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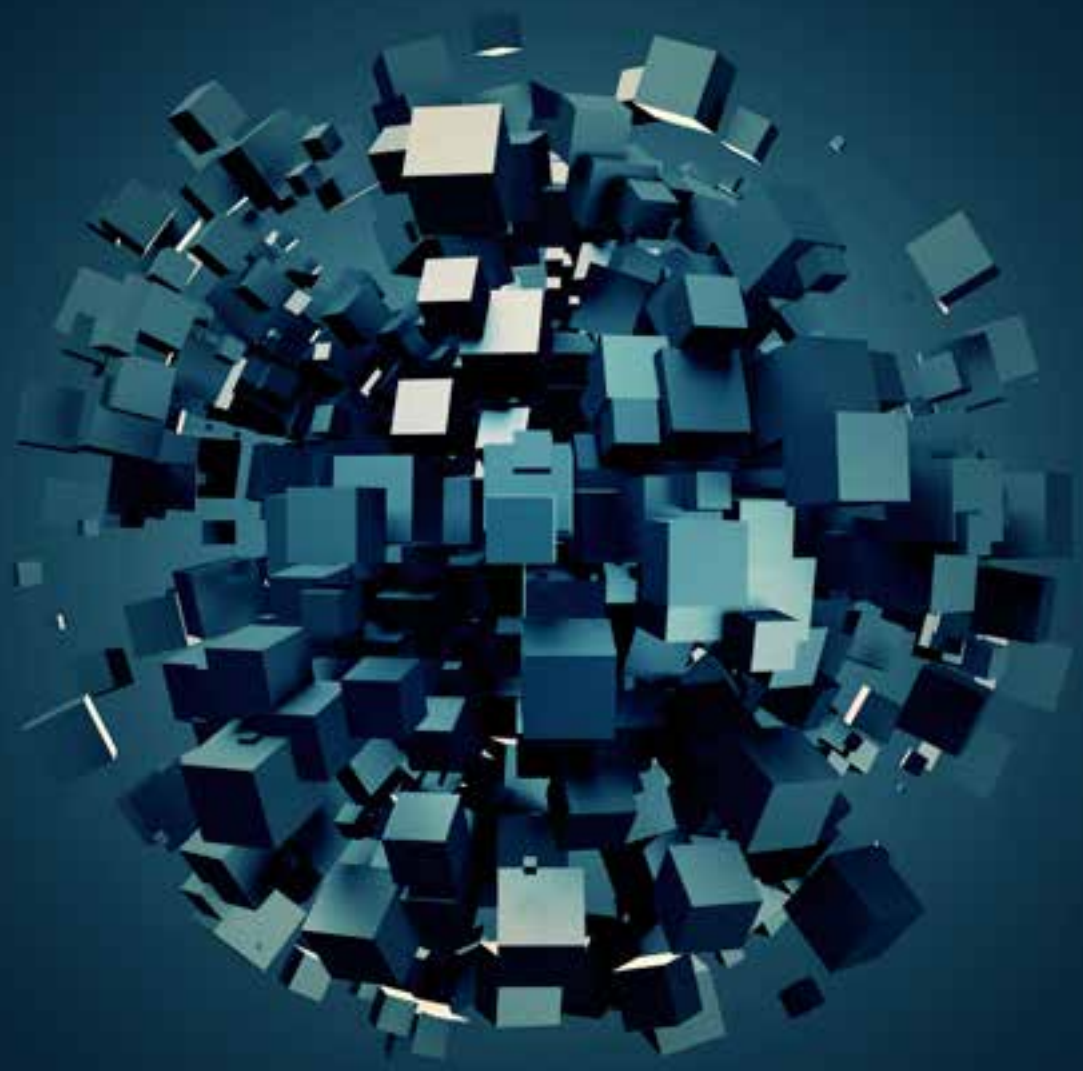


Automated Driving: Safer and More Efficient Driving in the Future

The Pathway to the Digital Transformation: An Opportunity for Europe

ARTEMIS Industry Association

DEWI: Dependable Embedded wireless infrastructure

eScop at and beyond the finish line

FOREWORD

Dear ARTEMIS friends,

Our industry association has reached a new milestone: a full update of the ARTEMIS Strategic Research Agenda (ARTEMIS SRA). This update was launched during our Spring Event in Vienna on April 13 this year. We thank the team of experts for all the work they have put into this document, and especially Laila Gide, the chair of the Working Group SRA. As Laila Gide says in her article in this magazine: the ARTEMIS SRA provides a pathway to the digital transformation or digitisation of Europe.

The SRA highlights in a broad way all topics in the field of Embedded Intelligence and Cyber Physical Systems on which Europe has to work on in the coming 10 years to remain/become European leadership. Focus areas are Embedded & Cyber-Physical Systems (as such), Internet of Things and Digital Platforms, although there are no sharp delineations between these focus areas.

All these elements have been discussed during the Spring Event in Vienna; you find a short report in this Magazine by Iris Hamelink.

During the spring event on April 13 the famous prof. Edward Lee from Berkeley University gave a very interesting key note presentation on Embedded Intelligent Systems in which he stressed the importance of deterministic models in relation to the real world which is very often non-deterministic. His presentation can be downloaded from the ARTEMIS-IA website. Before Edward Lee came to Vienna, he was interviewed by Chris Horgan; you find the interview (Cyber-Physical Systems: a coin with two sides) in this magazine.

After Austria and Germany, now also Italy has started an ECSEL group. Roberto Zafalon reports about it.

On the topic "Automatic Driving" Daniel Watzenig gave an interesting presentation in the ARTEMIS Technology Conference last year, and he recently co-edited with Martin Horn a book on this topic that will be issued in May of this year. Daniel gives some background information of the book in this magazine. Daniel further gave in February a presentation to the Commission on the "Importance of Embedded Software in Automated and Automotive Developments"; Chris Horgan reports on this.

Important ARTEMIS-JU projects are highlighted in this Magazine: Arrowhead (by Jerker Delsing), DEWI (Werner Rom at al.), EMC2 (by Werner Weber and Erwin Schoitsch) and ESCOP (by the ESCOP project team).

Jürgen Niehaus reports about the quo vadis of the important topic "Interoperability Specification" and its coordination by ICF (Interoperability-specification Coordination Forum).

Finally you can find an interesting article by Martijn Klabbers from EIT Digital, on education in our field of interest "Internet of Things through Embedded Systems".

I wish you an en enjoyable read.

Jan Lohstroh
Secretary General of the Industry Association

CONTENT

THE PATHWAY TO THE DIGITAL TRANSFORMATION: AN OPPORTUNITY FOR EUROPE

by LAILA GIDE

This is the motto of ARTEMIS-IA SRA renewed edition of March 2016 that has been published during ARTEMIS-IA Spring Event at Vienna.

Indeed, Embedded Intelligence is key enabler for the Digital Transformation and it is described in the SRA as the silent revolution touching our everyday life in all aspects, our businesses and ultimately our society.

But this transformation has a price as the growing complexity of products, systems and services with built-in embedded intelligence are relying on software development cycles and programming. Mature, interoperable software tools are now needed more than ever.

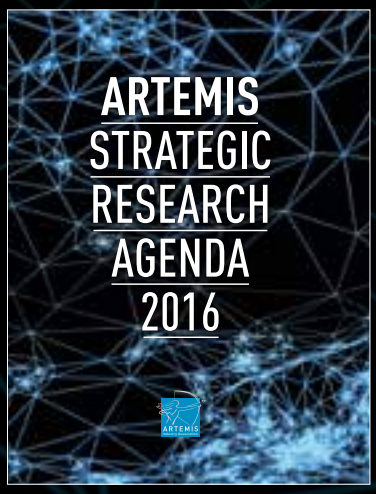
The ARTEMIS-IA new SRA therefore put the high value creation of software as a core priority in order to serve the users and business. Indeed the economic visibility of Embedded Intelligence is vital to the European Embedded Systems industry, whether large-scale business platforms or nano-transactions between IoT's. Software-driven transactions can be scaled very efficiently, which opens up interesting opportunities across many application markets. Embedded Intelligence adds value for each of these areas in various forms like increased functionalities, reduced engineering time, improved product quality, increased raw material efficiency and higher OEE market and sales platforms.

For Europe to take advantage of the disruptive technologies shaking the computing systems areas, and to realise the digitisation vision of European businesses, a stronger software ecosystem is needed to nurture sustainable, interoperable CPS software development. This is a major challenge for Europe within the global competition and availability of funding is indispensable.

The renewed vision and strategy of the present SRA includes the paradigm shift in the smart products where the emergence of highly distributed and large-scale Cyber-Physical Systems means that software has to live in an open and highly dynamic world, enabling these smart products to be remotely and continuously upgraded via their embedded software, thus generating a large variability of products and services, and making their production cycle and time on market more economical, more environmentally friendly and responsible.

The hyper connected society required us to revisit the research strategic planning and its agenda to take account of this digital transformation, and to maximize the impact of the technological solutions on value creation, businesses and market.

It became evident to continue the cross-domain approach adopted since ARTEMIS-IA SRA 2006, and to reinforce it by building better and more efficient technological solutions to be stronger together in the context of global competition. This new approach aims to complement the cross-domain approach to provide components or subsystems as building blocks, in a Model Driven xxx. The purpose is to increase development efficiency, enhance usability, to achieve better and easier adoption of engineering methods and tools, and to provide a holistic product/system view covering the whole life cycle and from a system-of-systems perspective.



The SRA 2016 meant to summarize in a comprehensive and short manner the main ARTEMIS-IA objectives in order to enable a more agile and shorter development cycle through stronger and wider adoption of design by composition and correct-by construction principles and to focus on research topics that would lead to higher-productivity, higher value software creation.

Laila Gide

Overcoming the fragmentation in the European supply base for the components and tools of design and engineering can be achieved by increasing investment and research in tools and reference platforms and their interoperability to maximize their use on the global market.

Extending the use of digital platforms to build the eco-systems is needed for accelerating the innovation and the creation of new business models goes hand in hand with security and user's trust considerations as they are essential features for any smart product and related services to be successful and meet a sustainable market acceptance and uptake.

In conclusion, the emerging Digital evolution relies heavily on Embedded Intelligent Systems technologies in domains where it is paramount that Europe takes a leadership role.

This renewed Vision and Strategy aims to follow this path in order to accomplish the ARTEMIS ambition and become a world-class initiative in the Embedded Intelligence and Cyber-Physical Systems.

We need increased investments to support our Research Agenda and to sustain our proposition of an "Innovation Environment" allowing high value creation in the new generations of smart products and services. Giving the right economic visibility of Embedded Intelligence is of utmost importance to the European Industry for the Digital Future of Europe.

I tried to give you a glimpse on the content this new ARTEMIS-IA SRA edition, where the Working Group experts conveyed the essentials for our Strategic Research.

Enjoy!

ECSEL MIRROR GROUP ITALIA

by **ROBERTO ZAFALON**

On December 16th, 2015 it was held in Milano (Italy) the founding event of ECSEL-ITALY, the Italian Mirror Group of ECSEL, with the participation of Italian leading industrial and academic partners. At this important event, both ARTEMIS-IA, AENEAS and EPoSS gave their endorsement and support to maximize the dissemination through their public channels.

Roberto Zafalon, STMicroelectronics Italy, is member of the Steering Board of ARTEMIS-IA and he devoted some great energy during 2015 to trigger the ECSEL-ITALY's idea. He is currently Steering Board member and the Chairman of the ECSEL-ITALY "Working Group on Regions and ESI Funds". He has accepted to talk about **ECSEL-ITALY** to the ARTEMIS Magazine.

Roberto, can you explain in a few words what is ECSEL-ITALY?

ECSEL-ITALY is the Italian Mirror Group of ECSEL. It is a strong cooperation initiative, triggered by key industrial Partners, federating the Academia, the National Association of Electronics Industry (ANIE) and the National Research Council (CNR), and it follows similar

initiatives in Germany and Austria.

What's the motivation to create ECSEL-ITALY?

Europe is a strong market for the Electronic industry, and it is world leading in several key sectors like automotive, medical, security, and industrial. To sustain and expand this position, it is necessary to invest in research, overcoming the present fragmentation between European, National and Regional initiatives, and supporting the full value chain, from Research to Product's Innovation, from components to electronic systems and embedded software. ECSEL-ITALY aims to implement the integration of all actors of Electronics eco-system nation wise.

