as Apple, Microsoft and Nokia came from humble beginnings. In fact, many of the newest and best ideas and applications start life within SMEs. These create the compact, highly-focused environments where the determination and enthusiasm to pursue new ideas and applications can flourish. The ECSEL JU has an important role to play in helping these SMEs to thrive. By establishing and encouraging clusters of these smaller companies, it creates an environment that offers support, promotes collaboration and stimulates knowledge transfer, generating returns greater than the sum of their parts.

From desktop to global market

Clustering has another upside; by creating hubs that concentrate expertise and entrepreneurship, it makes it easier to attract the attention of potential investors and partners. In a sector where applications may have a global reach, this is vitally important. Smaller companies may be designing innovative new applications and products, but may lack the finance - or the desire - to go from the desktop and drawing board to market. Often, they will look to work with larger companies to exploit their ideas. Attracting capital investment or commercial partners lets them access the resources and skills they need to turn ideas into applications and applications into products.

Trailblazer role

ECSEL JU also plays the role of trailblazer here, by helping to fund pre-competitive research in areas that offer high potential for Europe’s future. Along with its industry partners, it invests in pioneering projects in smart energy, smart health and smart mobility. Sharing risk with partners encourages exploration of areas of research that single companies may otherwise find too onerous to pursue alone. Equally importantly, ECSEL JU also acts as a leading light for the other European Joint Undertakings, attracting its own cluster of complementary projects.

“The ECSEL JU is the leading instrument for securing essential and key enabling technologies in Europe”, insists De Colvenaer. “Each project actively contributes to Europe’s sustainable wellbeing, security and prosperity. We also help enable participating countries in developing innovation while strengthening Europe’s global competitiveness in this critical technological area”.

“The EU must be the master of its own destiny in Smart technology; a leading - and independent - ‘player’ in electronics and electronic systems”
The high demand and consumer requirements, in markets such as wireless communication applications, have always been strong technology drivers for advanced packaging. The process of finding new solutions for increased performance, improved form factors and reduced costs is ongoing. The progress made in packaging technologies for consumer products are later transferred and adapted to more demanding applications, such as automotive, industrial, medical/healthcare and aerospace, after a wide market acceptance and technology maturity have been reached.

Even though research and development activities in electronics are still in a major part done in Europe, 90% of the semiconductor manufacturing supply chain has moved to Asia-Pacific during the past 2-3 decades. The increasing complexity of electronic systems creates a chance to bring back manufacturing and packaging value chain to Europe, as the need for advanced packaging, for instance multiple sensor integration into system-in-package increases. In order to achieve the impacts, there is a need for a collaborative approach along the value chain, via new business models.

The EuroPAT-MASIP project will reinforce the European semiconductor manufacturing position through focusing in the semiconductor and MEMS packaging ecosystem. Semiconductor packaging, assembly and test involve most of the semiconductor value chain, ranging from material suppliers to software design and packaging foundries to test houses. EuroPAT-MASIP will consolidate and extend the leadership in semiconductor processing know-how, by developing and fostering packaging related technological and manufacturing building blocks, serving different (emerging) industrial sectors.

EuroPAT-MASIP will increase the competitiveness and the global market share of the European semiconductor industry by fostering the competence and capabilities of semiconductor packaging. The project’s consortium will take steps to facilitate the collaboration of European semiconductor and MEMS packaging ecosystem, in order to ensuring a co-creation network after the project have completed. EuroPAT-MASIP will actively promote the capabilities and the related ecosystem, feeding also to attracting talent and academic education issues. Ultimately, the project results will increase the attractiveness for private investments and talent by developing and promoting the key capabilities to match the future needs of European industries and emerging technology drivers.
Images play a central role in human perception and understanding of our environment. In the same way, Cyber-Physical Systems need visual context and awareness to make autonomous and correct decisions, and eventually take appropriate actions. However, advanced image and video processing is compute intensive and challenging.

FitOptiVis will balance power demand versus performance of the increasingly complex distributed configurations in Cyber-Physical Systems, reflected in the growing number of sensors, actuators and other smart devices, their growing autonomy, and the increased need for performance. This complexity increases even more when multiple heterogeneous sensor inputs are combined for analysis and through integration of both generic and specialised devices. On top of that, CPS need to satisfy rigorous constraints on real-time behaviour, safety, security, reliability, quality, performance and energy consumption. FitOptiVis will provide end-to-end multi-objective optimisation for imaging and video pipelines of CPS, with an emphasis on the latter two elements – energy and performance.

The objective of FitOptiVis is to develop a cross-domain approach covering a reference architecture, supported by low-power, high-performance smart devices, and by methods and tools for combined design-time and run-time multi-objective optimisation within system and environment constraints. Low latency image processing is often crucial for autonomy, and performing the right interaction of the CPS with its environment. Many CPS demonstrators in the project have sensors and processing at distributed places. For many reasons (parts of) CPS have to operate on low energy, whereas the complete system needs results with low latency. The focus of the project is on multi-objective optimisation for performance and energy use. However, other qualities, like reliability, security etc. also play a role in the optimisation.

FitOptiVis will provide a reference architecture supporting composability built on suitable component abstractions and embedded sensing, actuation and processing devices adhering to those abstractions. The reference architecture will support design portability, on-line multi-objective quality and resource management and run-time adaptation guaranteeing system constraints and requirements based on platform virtualization.

Start date         1 June 2018
Duration                                                                  36 months
€M Total costs / EU / National                   22.5 / 6.7 / 7.6
Number of participants                                                      30
The European and global automotive industry currently faces the challenge of reducing CO2 emissions, since improving air quality and avoiding global warming is high priority on the agendas not only in Europe, but also in the rest of the world. With a share of approximately 23%, the transportation system in Europe contributes significantly to the total greenhouse gas emissions and global warming. By a tremendous increase of affordable and efficient electric and hybrid vehicles, Europe can pave the way for a decarbonized transport system. Nevertheless, this is only one of many important measures that are needed to fight global warming. HiPERFORM will directly address this topic with the introduction of wide band-gap power electronics in the drivetrain of electric vehicles. The project’s activities will help to secure Europe’s top position in industry and research along the value chain of vehicle, semiconductor, and test system design and manufacturing. With the design and development of efficient power electronics, HiPERFORM will have a positive impact on the next generation of highly efficient electrified vehicle systems, chargers, and test systems.

HiPERFORM will deal with all areas of GaN power electronics (from base materials to complete subsystems), with a special focus on the enhancement of reliability and applications with lower voltage, like 48V systems. Since a broad community worldwide is undertaking research activities in the area of GaN, investments in research for GaN devices are key to secure innovations and patents. In addition, latest SiC components will be introduced into new architectures, controllers, and applications for advanced inverter systems in high power drivetrains and test systems to reduce the energy losses and reduce the components weight and size of modern EV-drivetrains.

The expected project results will enable the European manufactures of wide bandgap-based electric vehicle components, charging devices, and test systems to deliver excellent technologies for the automotive industry, to develop next generation affordable green vehicles. Affordable electric and hybrid vehicles will pave the way for the envisioned green transportation system. All citizens will directly benefit from longer driving ranges, less energy consumption, and lower prices due to the advanced technologies in next generation electric vehicles. Moreover, the European electronic components industry and system suppliers will tremendously profit from the expected results in this research project. The outcome will also safeguard current jobs as well as build the base for further growth in all sectors.

HiPERFORM

Start date          1 May 2018
Duration                                                                  36 months
€M Total costs / EU / National                 41.2 / 11.8 / 9.3
Number of participants                                                      33
The ongoing digital transformation of the European industry will create enormous opportunities for business and society. Researchers and business leaders recognize the role of digital technology, which is shifting from supporting processes towards becoming the enabler of fundamental business innovation and disruption.

However, companies aiming to benefit from digitization will have to radically re-think not only how they can apply digital technology, but moreover on how they can increase their level of digital maturity to better integrate their processes – most notably development and production – within a future digital value chain.

iDev40 introduces seamlessly integrated ECS development processes, safe and secure digital automation workflows, interoperable and inter-organizational network solutions as well as an enhanced transparency of data and intelligence that will lead to a reduction in the time to market (T2M) race for ECS solutions. This project will take the human factor seriously throughout all planned industrial use cases and will increase people excellence by identifying human-centric complexity drivers for integrated development and production, defining the right skill profiles of the employee in the factory of the future to cope with digitalization challenges and thereby scale digital technology adoption.

Concerning the impact beyond the ECS industry itself, it is obvious that competitiveness of key European industrial domains heavily depends on the availability of leading edge ECS. 80% to 90% of the key differentiating competitive features of e.g. leading edge industrial and mobility suppliers are dependent on the built-in electronic components and software.

Thus, the strategic goal of iDev40 is to enhance essential competencies for ECS “Made in Europe” to support in a sustainable manner European companies that have dominant global positions in key application areas such as efficient use of limited energy resources, smart mobility as well as in equipment and materials for worldwide semiconductor manufacturing.

Ultimately, iDev40 will foster European Leadership on Industry 4.0 as an important measure to safeguarding more than 15,000 jobs directly in the participating partner facilities, ~50,000 jobs of the people employed at all industry partner facilities worldwide as well as ~3 Million jobs in the whole European ECS value chain.
Smart mechatronic systems, a specific class of cyber-physical systems (CPS), face increasing constraints on size, speed, precision, adaptability, diagnostic capability and connectivity. At the same time, they need to accommodate ever more demanding smart cognitive features. Addressing these constraints is essential for building smart and reliable production Systems-of-Systems (SoS). These new SoS demand highly capable, flexible, stable and reliable motion control infrastructures which cannot be delivered by outdated commercial automation products.

I-MECH will provide augmented intelligence for wide range of cyber-physical systems having actively controlled moving elements. This implies new demands also on bottom layers of the employed motion control system, which cannot be handled by available commercial products. This motivates the main mission of this project - bringing a novel intelligence into Instrumentation and Control Layers, essentially by bridging the gap between latest research results and industrial practice in model based engineering fields.

Service Oriented Architecture (SOA) concepts will be used to achieve a high degree of configurability, scalability and interoperability of the individual components, while maintaining the reliability, safety, certifiability and time-to-market benefits of off the shelf solutions. The project vision is to provide enhanced motion control intelligence for wide range of CPS involving actively controlled moving elements. In consequence, such CPS will:

- be able to measure the performance of its individual instrumented parts (drives, sensors, actuators)
- optimize and adapt control actions according to condition and machine dynamics changes
- be able to actively detect and reject residual vibrations when pushing machine performance to the physical limit
- learn during repeating tasks and optimize its performance automatically
- accommodate new sensors and actuators with different performance profiles
- integrate multiple motion and control activities on multi-many core platforms

The high added value of I-MECH reference platform will be directly verified in high-speed/big Computer Numerical Control (CNC) machining, additive manufacturing, semiconductors, high-speed packaging and healthcare robotics. The platform will also be applicable in many other generic motion control fields. The project outputs will impact on the entire value chain of the production automation market and, through envisioned I-MECH center, create sustainable proposition for future smart industry.
Smart mobility offers the potential to solve many of Europe’s urban traffic challenges. But can the EU’s innovative ECSEL Joint Undertaking, in the words of famous futurist Jules Verne, mean “making real what others imagine?”