Who are the stake-holders of ECSEL-ITALY?

ECSEL-ITALY aims at creating a strong link among industrial and academic research in the fields of Nanoelectronics, CPS and Smart Systems Integration.

The industrial stakeholders include Key partners and SME: among them STMicroelectronics , Lfoundry S.r.l., Finmeccanica S.p.A., Bitron, Thales Italia, Applied Materials, CRF-FCA, Soft-in, LPE SpA, IFEVS et al.

The academic partners include University of Bologna, Politecnico Torino, Politecnico di Milano , University of L'Aquila, IU.NET Consorzio Nazionale Interuniversitario per la Nanoelettronica, and CNR IMM.

The main associations participating in ECSEL-ITALY are **AEIT** - Associazione Italiana di Elettrotecnica, Elettronica, Automazione, Informatica e Telecomunicazioni, with its branch Society AMES, the **AIGE** Associazione Gruppo Italiano di Elettronica, representing Italian academics working in Electronics and coordinating and promoting Research & Innovation for electronic systems, components and technologies, the **ANIE** Federation, part of Confindustria, with over 1,200 industrial firms (Large and small/medium Enterprises) in the electrical/electronics business.

ANIE: *this Industrial Sector involves more than 1,200 firms, employing more than 410,000 qualified people, with an aggregate turnover of 55 Billion EUR per annum. Indeed, it is a proof of technological excellence made in Italy, mobilizing 30% of the annual private investment in Research & Innovation country wise.*

I would like also to stress the fact that the ECSEL Mirror Group Italy brings together Italian partners of the three IA's who are part of the Private Members Board of the ECSEL Joint Undertaking, i.e. AENEAS, ARTEMISIA and EPOSS, with the goal to foster a comprehensive "System View" across the electronics components and system industry in Italy.

What are the goals of ECSEL ITALY?

+ to promote networking and collaboration between Research, Associations, large industry and SMEs, mobilizing also private money to innovation and risk-investment
+ to aligning the Italian participation in ECSEL to the level deserved by its Electronics Industry.
+ to involve Central and Regional authorities, through the Smart Specialization concept, to strengthen all possible resources and synergies, to ensure that the funding for Research and Innovation in Italy for Nanoelectronics enabled technologies is up to the industrial relevance of the sector.

To this purpose, two working groups have been created inside ECSEL-ITALY, to facilitate and support the decision process at Regional and National level, respectively.

Further activities will be dedicated to create and share the vision, create demand, identify the potential for Italian participation in the call for proposals and create a Top level support in each Participating Organization, Company and Public Authorities.

It sounds to be an ambitious program. Do you think you can achieve it?

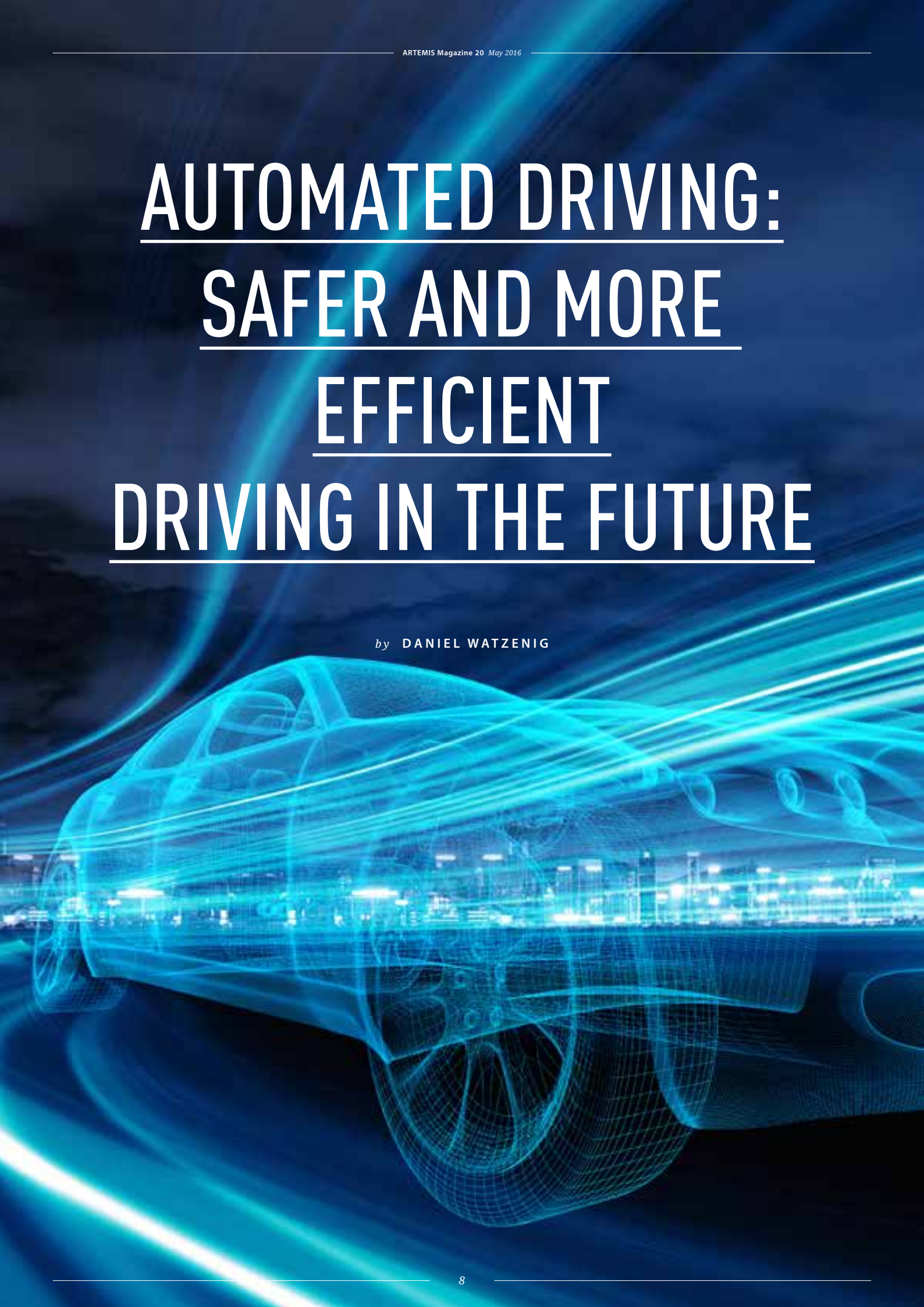
In only 5 months from its birth, ECSEL-ITALY has already been instrumental to boost the Italian budget in ECSEL: 18.5 MEUR in 2016 up from 2.5 MEUR in 2015.

This is a great preliminary result! isn't it? …We are looking forward for the future!

ECSEL-ITALY is now fully registered as a no-profit Legal Entity and, as such, it is fully eligible to participate to H2020 funded projects. Actually, we already shot a CSA under H2020-ICT-2016 call, recently closed on mid-April, with the purpose to cluster similar initiatives at European level in the field of Smart Systems.

AUTOMATED DRIVING: SAFER AND MORE EFFICIENT DRIVING IN THE FUTURE

by **DANIEL WATZENIG**



Daniel Watzenig on the current state of the art along with the research, technology and engineering challenges of automated driving in Europe anno 2015

About a year and a half ago, Daniel Watzenig (more on Daniel in the Baton Blues column) came up with the idea of inviting various people from industry and academia to contribute their thoughts to what is quickly becoming an increasingly prominent topic: automated driving. The book which he has co-edited with Martin Horn – Automated Driving: Safer and More Efficient Driving in the Future[1] – is now about to be published by Springer in May or June this year. We put a few questions to him.

What was the motivation behind this book?

"Being very much involved in the field, I wanted to find out what the state of the art was in terms of automated driving. Where is industry and where is research at this point in time? Where are we heading and what are the prospects for this revolution in road traffic and transport? The book is geared almost exclusively to presenting a technical overview, so non-technological aspects like legislation, public acceptance and liability are not considered, except where those are directly relevant.

"Until the end of the last century, automated driving was something confined to the realms of science fiction but the technology has caught up to such an extent that it is already becoming science fact. The main topics of the book include advanced control, cognitive data processing, high-performance computing, functional safety, and comprehensive validation. These topics can be seen as the technological building bricks to drive forward automated driving. The current state of the art of automated vehicle research, development and innovation is presented and the book also addresses industry-driven roadmaps for major new technology advances as well as collaborative European initiatives supporting the evolvement of automated driving."

To whom will this book appeal?

"The book will certainly be of interest to academics and researchers within engineering, graduate students, automotive engineers at OEMs and suppliers, ICT and software engineers, managers and other decision-makers. The book contains the views of carmakers from BMW to Volvo and university research centres from Aachen to Stockholm. Each chapter contains both perspectives. The 22 chapters present a snapshot of the state of the art in 2015. One specific chapter is devoted to the automated driving related projects in Europe, and ARTEMIS is very well represented in that respect, being at the forefront of a number of initiatives here, such as SafeTRANS[2]. Another key project highlighted is the ITS (Intelligent Transport Systems) corridor from Rotterdam to Vienna because this shows how important the infrastructure is in the whole automated driving picture, especially when you consider how automated vehicles rely on data coming in from the outside, whether from roadside equipment, other vehicles or the cloud."

Is there sufficient R&D in Europe in this domain of automated driving? And is Europe still competing with Asia or the US in this domain?

"It's quite fascinating to see that, for example, you have Renault and Nissan engaged in collaboration and there are more examples of Euro-Asian partnerships is all kinds of automotive areas. So in some respects that leaves the US as the main competitor if you like. Europe tends to be more conservative in its R&D whereas the US has a get-up-and-go attitude, with caution thrown a little bit to the wind. In part, the complexity of legislation and regulation in Europe that manufacturers have to negotiate does mean that developments take a little longer to take hold and flourish. But the engineering is both strong and thorough so that when a technological 'extra' does come onto the market, bit German, French, Swedish or other manufacturers, it will have had to prove itself according to the most rigorous requirements. What this says about the state of R&D in the domain of automated driving, therefore, is that when R&D results actually go into practice, they will have passed the most stringent demands. In fact, I would go so far as to say that our expertise in Europe is so good and so renowned that there might even be the danger of a brain drain west to carmakers in the US."

Daniel Watzenig

How do you think the public will take to automated driving?

"While this is not really the focus of the book, it is a relevant, even tough question to answer. We can solve the technical questions but with security and privacy top of the mind, these are issues that won't go away and have to be dealt with, whether by legislation, a shift in attitude, culture … No, it's not an easy one. We have to convince the user that automated driving is about improving safety and comfort, to give the driver confidence and relieve driving workload and stress. Automated driving has the potential to drastically reduce road fatalities – there are already driver assistance systems like LDW (lane departure warning) or ACC (adaptive cruise control) that are already making driving safer and less stressful. But, of course, driving is just as emotional an activity as it is rational. You want to get from A to B safely and comfortably but you also want to 'feel' the driving experience. I think that firstly the 'acceptance' will have to be gained in a structured or controlled environment before automated driving finds its place in the mixed vehicle/infrastructure environment. But I think that in the future our children's children are likely to know nothing other than the automated driving environment."

[1] ISBN 978-3-319-31893-6

[2] http://www.safetrans-de.org/

CYBER-PHYSICAL SYSTEMS: A COIN WITH TWO SIDES

by **CHRIS HORGAN**

Interview Prof. Edward Lee, UC Berkeley

Edward A. Lee is the Robert S. Pepper Distinguished Professor in the Electrical Engineering and Computer Sciences (EECS) department at U.C. Berkeley. His research interests centre on the design, modelling and analysis of embedded, real-time computational systems. He is director of the nine-strong university TerraSwarm Research Center (http://terraswarm.org), a director of Chess, the Berkeley Center for Hybrid and Embedded Software Systems, and director of the Berkeley Ptolemy project. From 2005-2008, he served as chair of the EE Division and then chair of the EECS Department at UC Berkeley. He is co-author of nine books (including second and third editions) and numerous papers. He has led the development of several influential open-source software packages, notably Ptolemy and its various spinoffs. He received a B.Sc. in Computer Science from Yale University, New Haven, CT, in 1979, a Master's in EECS from Massachusetts Institute of Technology (MIT), Cambridge, in 1981, and a PhD degree in EECS from the University of California Berkeley, Berkeley, in 1986. From 1979 to 1982 he was a member of technical staff in the Advanced Data Communications Laboratory at Bell Telephone Laboratories in Holmdel, New Jersey. He is a co-founder of BDTI, Inc., where he is currently a Senior Technical Advisor, and has consulted for a number of other companies. He is a Fellow of the IEEE, was an NSF Presidential Young Investigator, and won the 1997 Frederick Emmons Terman Award for Engineering Education.