Our modern economy increasingly depends on a mobile workforce and the capacity to work remotely and flexibly. At a time when a return to inner-city living is regenerating urban areas, increasingly overcrowded road and rail is holding us back. While advances in technology seamlessly shape this new way of living, how we leverage these advances for personal mobility lags behind. Although the long-term solution – upgrading transport networks – remains a necessity, we need other, more radical, approaches to help ease the strain.

Thanks to research being undertaken by several projects funded through the EU’s Electronic Components and Systems for European Leadership Joint Undertaking, the solutions for personal mobility may be more radical than we expect. We could soon be stepping inside cars with robot drivers. While the robots may not resemble those we know from science fiction, what’s important is that they are – literally – just around the corner.

That’s JU, as in Jules Verne

Get smart

The robot drivers form part of Smart mobility solutions. This approach uses technology to tailor availability to demand, integrating trains, buses, trams and cars. It offers major potential benefits, and is a concept strongly favoured by the innovative thinkers behind the ECSEL JU. It will reduce traffic congestion and accidents, improve urban air quality and shorten commuting times.

Another likely consequence of smart mobility is that people living in cities will no longer rely on individual car ownership; they will use much more public transport and on-demand vehicles. This is no bad thing; despite the resources they consume, private cars tend to be used rarely and their parking footprint shrinks our road capacity.

Mobility on demand

It is here that the crucial promise of Smart Mobility lies; autonomous vehicles specifically designed for urban transport, available on demand through a few taps on a Smartphone app. This will lead to far fewer vehicles using our roads, and those that do will be use them more effectively and efficiently. They will also bring the benefits of personal transport to a wider range of social groups including the young and the elderly.

If the concept of driverless cars and taxis seems far-fetched, it may surprise you to know that there are a growing number of examples already on our roads. A convoy of self-driving trucks recently drove 2,000 kilometres on motorways across Europe. Meanwhile in 2016, a
transport company pioneered a fleet of driverless vehicles in Pittsburgh. The next step, already being taken, are moving from these tentative experiments to fully planned, coordinated and universally accessible smart mobility.

Managing complexity

The most challenging element is replacing the existing operating system - the human brain. Managing the level of complexity required to independently drive a vehicle is a remarkable achievement; convincing the public that allowing technology to control their vehicles is safe will be another.

In reality, no single system will do this. Instead, a series of interconnected technologies working in harmony - some networked, some onboard - is the solution. These will need to be fully compatible, using identical parameters and metrics and be able to communicate with other vehicles. Most importantly, all systems need to work together to fail safe for all users; passengers, pedestrians and other road users.

Sensor sensibility

Fortunately, many of the safety devices that autonomous vehicles will need already exist, including light and rain sensors, adaptive speed control and automatic braking. Currently however, conditions such as rain and snow tend to make them less effective. Therefore a number of ECSEL JU projects are already working to make them smarter and more effective. Two of these - DENSE and RobustSense – are working to validate a suite of sensors, including radar and laser-based technologies, that effective in all weathers. According to Project Coordinator, Werner Ritter, “It’s the first time that such a full array of technologies has been tested as a package, and will represent a major advance in all-weather environment perception.”

ECSEL JU projects are also working to support industry. ENABLE S3 is using technology to virtually test and verify the safety and security of these complex systems before deployment. This will shorten lead times and keep costs down. This will be a €60 billion industry within ten years; success for ENABLE S3 will help keep Europe’s automotive sector globally competitive.

New ECSEL JU projects in this field include AutoDrive, HIPERFORM and PRYSTINE – you can read more about them in this Book of Projects.

Jules Verne is widely recognised as one of the first modern writers to bridge the gap between science and the public. What, one wonders, would Verne make of the current mix of scientific research and the creation of economic and societal added value at the heart of the ECSEL JU’s trailblazing smart mobility projects?
European industry faces stiff global competition. The electronic systems become more and more complex and demand modern engineering practices to tackle productivity and quality. The model-based technologies promise significant productivity gains, which have been proven in several studies. However, there is a need for more research and development to scale these technologies for real-life industrial projects and provide advantages in runtime.

MegaM@Rt will create a framework incorporating methods and tools for continuous development and validation leveraging the advantages of scalable model-based methods to provide benefits in significantly improved productivity, quality, and predictability of large and complex industrial systems. The project brings the model-driven engineering to the next level in order to help European industry to reduce development and maintenance costs, as well as to reinforce productivity and quality.

The specific scientific and technological objectives include development of:

- Scalable methods and tools for modelling of functional and non-functional properties such as performance, power consumption, security, and safety with mechanisms for representation of results of runtime analysis.
- Scalable methods and tools for application validation at runtime including scalable methods for models@runtime, runtime verification, and testing.
- Infrastructure for efficient handling and management of numerous, heterogeneous and large models potentially covering several functional and non-functional domains.
- Holistic traceability capable to link and manage models and their elements from different tools, and suitable for large distributed cross-functional working teams.
- Specific demonstrators and validation of MegaM@Rt technologies through 9 complementary industrial case studies.

MegaM@Rt will significantly increase productivity and quality of system development and shorten time-to-market for complex systems. This will help to reinforce European scientific and technological leadership in the design of complex systems. The project will also improve competitiveness of European companies that rely on the design and integration of complex systems in their products by reducing design and maintenance costs as well as the time-to-market.
Micro-transfer-printing, or μTP technology, is a key enabler for smart systems integration thanks to its various unique features. The know-how and processing capability for the μTP technology needs to be transferred from a research level to an industrially relevant environment in order to make use of the various advantages of the μTP technology. To achieve this objective a μTP tool used for research application with manual-handling, will be re-designed and adopted to be suitable for industrial manufacturing.