Referring to an article in the ARTEMIS magazine (April 2014) in which professor Alberto Sangiovanni-Vincentelli gave his views on the differences between the USA and Europe in terms of their respective approaches to research, development and innovation of Cyber-Physical Systems, Edward Lee could only concur with his eminent colleague. "In terms of what is happening in Europe and the US, Alberto's insight is hard to beat. While European industry tends to be more conservative than US industry, I feel compelled to point out that exceptions do exist. Good examples are Airbus, which is much more aggressively using new technology in safety-critical software than Boeing, and the Bosch Rexroth printing press in 2008, which was a cyber-physical factory that used Ethernet and TCP/IP for real-time networking in a safety-critical system. At the time this was quite unique but I believe this is something that we will see become pervasive in the future, especially among automotive manufacturers."

What are, then, the essential differences in approach?

"Most European industry is probably more hard-core industrial revolution – machinery – and the systems tend to be much more safety-critical than, shall we say, a Facebook page. In the US you have a lot of dominant companies that come from the IT world, like Google, starting to move into the physical world, as in its self-driving car. But apart from the safety-critical Google car, there is more of a tendency to probe those areas that are less safety-critical and so there is more of a shoot first, ask questions later mentality. I also think that there is a much greater culture of entrepreneurship in the US along with a more established venture capital machinery in place. This fuels an approach towards innovation that involves small groups of younger entrepreneurs that aggressively go after speculative targets."

Digitisation? A term to be revered or reviled?

"I first heard the term when I was in Toulouse for ERTS2, where I gave a keynote talk a month or so ago. I don't like the term, for two reasons. One is that it reminds me of the shift towards the paperless office in the 1990s. Digitising all the papers that we have and putting them into the IT environment. Although that is clearly not what is meant, it just has that connotation for me. But the second, and more fundamental, reason is that it reflects a bias that the problem of CPS is to make physical systems more cyber. I believe the problem is much more symmetric. I believe it's an equally difficult problem to make cyber systems more physical. Perhaps even harder. I think this gets to the heart of what I believe is the intellectual challenge behind CPS. On the physical side of engineering, the history of engineering methods and tools goes back a few hundred years or more. Computer science, on the other hand has been around for just a hundred years at most, developing a set of engineering methods and tools that focus on processing information. That was considered the job of a computer. But CPS has changed that perception with the notion that the job of a computer is to sense and actuate what is happening in

"I'm a great believer in leveraging and using existing technology but we must not get stuck and just assume things have to be the way they are."

the physical world. And the engineering tools that have been developed in the computer science world are not very good at doing that job. The problem is that dynamics – how the system changes over time – in the physical world is important but in computers it doesn't matter. And that makes for a mismatch. We have an engineering tradition that we're trying to use for something for which it was not intended. But Moore's Law allows us to get away with a lot of sloppy engineering."

So what can we do about it?

"Well, if we want to digitise the factory floor, we have to get the software to talk to the machines. It's a problem with contradictory requirements. And, as an academic, it's the kind of problem I like to tackle. CPS is full of such problems. We want everything to be connected but we also want everything to be secure. We want things to scale up but we want behaviour to be repeatable and controllable. Such fundamentally contradictory requirements are fuel for innovation."

Square pegs in round holes?

"In many ways I feel there really is a cultural gulf between the cyber and physical sides. The separation between computer science and physical engineering is more evident in the US than in Europe. In my view, that's an enormous mistake."

Despite all the problems, what achievements have been made in the field of CPS in the past decade?

"A lot has happened, no doubt about it. And there has been progress, too, at least in terms of potential. Like a lot of people, though, I'm frustrated by the generally slow pace of uptake of new technology in industrial automation. Of course, engineers have good reason to stick with what they know to be reliable and robust. They will eye with some scepticism someone like me who comes to them very excited with a new technology that is fundamentally unproven and ask them to help me prove it. Of course, for them there is a huge risk involved. That said, I believe the stage has been set over the past ten years for some really radical advances in the near future."

Such as?

"Networking technology. The technology that was originally developed for using the internet is becoming eminently usable in CPS. One of the reasons for this is the introduction of high-precision clock synchronisation protocols, which ultimately enable software in a distributed system to orchestrate its actions in a very controlled way, much as the Bosch-Rexroth printing press I referred to earlier. Another example is that you can take embedded systems and put them on a bigger network and, if reliably designed, connect them up to the internet in a way that is safe. The fact that this is now possible is potentially transformative because once these systems become networked, this will enable us to leverage a lot of other exciting developments in technology such as big data, where, using algorithms, data coming from a multiplicity of sources can be turned into intelligence. A third exciting development I would like to cite is the development of ubiquitous low bit-rate, low-cost wireless communication for IoT devices."

Your recent publication is entitled 'The Internet of important things'. Why do you add 'important'?

"I'm trying to correct a public misconception here. IoT is not simply about toys or for hobbyists; it's about serious systems. What I'm trying to convey is that we can and should be taking IoT to a much more mission-critical level, but it will take good quality engineering to do that."

So we could do better?

"Absolutely. I think that software and computing as construed in the 20th century represent a mismatch of technology. We really can do much better. For example, there has been a notion among computer engineers over the past 40 or 50 years that you can't improve performance without sacrificing control over timing. That has been debunked in a recent project, and was a bit of a surprise to many in the field. Distributed software is another example. I'm a great believer in leveraging and using existing technology but we must not get stuck and just assume things have to be the way they are. People coming at CPS from the physical side tend to lack a deep enough background in computing to be able to question the premises that are given to them in computing. But to rope in the computer experts is also an obstacle here, especially when many treat CPS as a niche, although this tends to be more of a problem in the US than in Europe where we have the separation I referred to earlier. In fact, I really enjoy visiting European institutions where there is a much greater sense of integration. And, in that respect, the US has a great deal to learn from Europe."

THE IMPORTANCE OF EMBEDDED SOFTWARE IN AUTOMATED AND AUTOMOTIVE DEVELOPMENTS

by **CHRIS HORGAN**

On 26 February this year, Daniel Watzenig, Head of the Electronics Department at the Virtual Vehicle Research Centre and Associate Professor at Graz University of Technology, was among a number of experts invited to an event hosted by Khalil Rouhana, Director for Components & Systems in the DG CONNECT, in Brussels. The main idea of this event was to explain the funding policy of the Commission and to highlight the need to avoid duplication and overlap but encourage complementarity. In this particular session, with the focus on embedded software in automated solutions and how different industrial sectors could learn from each other, Daniel had been invited to give a keynote. He took the opportunity to present his vision: Embedded Intelligence enabling Automated Driving.

"While the physical event took place in Brussels, there was a video link to the Luxembourg office, which enabled programme and project officers from the A1, A2 and A3 units to actually attend and participate in the event," Daniel explains. "I actually tried my best to highlight and to emphasise the importance of (embedded) software in the automotive world, in other domains, and also the beneficial cross-domain effects. For instance, security is a key issue especially in the aerospace domain and automotive can learn from this. In the ARTEMIS and ECSEL communities the cross-domain approaches are highly valued by the Commission. In addition, I made brief mention of the upcoming German roadmap driven by SafeTRANS, in which many people from the ARTEMIS community have a strong influence as well as the aready published Austrian Roadmap on automated vehicles which is strongly influenced by two ARTEMIS-IA Vice Presidents (Michael Paulweber from AVL and by myself). Werner Steinhoegl and Sandro D'Elia both from the European Commission gave short introductory talks and supported me in their statements, giving software a good push in the right direction. That was really good to see."

ARROWHEAD: BREAKING DOWN THE BARRIERS TO COLLABORATIVE AUTOMATION

by JERKER DELSING

With new dynamic interactions occurring between energy producers and energy consumers, between machines, between systems, between people and systems, and so on, cooperative automation is the key for these dynamic interactions and is enabled by the technology developed around the Internet of Things and Service Oriented Architectures. Arrowhead addresses these issues by focusing on collaborative automation and digitisation for production, smart buildings and infrastructures, electro-mobility and the virtual market of energy. The project provides n local automation cloud approach to support this collaborative automation and digitisation. The local clouds are supported by a number of core services enabling real time control, automation security and system engineering and administration. With the project entering its final twelve months, what has been achieved, where does the project now stand and what are the recent developments – technology, dissemination and business – that should excite the senses?

WIKI – LOWERING THE THRESHOLD, RAISING THE PROFILE

And how better to inform stakeholders, interested parties and the wider public about the developments, trends and results than through a wiki page, or the Arrowhead Framework Wiki, the main entry point to documentation and code for the Arrowhead Framework, which addresses IoT based automation based on the notion of local automation clouds. A local Arrowhead Framework cloud is comparable with a global cloud that provides improvements and guarantees regarding real-time data handling, data and system security, and automation system engineering.

The Arrowhead Framework builds on one of the fundamental principles of Service-Oriented Architecture, loose coupling. A service-consuming system has little or even no knowledge of other systems that provides the services it is interested in consuming. Systems can be deployed in networks without being initially bound to other systems, where service bindings (establishing a service instance provision-consumption binding) can be established, broken up or changed in runtime. Which is precisely what the Arrowhead Framework supports.

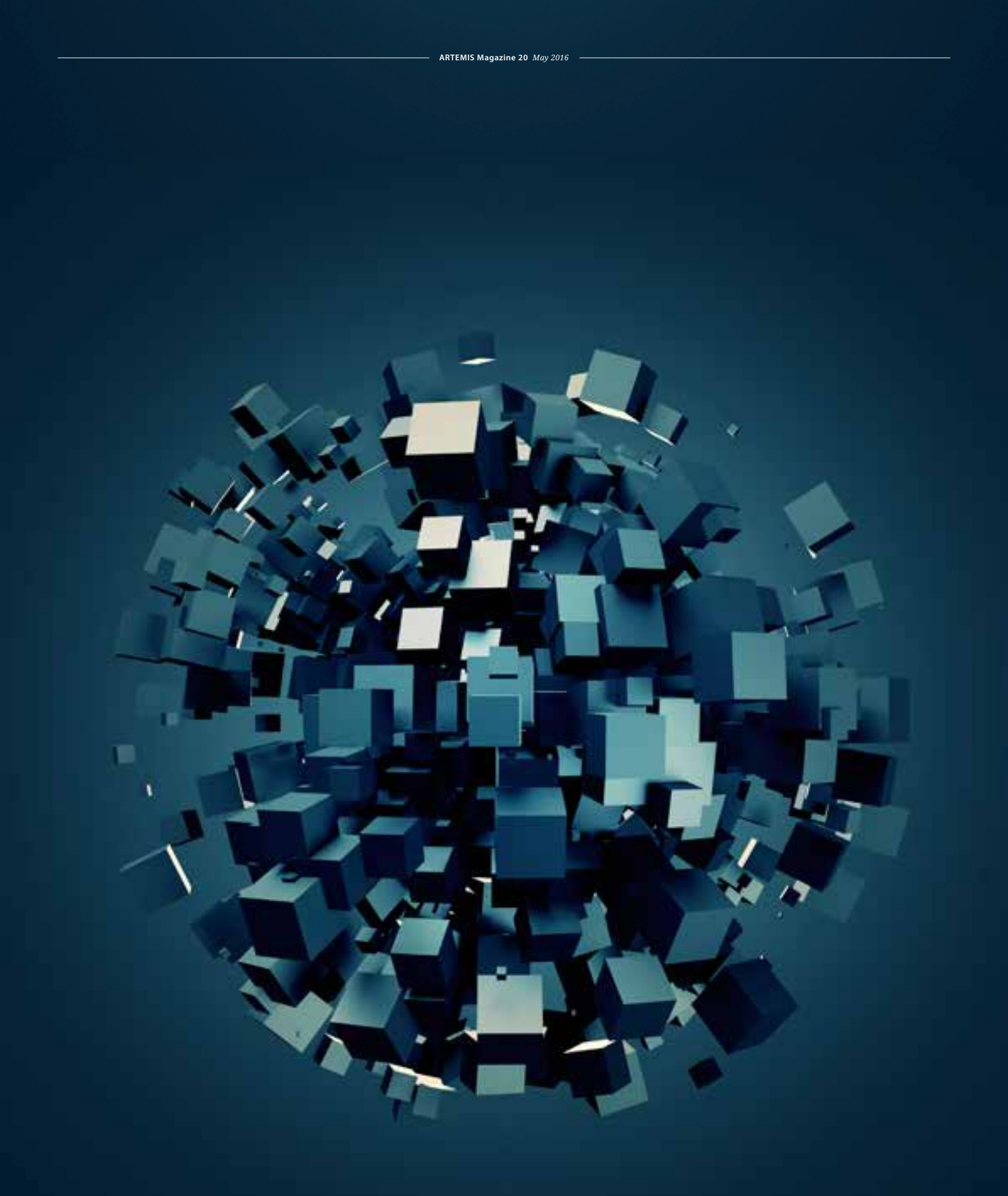
The wiki page contains links to architecture, code examples, working code and working systems plus documentation on how to use the Arrowhead Framework and how to implement your own IoT automation services and systems. The wiki aims to support the wider use of the Arrowhead Framework among the (potential) user community and act as a kind of meeting place where ideas can be shared and where organic growth and change can be facilitated .

A EUROPEAN PROJECT WITH WIDESPREAD, GLOBAL APPEAL

Of course, collaborative automation, driven by software and distributed through the Internet of Things, knows no borders. Over the past few months Arrowhead has scheduled the second generation of demonstrators and has been invited to give keynote speeches at a number of interesting and important conferences, which provided a real opportunity to spread the message about what the Arrowhead project is doing and accomplishing. Invited keynote speeches have been made at IEEE ETFA Sept. 2015, Luxemburg, DATASYS, Brussels June 2015, Swedish embassy, Tokyo Nov. 2015. As an outcome USA companies are voicing requests for the active standardisation of Arrowhead Framework. Good news spreads fast in our interconnected world, and with some companies already claiming that results of the Arrowhead project already enabling savings on engineering costs by a factor of five, it should be no surprise that the results of Arrowhead have filtered as far afield as Japan, where real tangible interest is being shown in the project. Project leader Jerker Delsing was recently invited to give a keynote presentation at the Japanese embassy in Stockholm, and a number of the Japanese company representatives present were keen to continue discussions. Furthermore, the world's largest mining company, BHP Billiton, has expressed interest in finding out more, with talks planned with representatives visiting Europe this year.

Speaking of mining, a good example of how the Arrowhead results have transferred into real technology is the Smart Rockbolt developed by Luleå University of Technology (LTU) and Eistec AB, winner of the IPSO (Internet Protocol for Smart Objects) challenge. Using results from the Arrowhead project, a low-power IoT device has been produced for industrial and mining applications. This device, a standard rock bolt with embedded electronics capable of a multi-year battery lifetime, aims to provide a safer working environment for people working in mines by providing online, real-time monitoring so that hazardous levels of seismicity or load will automatically generate optical alarms using multi-coloured high power LEDs, as well as wireless alarms in mine control systems. The design team employed 6LoWPAN for IP-based wireless communication, IPv6 and IPsec for secure communication, NTP for time synchronisation, CoAP for data transfer, OMA LWM2M for device management and metadata, and IPSO Smart Objects as the object model for sensors and actuators, among other technologies. Although the Smart Rockbolt is targeted at the mining industry, it could be applied to bridges, tunnels, quake infrastructure or any other domain that could benefit from vibration or load measurements.

It is very clear that the Arrowhead project has captivated not only the imagination but is also gaining growing support and demand for the Arrowhead Framework. The community is increasing in size and strength, demand is tangible and the foundation has been laid for collaborative automation to have widespread real business impact.



by **WERNER ROM, MICHAEL KARNER, PETER PRILLER, JANI KOIVUSAARI, RAMIRO ROBLES, LUIS DOMINGUEZ & WILLEM VAN DRIEL**

DEWI: DEPENDABLE EMBEDDED WIRELESS INFRASTRUCTURE

Preface (by the Programme Officer Georgi Kuzmanov)

DEWI is one of the largest research and innovation projects funded by the ARTEMIS programme. This activity brings together leading industrial and academic partners from all over Europe in pursue of innovative wireless solutions for a wide group of application domains – ranging from ground, rail and air transport to smart cities and infrastructures. The project successfully went through its first monitoring period and has just reached its second year milestones with the next review meeting scheduled in the end of April 2016. While the first year was mainly dedicated to „setting up the scene", when the consortium identified key requirements and specifications to substantiate the proposed wireless interoperability concept; the second year has been dedicated to the development of an integrated interoperability framework and the demonstration of its advantages through several appealing prototype developments. Potentially, DEWI could positively impact our daily routines in the very near future allowing a vast variety of services and products to further improve our life quality and comfort. Moreover, the DEWI consortium is in a strong position to influence current and future wireless and interoperability standards with its technological achievements. Therefore, ECSEL-JU is eagerly supporting this daring research and innovation endeavour with a clear attitude of a partner contributing in its way to the common goal - the final success of DEWI.

The ARTEMIS project DEWI ("Dependable Embedded Wireless Infrastructure") focuses on the area of wireless sensor / actuator networks and wireless communication. With its four industrial domains (Aeronautics, Automotive, Rail, and Building) and 21 clearly industry-driven use cases / applications, DEWI aims at providing and demonstrating key solutions for wireless seamless connectivity and interoperability in smart cities and infrastructures, by considering everyday physical environments of citizens in buildings, cars, trains and airplanes.

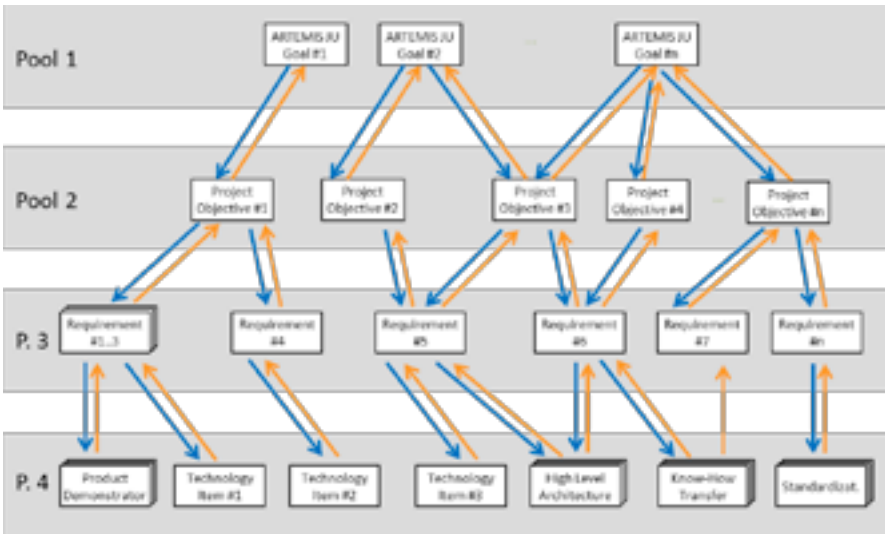
DEWI, led by the VIRTUAL VEHICLE Research Center in Graz/Austria, currently is one of the largest funded European R&D projects, comprising 58 renowned industrial and research partners from 11 European countries and lasting from 2014 to 2017. It covers 400 person-years with a total budget of €40m.

Currently, the second project year of DEWI has been very successfully finished and DEWI is really well on track: In addition to up to now 200 deliverables (!) comprehensively documenting the work done in DEWI so far, a lot of demonstrators and prototypes across all industrial domains are already available. This includes real rockets, trucks, trains and a lot more (for details see below). Furthermore, DEWI has accomplished a high-level architecture across all domains, which is fully compliant with the ISO/IEC 29182 standard Sensor Network Reference Architecture. Thus, DEWI will add clear cross-domain benefits in terms of re-usability of technological building bricks and architecture, processes and methods.

This article presents selected highlights and achievements since the last ARTEMIS-IA Newsletter on DEWI, published in July 2015.

HIGHLIGHTS FROM THE FIRST TWO YEARS OF DEWI DISSEMINATION AND EXPLOITATION

So far, the DEWI consortium has performed more than 100 dissemination activities, including more than 40 scientific publications. The DEWI Website (www.dewi-project.eu) was fully re-furbished one year ago with focus on technical content to further attract researchers and developers. It provides a comprehensive overview on all the industrial domains and uses cases, and makes numerous deliverables available for public download. There a dedicated DEWI Use Case Booklet can also be found. This booklet aims at presenting all the industry-driven use cases of DEWI to a broader public. Over the next months, at several international conferences DEWI will carry out special sessions such as the "Dependability and Robustness of Wireless Sensor Networks" session at the IEEE ETFA'2016, September 6-9, in Berlin, or at the ARTEMIS Technology Conference 2016, October 5-6, in Barcelona.



1 *Organisation of goals, objectives, requirements and innovations and related interlinking in DEWI-Frame*

THE DEWI ASSESSMENT AND MONITORING FRAMEWORK: GAINING AND KEEPING OVERVIEW OF COMPLEX RTDI PROJECTS

Research, technology development and innovation (RTDI) projects like DEWI pursue the fulfilment of high-level objectives (defined by the project itself, but also defined by funding authorities) and strive to increase the technology readiness level (TRL). In general, it is very difficult to measure and quantify such characteristics during the project life cycle due to their rather high level. However, this quantification is very important - for both project partners and funding authorities - to get a measureable assessment of project progress towards the objectives. Within DEWI, we developed the comprehensive DEWI Assessment and Monitoring Framework ("DEWI-Frame"). Based on a consistent mathematical-logical framework, it can be used for the assessment of project progress towards the objectives as well as for monitoring of project innovations. The key mechanism of DEWI-Frame is the consideration of requirements in the assessment process, and bi-directionally linking them with project innovations and high-level objectives. The application of DEWI-Frame in the ARTEMIS JU project DEWI shows that the fulfilment of project objectives can be easily tracked on a continuous basis. By using this method, overview of complex RTDI projects can be gained and kept, and a clear assessment of project progress towards the objectives is available to project partners as well as funding authorities. The methodology of DEWI-Frame can be tailored to be used in RTDI projects of any kind with an easy parameterisation of scaling factors [1].

AERONAUTICS DOMAIN

The aeronautics domain consists of two use cases with the general objective of implementing and designing dependable wireless sensor and actuator networks in two different aerospace scenarios.

Use Case Multilink Telemetry Logger for Rocket Launchers

The first use case focuses on using wireless sensor networks to replace cables and subsystems based on wired interfaces in space crafts. This task faces the challenge of deployment in extreme environmental conditions, such as wide temperature ranges, vibrations and increased electromagnetic exposure. Another major challenge of replacing cables in aircrafts is the highly critical operation of wired industrial interfaces. Therefore, wireless technology must be appropriately adapted to minimize the effects on real-time and highly reliable industrial wired networks. On the other hand, replacing cables of space crafts with wireless links is expected to provide a number of advantages such as flexible design, improved troubleshooting, coverage of parts of the aircraft difficult to reach with wires, and mainly reduced weight. Reduced weight, in turn, translates onto fuel savings as well as improved flight ranges and speed. Currently the integration of wireless sensor networks and tracking modules into the body of a rocket are completed.

Several flight tests have also been completed, each one with increased functionality of the different modules, thus successfully proving the use of wireless on board a spacecraft.

2 *Use case Multilink Telemetry Logger for Rocket Launchers*

Use Case Active Flow Control

The second use case of the aeronautic domain focuses on a different aspect: using a dense wireless sensor and actuator network to track the formation of turbulent flows across aircraft surfaces (e.g. wings) and attempt to counteract it with convenient actuation (e.g., synthetic jet actuators). The ultimate objective is to reduce skin drag effects, thus improve lift forces, save fuel consumption as well as improve range and speed of commercial aircrafts. The major challenge of this use case is the design of a highly dense network of nodes with wireless capability and the convenient management of sensor and control information within the aircraft. The current status of this prototype is the full integration of pressure sensors and synthetic jet actuators into a wireless sensor network. Full scalability analysis based on different analytical assumptions and computational fluid dynamics simulations have been achieved. A system level simulator integrating flow turbulent models and simulation results has been produced. The integration with the internal aeronautics network of a commercial aircraft has also been completed.