MICROPRINCE will create a pilot line for heterogeneous integration of smart systems by micro-transfer-printing (μTP) in a semiconductor foundry manufacturing environment. Functional components like processed III/V devices, optical filters, and special sensors will be transfer printed to demonstrate the capabilities of the technology and the pilot line. The project will demonstrate its capability on five defined target application scenarios:

- μTP for magnetic sensors
- μTP of optical filters on photosensitive sensors
- μTP for silicon photonics
- μTP for LED devices and
- μTP for life science applications

The design and characterization of such heterogeneous integrated systems will be supported by advanced design and simulation technologies. Furthermore, the MICROPRINCE pilot line will target cost-effectiveness and energy-efficiency in production of robust and stable processes, as well as technology and product diversification with high yield and outstanding quality in a world-class environment.

The project will create a new environment for the heterogeneous system integration to enable innovative ECS solutions as a crucial building block to tackle societal challenges and to strengthen Europe’s industrial leadership. MICROPRINCE will improve the competitiveness of industrial small, medium and large enterprises and strengthen the position of research institutes. This will influence the long- and medium-term position in key markets leading to economic and employment growth in the European Union. The development and production in Europe will also strengthen the world market position through new innovative products and smart solutions enabled by μTP.
For the last years, electronic components become more and more widespread in the automotive industry. Today they create a superior value for the final customer and represent an important vector of differentiation in the industry. The sharing economy model, which drives innovation strategies in Smart mobility, will further increase the need for safe, cost efficient, secure, reliable and unhackable operations. This will enlarge costs of electronics and software in the total cost of a vehicle.

OCEAN12 will bring very concrete technological solutions and corresponding demonstrators for this problem. Based on the innovative Fully Depleted Silicon On Insulator (FD-SOI) technology, the project will develop new processors and applications design, which will leverage FD-SOI to offer the industry’s lowest power consuming processor and components, mainly for automotive and aeronautic applications.

The OCEAN12’s team will also develop a technology platform benefiting from FD-SOI design’s extreme low leakage and operating voltage (Vdd) scalability attained thanks to reverse and forward body biasing (RBB/FBB) of the integrate circuit and its power system architecture. This high performance, low power solution will enable the next strategic generations of smart vehicles.

This platform will rely on:
- a pilot line facility capable to manufacture advanced substrates compatible with 12FDX technology,
- the definition of path finding solutions to push 12FDX technology performances and substrates solutions for innovative sensors,
- the development of innovative designs at the forefront of state of the art to enhance FD-SOI capacity and guarantee the highest level of integrated solutions,
- the manufacturing of high performance ICs using all palette of FD-SOI technologies

The produced highly integrated, reliable, ultra-low power and lower cost components will be integrated in complex embedded systems accessible to the automotive industry suppliers, as well as manufacturers, answering strategic challenges of future autonomous vehicles generations (land or air). Several product demonstrators are targeted: high end microcontroller plug and play board, high performance sensors data fusion, highly integrated low power video processing, awaking systems.

The project will highlight Europe’s unique leading position on FD-SOI technology, integrating the entire manufacturing chain - from substrate suppliers and foundries to TIER-1 and OEM, involving academia and RT0’s. By doing so, it will secure a unique FD-SOI roadmap beyond the 22FDX.
A bout 10% of the western population will, at a cer-
tain age, be taken to hospital for heart surgery, such as treatment of an arrhythmia or a heart valve replacement. Fortunately, most of these interven-
tions can now be done using minimally invasive tech-
niques, assisted by a host of smart imaging and sensing catheters, that are the “eyes and ears” of the surgeon di-
rectly at the point of intervention. Many clinical studies have underlined their value in improving the outcome of interventions and in reducing cost. However present de-
vices from traditional catheter manufacturers are made with outdated 20th century technology, requiring exten-
sive and costly manual assembly.

This is where POSITION-II steps in - the next generation of smart catheters developed within the project will:

• Use open platform technologies that are steered by roadmaps enabling end-users to focus on applications, rather than technology development. The technology platforms will be accessible to multiple end-users;
• Bring digitization at the tip to reduce wires and thus as-
sembly cost and pave the way towards standardization and wireless connectivity to “unclutter” the cath lab;
• Enable a better diagnosis by using state of the art sen-
sors and (ultra-sound) MEMS devices, and signal pro-
cessing directly at the tip of the instrument. A unique pan-European MEMS ultrasound transducer benchmark with 8 participating companies and institutes is organ-
ized to align development and avoid duplication;
• Streamline the work-flow in the cath lab, resulting in a more intuitive work environment for the surgeon, result-
ing in less errors and better diagnosis.

POSITION-II will establish a pilot line for realising the next generation of smart catheters and implants. Many scalable, open technology platforms, based on essen-
tial technologies contributed by a number of European companies, will be integrated into one manufacturing network.

Building on work from the INCITE project (ENIAC 2014), and the infrastructure developed in the InForMed pro-
ject (ECSEL JU 2015), POSITION-II will further enable Europe to become an innovator in smart catheters and implants, by building on Europe’s strength in medical di-
agnostic equipment and monitoring systems. It will also consolidate Europe’s number one position in cath lab in-
frastructure, by taking the lead in the development of the next generation smart catheters.
Productive4.0 is an ambitious innovation project with partners from academia and industry, led by Infineon Technologies. As a brain pool, the framework is meant to link the potential of Digital Industry and maintain a leadership position of these industries in Europe. "Industry4.0" promises smarter and more flexible production, better use of resources, new standards and improved work environment.

Preventing the digital transformation

New technologies and tailor-made solutions that allow efficient design and integration of the hardware and software of Internet of Things (IoT) devices are needed to link the digital with the real world. The project addresses various industrial domains with one complete approach, focusing on three main interdependent fields: digital production (DP), supply chain networks (SCN) and product lifecycle management (PLM).

Productive4.0 is currently the biggest project within ECSEL JU and is the basis of the Industry4.E Lighthouse Initiative. It started in May 2017 and aims to promote the development of technologies that facilitate digitalising the industrial sector. Over a period of three years, 108 stakeholders from 19 European countries will work on hands-on solutions by means of Electronics and ICT across the entire value chain – up to TRL8.
Productive4.0 has ten main objectives:

- Furnish the Digital Industry with SoS-based architecture platforms
- Set up a data analytics framework and a secure communication environment
- Provide the industry with IoT-enabling components
- Develop complex simulation models for DP, SCN and PLM
- Create powerful systems for planning, virtualising and controlling
- Foster relevant standards in the industry
- Establish the Productive4.0 Framework as a cross domain platform for the Digital Industry
- Provide for practical solutions and reference implementations for the Digital Industry
- Implement reference product use cases for the different industrial domains
- Establish an appropriate environment for the Productive4.0 brain pool partners

One example use-case is the production of a shaver system, where a link between the electric shaver itself and the production facilities will be implemented. Several sensors will form a link between the process lines and the components, and data analytics will guide the development of future consumer products. The results will be available to different stakeholders.

Another example is vehicle individualisation in a highly automated Automotive assembling process, in the logistics based on product lifecycle management systems. Autonomous transport systems or smart logistics robots will make the whole production more flexible, reduce costs and allow for an improved and predictable quality.
Smart catheters: reaching the tipping point

Ronald Dekker knows a great deal about medical technology, particularly when it’s being used to treat heart disease. However, this is not only because he works for Philips Medical as a technologist in their catheter laboratory division. His knowledge also comes from personal experience, as he was successfully treated for a heart arrhythmia a few years ago.

In line with many such procedures, the physicians treating Ronald used a minimally invasive technique. This involves guiding a catheter through a vein and into the heart, following its progress on a screen. The advantages of such an approach are immense. No longer do cardiovascular surgeons need to open a patient’s chest; instead they can be treated under local anaesthetic and often sent home the same day. These techniques dramatically lower the risk of complications or infections and offer a much more rapid recovery.

Fast forward

However, as Ronald himself noted, although the surgical procedure at the time was state-of-the-art, the catheters his doctors used were something of a blunt instrument compared to current technology. Fast forward a few years and catheters are increasingly ‘smart’. The tips can incorporate a range of sensors such as miniaturised ultrasound probes; for a physician dealing with a blocked artery, this can provide vital information. Knowing the size and shape of the occlusion can help tailor the treatment required.

Yet despite the clear advantages these smart catheters offer, they are only just beginning to realise their potential. This is because virtually all the smart catheters currently available rely on technology that is practically obsolete.

Given the rapid advances in so many areas of technology, this may seem surprising. However, it reflects a particular challenge that their development poses.

Valuable tools

Historically, many of these devices were usually the result of individual manufacturers choosing to add extra functionality to their products. Normally, this was to address a specific problem or situation; a so-called ‘point solution’. To do this, they went to local electronic developers to get them to add the relevant technology to their specification. Once validated, it turned out that these were genuinely valuable tools. However, as one-off solutions, further incremental improvements were not an option, since little, if any, thought
was given to how to mass-produce or improve the technology.

If the potential of smart catheters was to be fully realised, it needed an approach to the technology that makes mass production feasible. Herein lay the problem; the capacity to squeeze more and more components onto silicon wafers has increased dramatically. However, the area of silicon wafer available within a smart catheter is tiny. Without economies of scale, innovation at this level is bespoke and prohibitively expensive.

**Individual needs**

The solution lay in developing an open technology platform for smart catheters. Correctly structured, using an open specification would offer sufficient commonalities to make mass production of relevant silicon wafers viable, while allowing tailor-made solutions to be introduced for specific applications.

**Collaborative approaches**

However, the open platform was only part of the solution. Having established the feasibility, the next step was to address manufacturing infrastructure. For medical devices, particularly invasive devices, this is a major consideration. They need to be manufactured to highly-specific standards, covering not simply materials but also the need to deploy clean room facilities, etc. In addition, smart catheters create challenges of their own, as they need to combine silicon-based electronics with polymers. The ECSEL-sponsored InForMed project has helped assemble the critical mass of expertise needed to tackle these challenges, ultimately developing a pilot manufacturing facility in the Netherlands.

For Dekker, these collaborative approaches are a core reason why the ECSEL projects work so well. “As a technologist, I’m always excited by the idea of combining technological advances to make new things; these projects give me the reason and opportunity to engage with different partners.” He acknowledges that ECSEL funding clearly plays a role, but he sees it as a facilitator of collaboration aiming to create breakthrough innovations, rather than a motivation in itself. “The funding is extremely welcome but for most collaborations it’s not pivotal. Undoubtedly it acts as an oil to help ease the process of engagement, opening doors to other companies. It allows the projects to become larger, but also more concrete and impactful. In the end, the real value for all of us is in what comes out of the collaboration.”
PRYSTINE

Fully automated driving is one major enabler to master the Grand Societal Challenges of safe, clean and efficient mobility, and autonomous driving will affect society and most disruptively change the automotive industry as we know it today. Consequently it will also greatly impact the semiconductor industry and open new market opportunities, since semiconductors play an indispensable role as enablers for automated vehicles.

Fail-operational behaviour is essential in the automation chain, in order to handle safety-critical situations on its own. State-of-the-art approaches cannot reach this, in part due to a lack of reliable environment perception and sensor fusion.

PRYSTINE will realize Fail-operational Urban Surround Perception (FUSION) which is based on robust Radar and LiDAR sensor fusion and control functions, to enable safe automated driving in urban and rural environments. It will strengthen and extend traditional core competencies of the European industry, research and universities in smart mobility and in particular the electronic components and cyber-physical systems domains.