AUTOMOTIVE DOMAIN

The DEWI automotive domain focuses on the application of wireless technologies in the automotive domain. Being wireless allows for innovative test system solutions that are required for the development and verification of automotive components like engines, transmissions or batteries. Wireless sensors also allow for a much more detailed instrumentation of units under test.
In combination with automatic identification, configuration and localisation technologies, such a WSN (wireless sensor network)-based test system can significantly push efficiency of the costly verification phase, and reduce potential sources of errors like miswiring, corroded contacts or misplaced plugs. For certain applications like the measurement of mechanical vibrations in construction vehicles, wireless sensors provide the only useable option to learn about the comfort level of human operators. Overall we expect to see a reduction of wiring efforts for test vehicles by 50% due to replacing temporary wired sensors and interfaces by WSN. First prototype demonstrations have already shown the impact in helping boost efficiency and quality in Europe's car industry.

Other teams work on innovative new solutions by combining personal mobile devices such as smart phones or tablets wirelessly with cars, allowing new modern applications for vehicle use.

Prototypes that were shown to selected users generated high interest and also demonstrated a clear need to provide strong security. This will be a focus of a future phase.

The establishment of wireless sensors in production vehicles (cars, trucks) has

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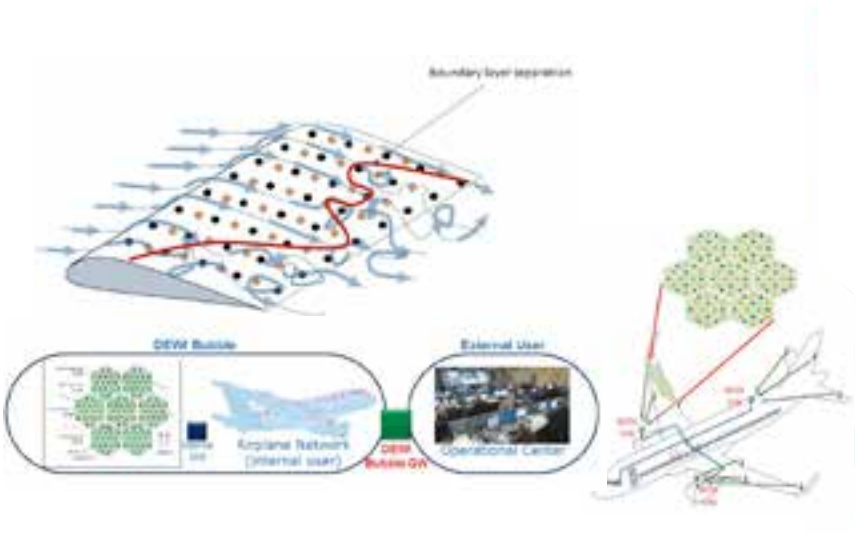

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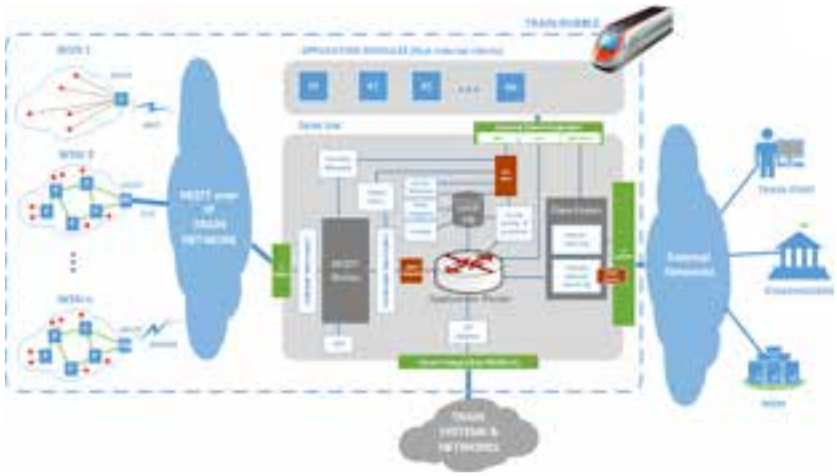

3 *Use case Active Flow Control*

4 *Wireless sensor prototypes for use in a truck*

5 *Examples of physical devices developed during the second year*

to overcome significant challenges like obstructing metallic structures or multi-path propagation and energy constraints. On the other hand such systems could provide clear weight benefits to car manufacturer and vehicle owners, because the wiring harness still provides a major share of weight and costs of vehicles. The mid-term goal of DEWI's effort in the automotive domain is to reduce this weight of the signal wirings by 30% by using WSN. An additional advantage comes with the flexibility of potentially mounting wireless sensors on existing mechanical parts, and even the possibility of integrating sensors into them.

DEWI partners demonstrated wireless sensors (e.g.: fuel level sensor, brake lining-wear sensor, etc.) in a real-life truck, showing the feasibility and dependability of wireless technologies like IEEE 802.15.4e in real-life scenarios. A series of campaigns at both RF and network levels have been carried out, accompanied with extensive analyses how to integrate such system in future automotive E/E architecture. The figure below shows some wireless sensor prototypes: Lining-wear sensor, Chassis Level Sensor (ECS), Fuel Level Sensor and Washer Fluid Level Sensor.

RAIL DOMAIN

During the second year of the DEWI project the rail domain has been very focused on the development of useful applicable technologies for trains, especially on safety applications and freight monitoring. Once the requirements for the different use cases were gathered and analysed during the first year, the last steps of the task 2 "Define Specifications", and the achievement of task 3 "Develop and implement" were the main goals for the second year, especially in those work packages (WP) related with the use cases and the demonstrators.

For the WPs on train integrity detection system, train composition detection system, freight monitoring and management system, and demonstrators the following steps were achieved:

+ The definition of the variables has been completed.
+ The sensors have been selected for each use case.
+ The high level architecture for the rail

domain, the interactions between modules, and the three levels of communication have been specified.
+ The communication protocols for level 0 (sensor- sensor) and level 1 (WSN-DEWI Gateway) have been defined.
+ The WSN has been prototyped, and the first physical devices are available.
+ The laboratory needs and environment have been defined to carry out the laboratory demonstrators.
+ First approach of a test protocol for the demonstrators has been created.

For the WP on centralized on board solution for seamless, safe and reliable WSN integration the following steps were achieved:
+ In the first half of the year the definition and prototyping for the DEWI gateway were completed.
+ During the second half of the year, the generic application of the DEWI gateway was developed
+ Different tests were applied to check the communication with a simulated WSN (stress, number of nodes, quality of service, etc.) and the behaviour against connection and disconnection of the modules.

6 *Work packages of building domain*

BUILDING DOMAIN

The second year of the building domain has been focused on the implementation of the various prototypes, components and sub-systems for the wireless technologies presented in the five building domain use cases. The prototypes and components developed include for example:

+ Indoor conditions monitoring WSN and backend SW and HW components based on BLE (Bluetooth low-energy), ZigBee and Wi-Fi
+ Indoor positioning solutions for personnel and assets tracking based on RF, optical and imaging technology
+ Automated lighting solutions based and study and simulations on dense lighting networks
+ Energy management solution for WSN gateways
+ Data fusion and context-aware and reasoning platform prototypes for processing WSN sensor data into information
+ Heterogeneous WSN components for smart home automation

Progress has been made in facilitating interoperability by specifying a high-level-architecture for the building domain. The final demonstrators for the building domain have also been specified and the results will be presented at several locations around the partner countries.

The building domain has produced several publications during the year. These publications are as follows:
+ Continuous Approximation of Stochastic Models for Wireless Sensor Networks [2]
+ Broadcast Storm Problem in Dense Wireless Lighting Control Networks [3]
+ RLL - Reliable Low Latency Broadcast Data Dissemination in Dense Wireless Lighting Control Networks [4]
+ DEWI - The Future of Wireless Sensor Networks [5]
+ Classification of Radio Channel Disturbances for Industrial Wireless Sensor Networks [6]
+ Troubleshooting Wireless Home Networks Using a Portable Testbed [7]

INTEROPERABILITY DOMAIN

The objective of the interoperability domain is to ensure an efficient technical management of all the domains along the DEWI project. Interoperability is defined as the *ability of diverse sensor networks or sensor nodes to exchange information and to make mutual use of the information that has been exchanged*. DEWI follows the official definitions coming from ISO/IEC 29182-2:2013 (E).

The interoperability domain targets to increase the visibility of the project results by developing generic methods, processes, and tools for resource management and mastering mixed requirements for intra-vehicle / smart environment / smart home / smart cities. The interoperability domain is split into the distinct activities of interoperability,

technology item & technology item groups, high-level architecture, know-how transfer and standardization, regulation, and certification.

Nine technology item groups (TIG) are defined within DEWI; they are listed in the table below and described in corresponding deliverables.

TIG	TIG Name
TIG01	Flexible data acquisition, aggregation & fusion
TIG02	Smart architecture
TIG03	HW/SW co-design
TIG04	Security, privacy, authorization
TIG05	Re- / auto- / self-configuration
TIG06	Smart energy management and harvesting
TIG07	Dependability, robustness & safety
TIG08	Wireless sensor / device detection & localization
TIG09	Wireless standards

Table 1 *Technology Item Groups addressed within DEWI*

Within the interoperability domain we have provided the final details of the definition of the DEWI high-level architecture (HLA), see Figure 8. The HLA gives guidelines for the development of wireless industrial sensor and actuator networks (WSANs) to be compliant with the DEWI Bubble concept and the DEWI HLA.

Cooperation with relevant standardization and regulation bodies is crucial to disseminate the findings from the DEWI project. We have managed to create contact with ISO/IEC JTC 1/WG 7 "Sensor Networks" and granted a category "C" liaison.

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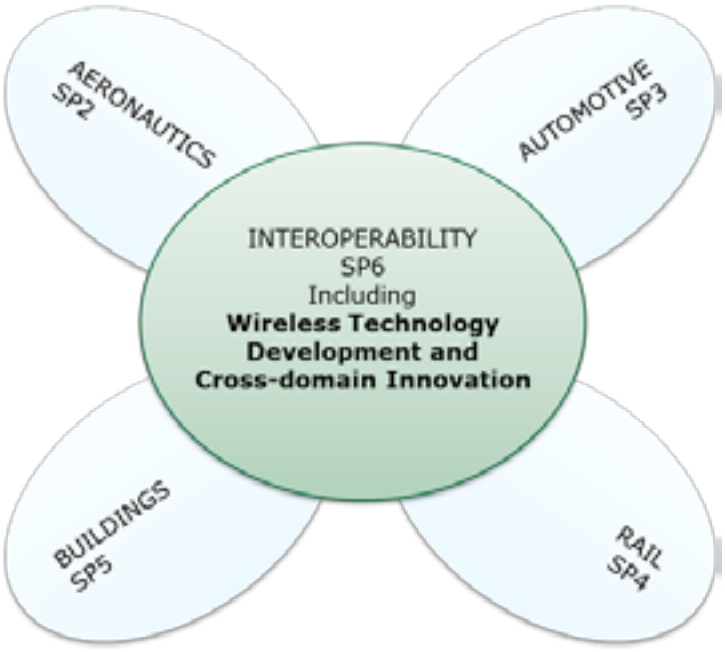

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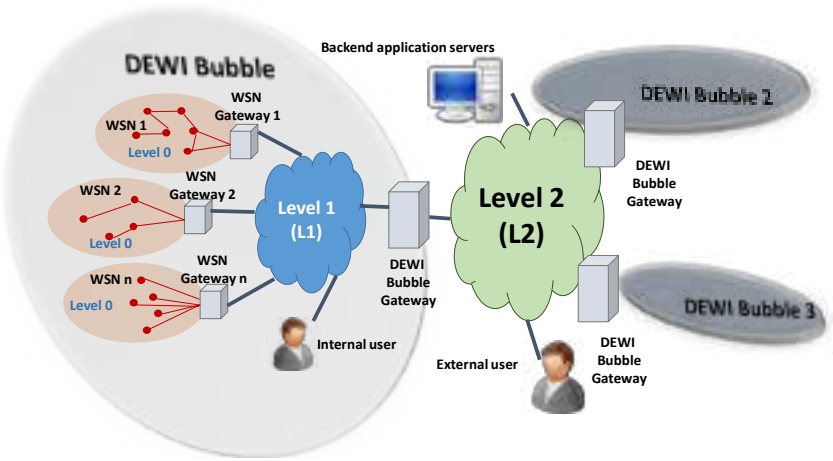

7 *Interoperability domain as central organ to align identical technologies amongst the four technical domains*

8 *The DEWI High-Level-Architecture (HLA)*

OUTLOOK

After two highly successful years of development, the third and final year of DEWI will clearly focus on demonstration. All different parts come together for building various impressive real-life demonstrators showcasing the DEWI results. As one of the highlights of the final year of DEWI, the planned "DEWI Demonstration Week" will present the results of the project to funding authorities, journalists, industry and an interested technical audience but also to the general public in various locations all over Europe. Stay tuned for more information about this event!