Technically, project targets are to develop and validate new, fail operational HW/SW platforms, high performance and dependable perception (sensor fusion on different levels) and AI-based decision-making algorithms – the functional safety methodologies are applied from the chip to the system level.

PRYSTINE will deliver:
- fail-operational sensor-fusion framework on component level;
- dependable embedded E/E architectures, and
- safety compliant integration of Artificial Intelligence (AI) approaches for object recognition, scene understanding, and decision making within automotive applications.

The resulting reference FUSION architectures and reliable components for autonomous systems will be validated in 22 industrial demonstrators, including an electrical and highly automated commercial truck equipped with new FUSION components (such as LiDAR, Radar, camera systems, safety controllers) for advanced perception and a highly connected passenger car anticipating traffic situations.

PRYSTINE’s well-balanced, value chain oriented consortium, is composed of 60 project partners from 14 different European and non-European countries, including leading car manufacturers, Tier-1 suppliers, engineering and semiconductor suppliers as well as supply chain partners, technology integrators, universities and research institutes. The project will also have significant impact on smart regions. High tech jobs in the area of innovation toward automated driving which are expressed core competences of the participating countries such as Austria, Germany, Italy, Spain and the Netherlands.
R3-POWERUP

3-POWERUP will push through the new generation of 300mm Pilot Line Facility for Smart Power technology in Europe. Through electric mobility and industrial power efficiency, the project will enable the European industry to set the world standards for innovative and competitive solutions for critical societal challenges, such as energy saving, CO2 Reduction, as well as sustainable environment.

Smart power ICs are key enabling components for applications in which Europe is playing a leading role: from mid-power automotive, to industrial power, battery management systems for HEV, FEV and electric bikes, domotics, LED lighting for both indoor and outdoor, computer and industrial peripherals. Power and RF nanoelectronics represents about 30% of the industrial semiconductors business, and has been characterized by a stable growing market. The global demand for power electronics in systems is expected to have a CAGR (Compound Annual Growth Rate) of 2% until 2020. This will drive the market to 134 Billion US$ within the 2020. At the moment, 300mm fabs for Smart Power devices are present or announced only in the USA and in Asia.

This is where R3-POWERUP steps in. It will establish the first 300mm Pilot Line in Europe for Smart Power and discrete power devices featuring 90nm lithography for high-density logic, analogue and power devices and embedded Non Volatile Memories for the realization of complex Systems-on-Chip. As such, it will fill the existing gap in the availability of 300mm Pilot Lines in Europe, which covers only Logic CMOS and discrete power devices.

This project builds on the accomplishments of its precursor R2POWER300, a project currently running under ECSEL JU Call 2014, which can be considered as a preparatory study for the big leap from 200mm to 300mm fab.
At the onset of the 21 century, the semiconducting pure silicon (Si) chip launched the revolution of electronics and computerisation that massively influenced life, as we know it; since then Electronic Components and Systems (ECS) are a high-growth area, with a worldwide market growing faster than the industry average. Pure Silicon technology is about to reach its performance limit and the ECS industrial race has so far been limited only to increasing wafer size (12” and over), where Asia and USA are winning by the most aggressive competition.

A new promising technology arises: Silicon Carbide (SiC). Compared with Silicon, SiC power devices have significantly better characteristics, make more efficient energy conversion devices possible. The lower on-resistance for the same breakdown voltage rating means a reduction in losses, resulting in an increase in power conversion efficiency, and the low source-drain capacitance result in much lower switching losses, enabling higher frequency operation. This gives improved PFC (power factor correction) in switch-mode power supplies (SMPSs), allowing inductive components and snubber networks to be either reduced in size or eliminated.

This results in a reduction in overall system size and weight, as well as a reduced cost of these components, which should outweigh the extra cost of using SiC devices rather than Si ones.

Nowadays worldwide SiC wafer production is still limited at 4 or 6 inches only and its state of the art availability is still limited to small-scale production due to several scientific/technical challenges.

REACTION will build the first worldwide and European eight-inch SiC wafer pilot line facility for power technology. The project will re-set European competitiveness, rearranging worldwide factories competition at the 8-inch wafer level, cancelling the gap and making the new silicon carbide technology industrially mature. This will enable European industry to set also the world reference of innovative and competitive solutions for critical societal challenges, like Energy saving and CO2 reduction as well as sustainable environment through electric mobility and industrial power efficiency.

It will have a terrific potential impact on the semiconductors market, on the continental value-chain of system applications as well as on the European semiconductors manufacturing strength. This will include the IP assets gained during the build-up phase, with a positive fall-out on business and job creation.
Creating trust in wireless solutions and increasing their social acceptance are major challenges in achieving the full potential of the Internet of Things (IoT). SCOTT will provide comprehensive cost-efficient solutions for end-to-end secure, trustworthy wireless connectivity and interoperability, to bridge the last mile to market implementation. SCOTT will not just deal with ‘things that are connected’, but with ‘trustable things that securely communicate’, i.e., things interconnected by dependable wireless technology and valuing the end-users’ privacy rules.

SCOTT uses a standardised multi-domain reference architecture, created in a predecessor project, DEWI and its “Bubble concept”. SCOTT has a clearly use-case driven approach, with 15 use cases from different areas of high relevance to European society and industry, with a specific focus on cross-domain use cases and heterogeneous environments, emphasizing 5G and cloud computing aspects to build up digital ecosystems and achieve a broader market penetration.

More than 20 demonstrators all over Europe will show tangible results from all use cases to a broader public. Nearly 50 technical building blocks for security/safety, distributed cloud integration, energy efficiency/autonomy of devices and reference architecture/ implementations, which are all necessary to realize the SCOTT use cases will facilitate composability of systems as well as cross-domain sharing of trustable wireless technologies and services.