ACKNOWLEDGEMENT

The research from DEWI project (www.dewi-project.eu) leading to these results has received funding from the ARTEMIS Joint Undertaking under grant agreement n° 621353 and from numerous national programmes/ funding authorities.

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EMC^2 SUMMIT 2016

"Embedded Multi-Core Systems for Mixed Criticality Applications in Dynamic and Changeable Real-Time Environments"

by **WERNER WEBER & ERWIN SCHOITSCH**

Cyber-physical systems (CPS) are the key innovation driver to improve almost all mechatronic products with cheaper and new functionalities.

In connection with the CPS-Week Erwin Schoitsch from AIT Austrian Institute of Technology and George Dimitrakopoulos, Daniel Schneider, and Werner Weber organized a summit of the ARTEMIS/ECSEL-funded project EMC2. EMC^2 is a project of 100 partners from embedded industry and research from 19 European countries with an effort of about 800 person years and a total budget of more than 90 million €, which started April 1, 2014 and will finish in 2017. For details, see http://www.artemis-emc2.eu/ .

Cyber-physical systems (CPS) are the key innovation driver to improve almost all mechatronic products with cheaper and new functionalities. Furthermore, they strongly support today's information society as inter-system communication enabler. Consequently boundaries of application domains are alleviated and ad-hoc connectivity and interoperability play an increasing role.
At the same time, multi-core and many-core computing platforms are becoming available on the market and provide a breakthrough for system (and application) integration, changing considerably the preconditions for dependable, safe and secure systems with respect to predictability. A major industrial challenge arises from the need to face cost efficient integration of different applications with different levels of safety and security (mixed criticality) on a single computing platform in an open context.

We have to find dependable solutions for dynamic adaptability in open systems, mixed criticality under real-time conditions, scalability and utmost flexibility, full scale deployment and management of integrated tool chains, throughout the entire lifecycle, and to address standardization with respect to qualification and certification. EMC^2 has presented work in progress and important intermediate results of the ongoing project.

In the first session Erwin Schoitsch introduced the audience of about 25 attendees to the summit. He provided an overview on European safety-critical systems working groups and on the "big picture" view of ARTEMIS projects building on each other's results, particularly the large projects (AIIPs) CRYSTAL, ARROWHEAD and EMC^2.

A keynote was given by Stefano Russo from the University of Naples on model driven engineering of critical systems providing a walk through various different levels of abstraction such as computation-independent modelling, platform-independent modelling, and finally platform specific modelling. Model driven testing was discussed to complete the value chain in this field. He finally provided a concrete example from the challenging certification-driven train signalling industry. The keynote was followed by a short presentation of Werner Weber et al. who set the scene of the EMC2 project and provided examples of concrete project achievements so far. Chahinez Hamlaoui presented the project S3P (Smart, Safe, and Secure Platform) in the field of Internet of Things with a budget of 45 M€ and a volume of 300 person years. It has started as a French project and wants to open up to new members from throughout Europe as S3P Alliance.

Service oriented architecture, real time applications and safety issues were in the focus of the session on **Automotive and Mobility.** Standardization and specification topics combined with various case studies were highlighted. Also a status report on the partner project CRYSTAL was given highlighting achievements reached so far, particularly in the area of the Interoperability Specification. In addition a study on mobility in smart cities was provided, extending the theme to "Smarter Cities", i.e. evolving continuously towards increased functionality.

The session on **Aerospace and Rail** highlighted mixed criticality and the certifications needed in those fields. The big challenges of using multicore and mixed criticality while at the same time keeping the extremely high required special and temporal isolation of tasks were addressed in a systematic way.

Security, Fault Tolerance, and authentication were discussed in the next session. Security hardening is achieved by redundant Rotating Virtual Machines in three roles – active, stand-by and cleansing, a concept called Virtualization-based Security and Fault Tolerance. The second presentation discussed how far camera based optical line of sight communication is reducing the risk of relay attacks. In particular, a 3D ToF (Time of Flight) camera concept provides promising results.

Finally, a session on **concurrency, multi-processing and dynamic systems** provided information on technical work on asymmetric multiprocessing in an industrial XILINX environment, on mining concurrency bugs by looking at the software code rather than addressing development processes, safety/security of adaptive systems by run-time evaluation and certification. For adaptive dynamic systems, vertical dependencies (between platform and application) and horizontal dependencies (between applications) are described by so-called Multidirectional Modular Conditional safety Certificates, a concept which allows safety evaluation and security updates at run-time and over life time. For parallelization of sequential applications, two complementary tools were introduced, to provide alternative development paths.

A display of 11 posters complemented the talks. In conclusion, this summit provided a valuable exchange of knowhow and research directions as they are conducted in the EMC2 project which will fertilize its research in the coming 12 months until the end of the project and beyond.

ESCOP AT AND BEYOND THE FINISH LINE

by **ESCOP PROJECT TEAM**

We have started to use OKD-MES in our company, which allowed us to create a powerful production management tool.

eScop (**E**mbedded systems **S**ervice-based **C**ontrol for **O**pen manufacturing and **P**rocess automation) is a three-year ARTEMIS/ ECSEL project which ran from March 2013 to February 2016. During the project ten European partners from academia and industry in four countries came together to create an open, knowledge-driven manufacturing execution system (OKD-MES).

During the project it was possible to create the right atmosphere that enabled a shift from traditional work package-oriented mindset to the joint development of different key elements for OKD-MES. The result is that now, an OKD-MES can be evaluated and built by using the tools and downloading the components available at http://www.escop-project.eu/tools/

These tools include simulators of three systems that were used as use cases in the project to validate the OKD-MES approach: INCAS, a supply chain automation company of warehouse equipment, the FASTory production line for electronics production, and an oil lubrication system by Fluidhouse Oy, a fluid automation solutions expert. The simulators allow the eScop OKD-MES approach to be tested and one's own solutions to be benchmarked against the service-based control and monitoring of different industrial systems. Once the FASTory simulator got up and running , within one month it got more than five thousands service invocations from all around the world. As it is also being used for educational purposes, the next generation of engineers will get a chance to master relevant technologies for a service-oriented, knowledge-driven approach.

Raspberry PI (small grey box between keyboard and the screen) hosts the orchestrator and testers for the FASTory line. It is probably the cheapest device seen in the photo.

Use of web services allows the fast and easy assembly of complex solutions. The following video demonstrates the work of the production line controlled by a Raspberry PI, a device that costs just a few tens of euros.

The tools and components are supported by training material accessible at the eScop Training Centre, which also contains set of presentations and videos explaining how to install and use the findings of the project: http://www.escop-project.eu/training

Some of the components can be purchased from the corresponding organisation's project partners while others are accessible as an open source and available at GitHub.

Technology director of Fluidhouse Oy, Mr. Otto Karhumäki, has commented on the results of the project as follows: "We have started to use OKD-MES in our company, which allowed us to create a powerful **production management tool**. We have got better awareness about the situation on the production floor and are therefore able to take better decisions. From the technology point of view, the use of well-known concepts and tools (e.g. links and browser) and browser-friendly standards enables anyone to use the system." Those ideas are shared by Giuseppe Lucisano, project coordinator at SCM Group, who explained, "Use of the knowledge-driven approach allowed us to get the information on key performance indicators (KPIs), which were stored in the ontology, and it was and is very easy to retrieve using dedicated SPARQL query language." Maurizio Foglia Taverna, CTO (Chief Technical Officer (R&D) at INCAS group said, "INCAS has performed quantitative tests to evaluate applied eScop technologies. We have found that we can have more than 10% savings, when upgrading software and hardware to the eScop solution, including the installation of eScop RTUs, and upgrading software and hardware. In our benchmarking we used two systems running in parallel - the conventional one and the eScop solution to make the assessment."

At the end of the project, the project partners established the open Knowledge-driven Service-oriented System architectures and APIs (KiSS) W3C community group. The group has a general focus on knowledge-driven and service-oriented solutions. The consortium members aim to use this channel to share their vision and experience gained in the eScop project and also learn from others.

INTEROPERABILITY SPECIFICATION – QUO VADIS?

Supporting Tool and Data Interoperability Standards for CPS development

by **JÜRGEN NIEHAUS**

Cyber-Physical Systems (CPS) are becoming omnipresent in our daily lives. However, because of their heterogeneity and increasing complexity, CPS development requires a huge variety of engineering tools from various engineering disciplines. To ease development – i.e., reduce costs and development errors – as well as to satisfy requirements for full-fledge traceability across the engineering artifacts and throughout the development lifecycle of safety-critical CPS – as required by more and more standards, like for example ISO26262 in the automotive domain – these tools need to be smoothly integrated into Engineering Environments, allowing fast and efficient development of CPS as well as smooth cooperation of all stakeholders (e.g., engineers, system architects, product managers, decision makers or analysts). This integration, however, poses huge challenges for CPS developing organizations, which are stuck between two extremes: Either to develop their own hard-to-maintain in-house and ad-hoc Engineering Environments, or to be locked-in with proprietary solutions, which are typically not fully tailorable for supporting their special needs. To overcome this challenge, past and ongoing large scale R&D projects – most in the context of ARTEMIS, e.g., iFEST, CESAR, MBAT, HOLIDES, CRYSTAL and others – have proposed **open standards for data and tool interoperability** in CPS development, namely the so called **IOS** (Interoperability Specification).

CP-SETIS (towards Cyber-Physical Systems Engineering Tools Interoperability Standards) is a 24-month Horizon2020 Innovation and Support Action which aims to leverage on these initiatives by proposing and implementing sustainable cooperation and governance structures to (a) facilitate long-term and sustainable cooperation between all involved stakeholder organizations – End Users, Tool Vendors, Research Organizations, Standardization bodies, R&D projects, etc. – and (b) support extensions, advancements and formal standardization of the IOS. CP-SETIS is

The Interoperability Specification covers many different aspects and all phases of the development process. It is neither feasible nor particularly desirable to put all these concerns within a single standard.

coordinated by SafeTRANS, with core partners AIT, ARTEMIS-IA, AVL List, KTH, OFFIS, Siemens, and Thales, and Associated Partners ABB, Airbus, ASAM, Daimler, ETSI, and Volvo, where the number of associated partners is expected to increase considerably as the project progresses. CP-SETIS is supported by ARTEMIS Working Groups on Standardization and on Tool Platforms, as well as by the ARTEMIS Center of Innovation Excellence EICOSE.