SCOTT project consortium covers the full value chain from silicon to end-users and operators. By providing reference implementations, SCOTT will establish an eco-system for trustable wireless solutions and services for both professional and private users by attracting 3rd parties and particularly SMEs. The involvement of open innovation approaches and stakeholder engagement as well as close cooperation with AIOTI (Alliance for Internet of Things Innovation), and other cluster organizations all over Europe will further boost and exploit the growing “Internet economy”.

SCOTT will open up new market opportunities for European industry, will significantly reduce time to market and decrease costs for trustable wireless solutions on the market, in particular by using new designs and technical building blocks. SCOTT will develop methods and tools capable of meeting prospect use-case requirements on reliability, robustness, security and functional safety even in harsh and/or not trusted environments.

Ultimately, SCOTT will foster the European leadership for Smart and Connected Things (including Internet of Things) and will strengthen Europe’s independence for security enabling components and systems.
Fully autonomous vehicles and robotic surgery machines have enormous potential to change society. However, the combination of safety, security & privacy of connected and automated systems is still a concern in multiple application domains for many consumers in Europe. As the trust to adopt these technologies is not yet here for many potential users, the industry and research communities need to work on an answer to ensure that these concerns are no longer roadblocks for further evolution in the transport and medical sectors.

The high-level goal of SECREDAS is to develop software for validating architecting methodologies, reference architectures, components and suitable integration, as well as verification approaches for automated systems in different domains. These will combine high security and privacy protection while preserving functional-safety and operational performance. SECREDAS will take a first important step to developing and enhancing trustworthiness, particularly for the future European transportation and medical industries. This will help to make connected and automated vehicles a reality, and ensure that European Original Equipment Manufactures (OEM) remain competitive and can maintain their world leading position. In addition, SECREDAS addresses cross-domain cybersecurity and safety related technologies in the areas of automated systems in the medical, railway & aerospace sectors, as well as support cross-domain actions.

Within SECREDAS, a number of relevant user scenarios with specific requirements of safety, security and privacy will be studied in detail. Together with current state-of-the-art reference architectures, the user scenarios will lead to a next generation of reference architectures and common elements for multiple application domains, supported by tooling incorporating design and development methodologies. On top of common generic elements to safeguard safety, security & privacy, a number of domain-specific solutions will be designed. With the inclusion of the automotive sector in particular, and the addition of the medical, railway and aerospace spin-outs, SECREDAS will enable a wide application of its results.

SECREDAS brings together a consortium with partners from 15 different countries, covering the whole automotive value chain (OEMs, TIER1’s, TIER2’s), key players in the medical area, a number of players in other transport domains (railways, aerospace) and key research institutes in order to tackle the objectives in a balanced way between generic common offerings and domain-specific solutions.
The way humans interact with machines (Human Machine Interfaces) has evolved, from single push buttons, keyboards & mouse to touchscreens. However, touching a screen can be inconvenient or even unsafe in lots of situations. How easy would it be if devices could be controlled with a simple gesture? Through voice commands, digital sound modulation and face recognition, the user interface technology will ultimately come to understand human ‘body language’. Never before was a user experience so rich!

Gesture recognition applications already exist, but most of them based on a video or a camera. Plus, they require lots of energy, they are expensive, and they can infringe our privacy. SILENSE will focus on using smart acoustic technologies – ultrasound in particular - the advantages of which are immense: they use a much simpler, smaller, cheaper and easier to use transducer. Even existing loudspeakers and microphones can already provide some functionality to support gesture control. The ambition of this project is to develop and improve acoustic technologies beyond state-of-the-art and extend their application beyond the mobile domain.

SILENSE will prove that acoustics can be used as a touchless interface, by improving or developing different smart acoustic technology blocks (hardware, software and system level) and employing them at system level.

At technology level, the SILENSE project will:

- adapt and improve cost, performance, directivity and power consumption of (MEMS) acoustic transducers (incl. testing and qualification);
- integrate arrays of acoustic transducers with other electronics, using advanced (3D) packaging concepts;
- develop smart algorithms for acoustical sensing, localization and communication;
- combine voice and gesture control by means of the same transducer(s)

At the application level, SILENSE will use acoustical sensing for touchless activation/control of mobile devices, wearables and, more generally Internet of Things (IoT) nodes. Demonstrators for smart home applications, such as a smart screen, smart automotive applications, and smart mobile/wearable applications will be built.

SILENSE is first-of-a-kind in many ways.Gesture control technology is only now being explored and introduced in different domains to enable more and more applications: it could be the ‘next big thing’, making SILENSE a unique opportunity for Europe to take a leading role in the development of novel human-machine and machine-machine interfaces for a wide-range of existing and emerging markets.
The TAKEMI5 project discovers, develops and demonstrates lithographic, metrology, process and integration technologies enabling module integration for the 5nm node. The project enables innovations to support the expected growth of needs of private persons, companies, public organizations and to provide better options to address the main societal challenges and the internet of thing infrastructure.

This main objective is realised with available EUV/NA 0.33 scanners that are optimized for mix & match with existing DUV/NA 1.35 scanners, and with system design, development and integration of a new hyper NA EUV lithography tool to enable more single exposure patterning for the 5nm node to create complex integrated circuits.

Process steps to achieve module integration in Front-end, Middle and Back-end of line are discovered and developed using the most advanced tool capabilities and they are evaluated morphologically and electrically. During the development, specific challenges in metrology are assessed and metrology tools are upgraded or newly developed. The results are demonstrated in the imec pilot line with qualified metrology tools enabling module integration at the 5nm node.

The TAKEMI5 project relates to the ECSEL work program topic Process technologies – More Moore. It addresses and targets (disruptive) new Semiconductor Process, Equipment and Materials solutions for advanced CMOS processes that enable the module integration of electronic devices for the 5nm node in high-volume manufacturing and fast prototyping. The project touches the core of the continuation of Moore’s law which has celebrated its 50th anniversary. The cost aware development process supports the involved companies, and places them in an enhanced position compared to their worldwide competition.
The overall objective of TAPES3 is to support the continuation of Moore’s law in line with the worldwide industry roadmap. Focus is on exploring and preparing the next innovations required to bring the industry’s capability in the fields of lithography, patterning, metrology, mask infrastructure and process modules to the levels required for creating 3nm products. To enable the industry to keep on Moore’s law projection, 3nm pilot manufacturing capability needs to be ready by 2022.

This objective requires not only bringing EUV lithography resolution, focus control, overlay performance and productivity to the next level, but also paying attention to process, device architecture and design solutions to effectively reap the benefits of 3nm technology at system level. Solutions required need to be sought in lithography, optics and metrology improvements, mask manufacturing, patterning, alignment, particle control, device architecture, standard cell and logic design. It is the combination of advancements in all these areas that eventually enable effective application of 3nm process technology in next generation product development. In TAPES3 a consortium of worldwide leading edge companies collaborate and take on the challenge of finding solutions to enable the next generation technology – the 3nm.

The project touches the core of the continuation of Moore’s law. Moreover, the cost aware development process will support the involved companies, and will place them in a preferred position compared to their worldwide competition. Through their worldwide affiliations, the impact of the TAPES3 project will be visible outside of Europe, in American and Asia Pacific semiconductor centres, and is expected to have a large benefit to the European economy by supporting its semiconductor equipment and metrology sectors with innovations, exports and employment.
TARANTO aims to break down technological barriers standing in the way of the next generation BiCMOS technology platforms, combining improved radio-frequency performance of Heterojunction Bipolar Transistors (HBT) with the high level of integration.

High-speed, high-data rate and affordable communication systems, for example 5G, that are enabled by TARANTO are mandatory in, for example, intelligent, automated transport systems. The superior radio-frequency performance of SiGe HBT makes BiCMOS technologies a key enabler for many applications which require the combination of high-performance radiofrequency (RF) front ends with the high computational power and low power consumption.

The main technology objective is to develop HBTs offering high maximum frequency (Fmax: 600GHz) built into very high density CMOS processes from different suppliers: 130 / 90nm from Infineon and 55 / 28nm from ST Microelectronics, while IHP will work to achieve maximum frequencies of 700GHz, seeking compatibility with Infineon and ST BiCMOS processes.
WAKeMeUP will set up a pilot line for advanced microcontrollers with embedded non-volatile memory, and design and manufacturing for the prototyping of many innovative applications.

Driven by the requirements of demanding end applications, especially for decreasing the power consumption, the project will target the industrialisation of the embedded Phase Change Memory (ePCM) technology built on top of the FDSOI 28nm logic process pilot line.

WAKeMeUP will build on the already defined microcontrollers with 40nm embedded flash technology in order to establish a solid manufacturing platform. Additional developments include the integration of memory, power management, connectivity, strong security on the same chip.

The WAKeMeUP consortium will study alternative memory solutions, as they have different - and complementary - traits in such areas as read/write speed, power and energy consumption, retention and endurance, and device density, and are benchmarked with the ePCM and the conventional eFlash. Continued advances in materials, device physics, architectures and design could further reduce the energy consumption of these memories.

To generate high value added semiconductor circuits in Europe using a breakthrough leading edge technology, the project will deploy all necessary activities to bring this new technology to an early industrial maturity stage. These activities include a number of further enhancements, including extended reliability, and temperature range (up to 165°C), high security demands, high flexibility, etc... as well as prototyping demonstrators in the different application areas - Smart Mobility and Smart Society.

The project will reinforce the leadership in microcontrollers where Europe is strong and the market is increasing. The first target of WAKeMeUP product demonstrators is the automotive market where the growth rate is expected to be the highest among all the electronic components. However, WAKeMeUP covers all aspects of the electronics industry, and the widest range of applications, not only automotive, but also secure payments, and all kinds of smart objects and appliances.
WinSiC4AP will develop reliable, efficient and cost-effective Silicon Carbide (SiC) technology bricks for applications addressing social challenges and market segments, such as automotive, avionics, railway and security, where Europe is a recognized global leader.

Silicon Carbide (SiC) represents the forthcoming alternative to Silicon (Si) to get a higher efficiency and a higher power density in electronic devices. SiC devices have the capability to withstand high currents and high breakdown voltages, and to operate at high temperatures. Hence, power systems based on SiC will exhibit a much higher efficiency and power density, also with smaller device size and lower losses for passive components (higher switching frequency) and miniaturized auxiliary cooling systems (higher operation temperature).

Though almost the full spectrum of SiC devices is available, at least at R&D level, the processes and the components are not yet always tailored for the different applications. WinSiC4AP aims to address this, working on the co-design of the system, of the semiconductors (together with its packaging) and of the passive components together, particularly focusing on the key sectors of mobility (electric road vehicles, railway systems, airplanes aerospace avionics) and energy distribution and conversion.

WinSiC4AP relies on the strength of a vertical approach, allowing the optimization of the technologies by fitting application requirements, developing the full ecosystem and by tackling the relevant issues (e.g. the reliability and the EMC) inside the project. It will develop new topologies and architecture for targeted applications, simulating at laboratory level the operational environment, driving the needed yet still missing technologies, components and demonstrators.

This approach will fill the gap between the current state of the art and the very high demanding specifications, will improve the competitive lead of EU Industries along the value chain, in a context where other geographies are currently accessing SiC technology to enter in the market.
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 authorities¹. 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 academia) 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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