INTEROPERABILITY SPECIFICATION – IOS

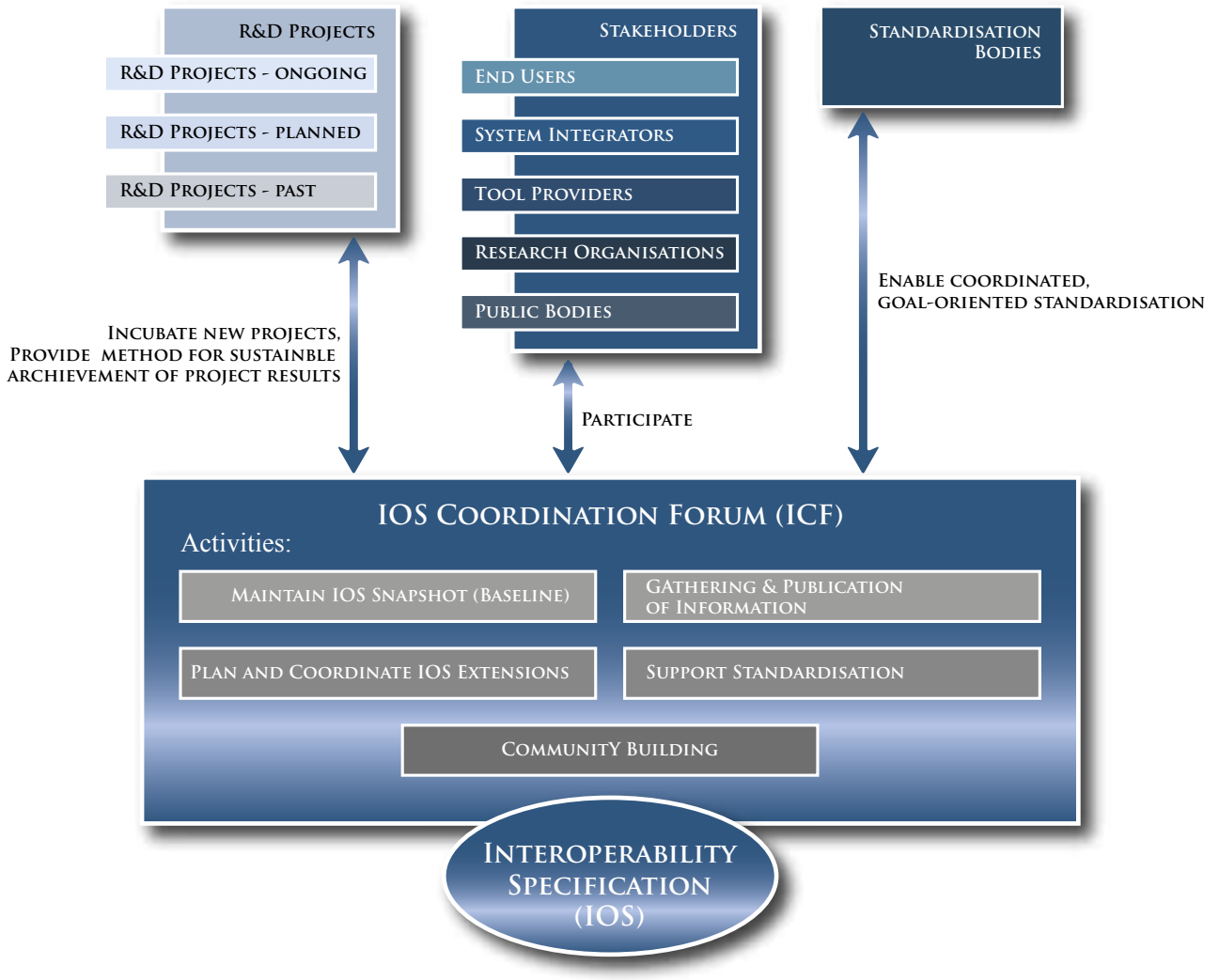
The Interoperability Specification covers many different aspects and all phases of the development process. It is neither feasible nor particularly desirable to put all these concerns within a single standard. On the other hand, there already are a number of standards that cover interoperability and/or data exchange between engineering tools, each of them covering specific aspects of CPS development, and it would be unwise not to take advantage of their existence and the trust in usability that stakeholders already put into them. The IOS therefore consists of different parts, each of which (a) deals with a specific aspect of CPS development (so called Engineering Concern), like for example Lifecycle Data Integration and Data Exchange or Heterogenous Co-Simulation and (b) is based upon existing standards and possible extensions of them, whenever an appropriate standard exists. For Lifecycle Data Integration and Data Exchange, the underlying existing standard is **OSLC** (Open Services for Lifecycle Collaboration, see http://open-services.net/), for Heterogenous Co-Simulation **FMI** (Functional Mock-Up Interface, http://www.fmi-standard.org) is under consideration. Two issues are noteworthy: On the one hand, IOS does not include all of the existing standards, but only those parts that are relevant for the respective Engineering Concern. On the other hand, IOS also includes additional specifications, either as extensions of existing standards (if the standard does not yet completely cover the Engineering Concern), or as an independent specification (if there is no existing standard yet covering this particular Engineering Concern). In addition, the IOS also includes so called Bridges, which describe the relations between the different Engineering Concerns and the corresponding interoperability specifications and standards.

Handling a complex structure like the IOS, with its relations to many different existing standards, with its additional specifications which might or might not become (part of) a formal standard in the future, with its cross-standard Bridges, and with new Engineering Concerns and corresponding specifications constantly being added, cannot be done within a single project, because these activities exceed both, the lifetime as well as the scope of any single R&D project. On the other hand, both, the importance of open interoperability standards as well as the huge investment already placed in the IOS together with its success stories delivered by the various projects, warrant further development and pushing formal standardization of IOS.

IOS COORDINATION FORUM – ICF

CP-SETIS develops a model for a sustainable organizational structure called ICF (IOS Coordination Forum) as a cooperation platform, in which all IOS stakeholders – CPS development organizations, Tool Provider, Research Organizations, Standardization bodies – can meet to synchronize and coordinate their IOS activities. Specifically, ICF will

- **A** collect and make available the current baseline of the IOS, together with information about the concrete specifications, maturity level, status of formal standardization, current versions, etc., and update this information according to results from projects, standardization activities, etc.
- **B** facilitate and give organizational support for stakeholders to coordinate their activities to extend and further develop the IOS – for example by incubating new R&D projects,
- **C** facilitate and give organizational support for stakeholders to synchronize their activities for formal standardization of parts of the IOS, and
- **D** support the building of an IOS community by collecting and proving all information related to IOS (from technical specifications and contacts to experts to workshop and event notifications) and organizing workshops, coordination meetings, etc.



ICF will not only be an ideal means for coordinating IOS related activities amongst the large and diverse group of stakeholders, but will also allow these stakeholders to

+ find allies and cooperation partners, e.g., to extend and shape those parts of the IOS that are relevant to this particular group of stakeholders, including pushing of formal standardization
+ find experts for IOS related matters
+ be able to guarantee sustainability and accessibility for their IOS related project results
+ use ICF as an independent, neutral forum, to meet other stakeholders at eye level
+ easily exchange and gather IOS related information, e.g., the current baseline, new extensions under development, standardization activities, etc.

while at all times being able to focus on those parts of the IOS, that are actually of interest to them.

ICF IMPLEMENTATION

ICF has been conceived as a lightweight structure, providing mostly information and facilitating IOS related activities by stakeholders. In particular, it was clear from the beginning, that ICF would not be a new legal body, but rather a structure within an existing organization. Currently, CP-SETIS is contacting various existing organizations to evaluate and find a potential hosts for ICF. In addition, the concrete working proceedings of ICF are defined in more detail, including stakeholder participation rights and obligations. Last, but not least, CP-SETIS is coordinating and harmonizing these activities with a variety of stakeholders.

http://www.cp-setis.eu

The CP-SETIS project receives funding from the European Union Horizon2020 program under grant agreement no. 645149.

BATON BLUES

Daniel Watzenig

In this edition, Daniel Watzenig, a member of the ARTEMIS Presidium and Steering Board, picks up the baton and takes us on his lap. Daniel is currently Head of the Electronics Department at the Virtual Vehicle Research Centre and Associate Professor at Graz University of Technology. Daniel studied Electrical Engineering in Graz and gained his PhD in Signal Processing in Embedded Software, spending six months in New Zealand on an exchange. After gaining his doctorate, Daniel produced a further thesis to become associate professor, which gave him the opportunity to supervise PhD students himself. But he is employed at the university only part-time because in 2009 he joined the Virtual Vehicle Research Centre where he now manages around 50 employees within his department, half of whom are involved in automated driving. All in all, a nice mix of industry and academia to fill up his days.

"My first contact with ARTEMIS-IA came by way of the CESAR project and I found out through this involvement what ARTEMIS-IA was doing and what it stood for. I was attracted by the thinking out of the box and became keen on joining the brokerage events and getting in touch with other projects. Which I did. And through Josef Afenzeller, whose notion of working in a cross-domain and cross-border way motivated me, I became more actively involved. There was a seat open in Chamber A and I was asked if I would fill it. I was lucky to have support from my SME in taking on this role, an important one in my view as I would like to see more SME representation in the ARTEMIS machinery, as it were. And when I was also elected to the Steering Board last year I was very pleased since this gives me an opportunity to gain more insight into the 'brains' of the organisation and the developments in embedded intelligence on a European level. What I am doing in ARTEMIS is well aligned with my work at the Virtual Vehicle Research Centre and the university. And as a member of the Presidium I have also been working on the Strategic Research Agenda due to appear this month.

You see ARTEMIS-IA from both sides of the fence – as both outsider and insider. That's an interesting position to be in. "Certainly, as an SME it's important for us to have access to an organisation like ARTEMIS, which gives us the opportunity to get into contact with other players in the research and industry field, from renowned professors to corporate leaders. Of course, European funding is an incentive but the chance to interact with partners in a consortium – give and take – is where the real benefits lie. And from a Steering Board point of view I am keen to facilitate projects that have a real pay-off, in terms of business prospects and strengthening the European position. From a Presidium perspective it has been a tough time following the merger with EPoSS and ANEAS. The idea was to bring these two industrial sectors under one umbrella but it turned out that the semiconductor roadmap and its implementation plan differ from that of the software and embedded systems roadmap. But if we can overcome these problems, bridge the gaps and align the programmes, then in ECSEL we have the opportunity to become efficient and reshape the landscape. As a matter of fact, software and hardware are closely tied together."

You are involved in 3Ccar, one of the few CPS oriented projects funded in the first call of ECSEL. What is the main added value of 3Ccar for your organisation? "Indeed, I am involved in this project. The three C's stand for comfort, control and cost-effectiveness. It is headed by Infineon and aims to address the vehicle control architecture and its subsystems in order to achieve the next level of efficiency of electrified cars. Such a project with its cross-domain, cross-disciplinary critical mass has significant benefits for us as a research-oriented SME, in terms of knowledge, experience, expertise, contacts and so on. It is a project where the semiconductor and (embedded) software domains are complementary and essential to a successful outcome. On the other hand, I also think it is valuable for ARTEMIS to continue concentrating in parallel on its domain since there are some projects that benefit more from a highly specific focus. The key should be to select the best projects for funding, whether in an ARTEMIS or ECSEL perspective, those that have a real chance to strengthen the European market and make it globally competitive. After all, we are talking about significant amounts of public money and we have to make sure that gets used in the best way."

In your opinion, what are the main challenges we face in the field of embedded systems in the coming years? "I guess the current SRA deals with this in quite a bit of detail. I would recommend a good read of that. But certainly autonomy and connectivity are two. And in this respect, we have to ensure that we have re-usability, dependability, and security. Altogether, the major trends in embedded Cyber-Physical systems are driven by embedding intelligence, connecting and distributing intelligence (internet of things, cloud and fog technology, digital platforms), as well as making intelligence available at any time and anywhere (e.g. service-orientation). But with things moving at such a dynamic and fast pace, you never quite know what challenges may confront you. We have to be prepared for this and that requires organisational flexibility, too."

And who would you like to hand over the baton to and do you have any particular question to this person? "Yes, I would like to hand over to Ronald Begeer, Programme Manager for Research at Royal Philips Electronics". I would be happy to learn how the healthcare domain might benefit from recent advances in autonomy.

Your musical choice? "Well, we take a lot of strengths from the US … and in my musical choice I would also take one of the legends, Bruce Sprinsteen. Be tougher than the rest. Full-on driving determination. And if things go wrong, then why not a bit of Monty Python's 'Always Look on the Bright Side of Life', because when things do go wrong, and they occasionally do, then why worry. Stay optimistic, stay positive."

OVERVIEW OF THE ARTEMIS SPRING EVENT

by **IRIS HAMELINK**

This year the ARTEMIS Industry Association organised the seventh edition of the ARTEMIS Spring Event on 13 & 14 April in Vienna, Austria. This event was co-located with the CPS Week in the Hofburg Palace.

DAY 1

ARTEMIS created a new Strategic Research Agenda based on the needs, developments, new technical options and challenges in the Industry. At day one of the ARTEMIS Spring Event, ARTEMIS released the 4th edition of the Strategic Research Agenda which aims to consolidate the pathway for the digital revolution, enabling a more agile and shorter development cycle of Embedded Intelligent Systems through the adoption of design by composition and correct-by-construction principles. It also aims to overcome fragmentation in the European supply base for design and engineering components and tools. In the coming years the Industry Association will focus on providing strong technological capability over the whole value chain, thus removing barriers between application contexts to yield multi-domain, reusable components and Embedded Intelligent systems, and extend the use of digital platforms to build the stronger eco-systems that are needed to accelerate innovation and create new business models.

In an industrial context Cyber-Physical Systems encompasses a wider class of systems than Embedded Systems in their most narrow definition.

Therefore, ARTEMIS-IA distinguishes three focus areas that together create this wider industrial context:

- Embedded and Cyber-Physical Systems,
- Internet of Things,
- Digital Platforms.

Jan Lohstroh, Secretary General of the Industry Association said: *"ARTEMIS Industry Association believes that there are no sharp delineations between technologies, and that such technologies should not be considered in splendid isolation. These areas together will allow the emergence of new innovative businesses that support the opportunities for value creation in several sectors that Embedded Intelligence creates."*

DAY 2

The second day of the ARTEMIS Spring Event was organized by the Horizon2020 project Road2CPS in collaboration with ARTEMIS-IA and the European Commission. 'Smart Cyber-Physical Systems - EC Clustering Event' was the theme of the second day and brought together about 150 experts from academia, industry and policy-making to learn about and discuss highlights of Cyber-Physical Systems projects from Horizon2020 and ARTEMIS. The second day was particularly set to foster exchange on and creating synergies regarding CPS innovation perspectives and generating strategies for the future.

For all presentation go to:
https://artemis-ia.eu/spring-event-2016.html#presentations

BLENDED MASTER PROGRAM IN INTERNET OF THINGS THROUGH EMBEDDED SYSTEMS

by **MARTIJN KLABBERS**

EIT Digital is supporting innovation, not only in products and services, but also in education. Within the EIT Digital Master School T-shaped engineers with technical knowledge, business sense, and managerial skills are educated. (See picture 3). They are called digital entrepreneurs and innovators. EIT Digital is now up for the next challenge: innovating education and at the same time increase the reputation of European universities of technology through MOOCs, massive online open courses. The topic of this new program is Internet of Things through Embedded Systems.

EIT Digital offers a unique infrastructure including excellent companies and universities of technology in Europe. Today EIT Digital offers more than 1000 students an on-campus Master or Doctoral program and across Europe educating professionals (See picture 1). The EIT Digital community is a unique eco-system aimed at innovation. EIT Digital advocates blended learning to combine the best of two worlds: online and face-to-face education, providing flexibility with a high retention rate. EIT Digital also wants to apply this to the Embedded Systems Master program by offering the first six months online.

The Internet of Things is changing the world at a disruptive pace and it is an exciting and innovative topic with a major impact on society. Innovations are growing rapidly as components are getting cheaper and new device combinations offer ground breaking products. The people that work in this area require a good sense of what the golden combination is of the (Internet of) things; the digital innovators. Attracting and educating good candidates also calls for an innovative approach.

Starting point of educational innovation is the strength of the European universities of technology; their high rankings show their excellence in research and education. However, their reputation shows room for improvement, as holds for their educational methods. Daphne Koller puts the finger on the wound: *"In many ways, the education that universities provide to their students barely changed in the last 100 to 200 years. If you put an instructor to sleep 300 years ago and woke him up in a classroom today, he'll say, 'Oh, I know exactly where I am'".* Europe's universities are no exception.

EIT Digital aims to demonstrate the excellent knowledge level of universities and educational power to a global audience, to market education and to start building a community and reputation. Which is why a cooperation with Coursera is set up as they also aim to innovate education and they are able to reach a massive amount of learners, both students and professionals. EIT Digital perceives its contribution as an addition to the more advanced courses of Coursera. EIT Digital supports their bold vision to enable anyone, anywhere to transform their life by accessing the world's best learning experience.

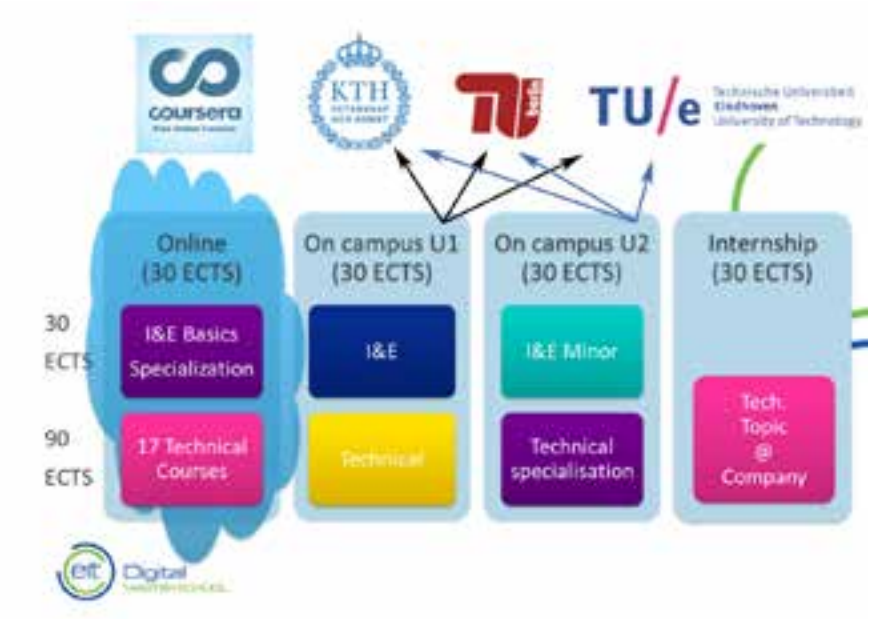
At the same time EIT Digital subscribes to the (r)evolution that is advocated in the book "Flip the System" edited by Jelmer Evers and René Kneyber. The EIT Digital course development puts the teacher as a starting point. Together with and instructional designer and an educational director, the teacher is the one who transforms his or her teaching experience into a small media production that satisfies the learning outcomes. The director empowers the teacher to make use of his strengths and to boost creativity. The instructional designer supports the teacher in applying the newest tools and methods in his or her courses. In an iterative approach this trio is developing web lectures, quizzes, and attractive learning outcomes. Note that the lectures are also supporting innovation in the regular on-campus courses as the so-called flipped class-room approach.

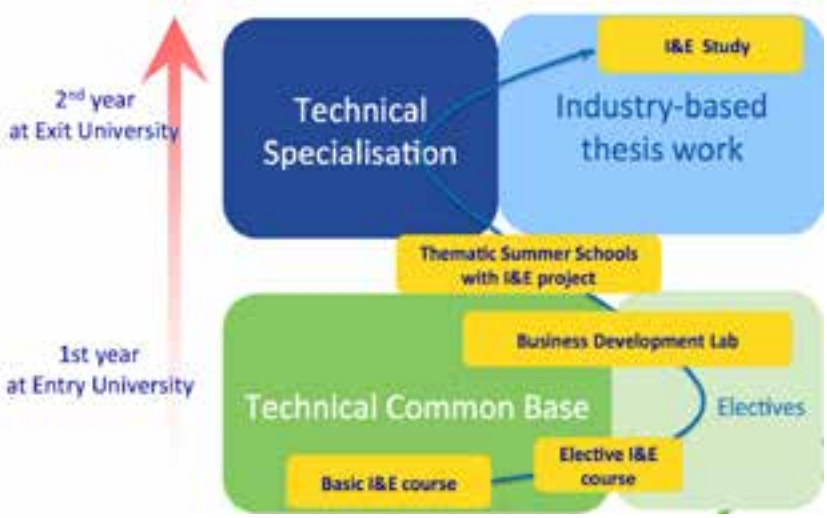
More than 20 courses with over 250 web lectures, together form a 30 ECTS online program in Internet of Things, one semester of an equivalent on-campus course. (See picture 2.) Development started in 2015 when it was set up and mid 2016 it will start to run. At that time, learners will be able to follow the courses on topics like 'Internet of Things', 'Real time systems', or 'System Validation'.

The soft skills are developed at KTH in Stockholm in cooperation with Haas School of Business, part of University of California Berkeley. Courses like 'The Impact of Technology' or 'Innovation and Entrepreneurship' are bundled in one 'specialization' as Coursera calls it. Learners need to conclude a specialization with a capstone project that allows them to apply the skills they have learned throughout the included courses. Because of the topic Coursera expects more than 100.000 students to follow this specialization.

EIT Digital aims to demonstrate the excellent knowledge level of universities and educational power to a global audience

Learners who have completed all the courses and the specialization can be selected and invited to the on-campus program at the program's on-campus Winter School, that starts after the first semester. Here they are tested for their knowledge and checked whether they comply with the Master School admission criteria. EIT Digital starts piloting with only the top students in the beginning of 2017.





The first course has been launched in November 2015 at Coursera with the name 'Quantitative Formal Methods and Worst Case Performance Analysis'. It is built around methods that provide learners with the techniques and tools to evaluate time performance of their design. Next to the humorous and personally addressed web lectures, the course has a strong theoretical emphasis, and with good reason. As dr. Pieter Cuijpers states in his first web lecture: formal methods are to abstract thinking what rope skipping is to boxing; you don't bring the skipping ropes to the boxing fight, but you sure can use its practical training value. This is the core of EIT Digital education: advanced courses in a learner-centric style.

January 11th, 2016, the internal launch of the Blended Master within EIT Digital took place at Schiphol. People attending, some of them online, were enthusiastic about the new program and its possibilities. Anders Flodström, Education Director of EIT Digital, was pleased to see this enthusiasm. Also head of the Master School, Calle Jansson, saw the benefits of marketing the Master School programs and even pointed out a new opportunity for more local recruitment; often these students do not get their Bachelor degree in time in order to enrol in the Master program, but now they would be able to do start the one and complete the otter simultaneously. Also Action Line Leaders were enthusiastic to take on students for an internship during their program.

The Blended Master Program in Embedded Systems improves and accelerates education as a basis for a better European work force. It supports the EIT Digital Schools in marketing their courses and programs while making them more attractive with learner-centric education. Completely in line with Coursera, as Daphne Koller stated: "We have never thought that this [Coursera offering MOOCs] is a way to replace universities. It is a way to opening up a much larger audience to universities and at the same time a catalyst for change on how teaching is offered at university campuses".

ARTEMIS Summer Camp 2016

22-23 June 2016
Lulea, Sweden

You can join the ARTEMIS Summer Camp when you are a member of the ARTEMIS Industry Association. In case you are not a member yet and interested to join us, please contact ARTEMIS-IA via: info@artemis-ia.eu.

CALENDAR

IOT WEEK
31 may - 2 june 2016
BELGRADE, SERBIA

The 3rd International Conference on System-Integrated Intelligence focuses on integration of new, intelligent functionalities into materials, components, systems and products to enable future technologies with enhanced capabilities. The conference provides a forum for academia and industry (Scope).

SYSTINT
13-15 june 2016
PADERBORN, GERMANY

On 15 and 16 June, the ARTEMIS project CRYSTAL will host its final dissemination event in Madrid, Spain, in conjunction with 5th European Conference on Interoperability for Embedded Systems Development Environments. The goal of this event is to present the achieved results in the project regarding sustainable interoperability for embedded systems development environments.

CRYSTAL FINAL DISSEMINATION EVEN...
15-16 june 2016
MADRID, SPAIN
ARTEMIS Event
ARTEMIS-IA will host its annual Summer Camp in Lulea, Sweden. Preparations are in progress. Keep an eye on our website for the latest news!

ARTEMIS SUMMER CAMP 2016
22-23 june 2016
LULEA, SWEDEN

Over 80 Industrial IoT international experts will be sharing their views on key topics such as: IoT and how it impacts business models | Monetizing the IoT in an industrial setting | Effective PLM strategies | Data driven decision making with smart data analytics | Legacy system and the new digital world | The role of security in this connected world?

INDUSTRY OF THINGS WORLD 2016
19-20 september 2016
BERLIN, GERMANY

Paper submission deadline: August 1st, 2016 · Notification of results: August 22nd, 2016; Final paper version: September 5th, 2016 · Distribution of online Proceedings: September 15th, 2016 · Questions and comments to peer presenters uploaded: September 30th, 2016 · Workshop: October 6th, 2016

WESE 2016
6-5 october 2016
PITTSBURGH, PA USA

IECON 2016 is the 42nd Annual Conference of the IEEE Industrial Electronics Society, focusing on industrial and manufacturing theory and applications of electronics, controls, communications, instrumentation and computational intelligence.

IEEE IECON 2016
23-27 october 2016
FLORANCE, ITALY

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Submissions:
The ARTEMIS-IA office is interested in receiving news or events linked to the aim of ARTEMIS-IA, related projects or in general: R&D in the field of Embedded and Cyber-Physical Systems area. Please submit your information to info@artemis-ia.eu

ARTEMIS Industry Association strives for a leading position of Europe in Embedded Intelligence