



## Annual Newsletter • June 2016

Dear ROS-Industrial Consortium Europe Members,

I am honored to celebrate two years of activity of our organization. I am happy to announce that in these two years RIC-EU has grown to 15 members, pushing the number of member organizations worldwide to close to 40. Remarkably, six of the new members in Europe are industrial entities. This is pursuant to our goal of complementing applied research with the development and commissioning of ROS-based automation solutions in production environments.

The ROS-Industrial denomination embraces both the software platform and the initiative to further its development and acceptance by securing funding sources, identifying and clearing non-technical obstacles, providing training and spreading the word. During the previous Consortium year we hosted five ROS-Industrial focused events at Fraunhofer IPA, starting with the annual ROS-I Conference in June 2015 and ending in April 2016 with a research camp on the legal aspects and best practices of Open-Source Software (covered at page 7). Given the positive feedback, we will continue hosting such events, starting with the next ROS-I Conference, combined with a new edition of our training classes, which will take place in Stuttgart on November 2–4, 2016. I also participated as RIC-EU Program Manager at further 14 events ranging from workshops at funding agencies and universities, to technology forums and outreach activities for SMEs. I encourage you to visit our website [rosindustrial.org](http://rosindustrial.org), where we provide extensive coverage of such events.

The Consortium will continue pursuing its goal of fostering the adoption of a shared open-source platform by:

- Expanding the geographical reach of the initiative: together with our partners at RIC-Americas, we will participate to an inaugural ROS-I event for the Asia Pacific region hosted by the Advanced Remanufacturing Technology Centre of A\*Star, Singapore. You can read more about the event at page 3.

- Expanding development and deployment of ROS-I based technology on the factory floor: we are assessing how to provide better support on selected hardware platforms through the active technical collaboration of OEMs. You can read about a representative example of this efforts at page 8.
- Continuing to provide support for the development of the ROS-Industrial software platform: we keep pursuing private and public funding, in coordination with our scientific advisor Prof. Martijn Wisse, which addresses this subject on page 4.

As the software platform is at the core of the ROS-Industrial Initiative, I would like to acknowledge the efforts of the ROS-I developer community and the technical leadership contributed by Shaun Edwards and Gijs van der Hoorn: thank you all!

All this is made possible also thanks to funding coming from, among others, the following entities:

- The European Union 7th Framework Programme (BRICS, SMERobotics, Factory in a Day)
- The German Federal Ministry for Economic Affairs and Energy, BMWi (ReApp)
- The Netherlands Organisation for Scientific Research, NWO (TrustROS-I)
- FEDER project, Region Bretagne
- NIST, NSF, and Google for generous support on the US side

Last but not least, thank you to all of you for your support!



*Mirko Bordignon*

**Mirko Bordignon, Ph.D.**  
Program Manager  
ROS-I Consortium Europe

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# An Address from RIC-Americas Program Manager

Dear ROS-Industrial Consortium Europe Members,

The ROS-Industrial Consortium Americas continues a promising trend toward participation growth, collaboration, and development/deployment of new ROS-I software capabilities. We are excited to see growth in RIC-EU and our joint efforts in the creation of open source software for industrial robotics and automation. RIC-EU has excellent leadership with Mirko Bordignon and Fraunhofer IPA.

In March, the RIC-Americas annual meeting had more than 50 attendees from 32 organizations. During the meeting, we learned about progress during the past year, and heard from speakers including Morgan Quigley (OSRF), RIC-EU Program Manager Bordignon (Fraunhofer IPA), Nicholas Yeo Chang Yee (ARTC), and Erik Nieves (fmr. Yaskawa and now PlusOne Robotics).



*Attendees of the RIC-Americas annual meeting.*

Quigley provided an update on the progress of ROS 2.0 and presented the latest data on the performance of the real time capabilities, which includes improved performance of micro second level dither, even with some network congestion.

Bordignon inspired the audience with his presentation of the philosophy and progress of ROS software usage for industrial robotics in Europe, including a number of deployed or productized applications.

Yee shared a look into the modern and flourishing R&D capabilities for remanufacturing at ARTC, which is part of A\*STAR in Singapore, and presented ARTC's vision to launch RIC-Asia Pacific.

Nieves kept us guessing with a riveting story of his personal journey to embrace ROS as a representative of a major robot OEM, and then his venture into the world of supervised autonomy with his startup company PlusOne Robotics.

During the morning, the attendees broke up into four groups and undertook roadmapping activities in a round-robin fashion on four topics: motion planning, ease of use, hardware interfaces/interoperability, and ROS core. In the afternoon, we learned about five upcoming Focused Technical Projects (FTP):

- Robotic Blending Milestone 4: Closing the Loop
- Scan-N-Plan for X: A generalized framework for CAD-free high mix part processing
- CAD-to-ROS Milestone 4: Calibration GUI
- 6 DOF Slicer Milestone 2
- NIST Agile Robotics for Industrial Automation Competition (ARIAC)

The meeting generated momentum for the coming international expansion. Thank you for your support and collaboration, and with the emerging RIC-Asia Pacific.

In closing, I would like to invite your collaboration in the expansion of our CAD-to-ROS Workbench, which is planned to build out over the course of five milestones. We've seen great success in collaborating with seven organizations to develop the first milestone – a URDF editor. A unique aspect of this project is that only Consortium members who submit new enhancements or squash bugs are granted access to the project. It will be released open source after two years, or sooner as financial support permits. We propose that the next three milestones be distributed among RIC-EU (Process Planner GUI), the future RIC-Asia Pacific (Workcell Planning Tool), and RIC-Americas (Calibration GUI). I invite you to join us in this endeavor.

Thank you for supporting open source industrial automation!



*Paul Hvass  
Program Manager  
ROS-I Consortium Americas  
Paul.Hvass@swri.org*



# ROS-Industrial for Asia Pacific

With the rise of robotic automation, the demand in Asia (including Australia and New Zealand) was stronger than in any other market with about 139,300 industrial robots sold in 2014, 41% higher than in 2013 as recorded by the International Federation of Robotics.

Industrial robots come in a variety of forms, sizes and configurations, while they can perform a whole array of tasks including pick and place, welding, and assembling. They are generally not straight forward and require intricate know-how to be developed and to be applied to specific applications. In addition, there is an emerging market for new areas like service and collaborative robots.

With the prevalence of robotic demands becoming more obvious, we see a growing need to push the boundary of robotic advancement and what it can do in the near future. Many countries including Singapore provide national commitment in funding to robotics R&D including training of the future workforce.

Hence, we believe forming an Asia Pacific Consortium for ROS-Industrial will help to incubate and accelerate robotic innovation in the region. To kick off the initiative, we have planned a workshop for like-minded users and communities. The event is organized in collaboration between the Advanced Remanufacturing Centre of A\*Star and the School of Mechanical and Aerospace Engineering of Nanyang Technological University, and will take place in Singapore on July 14–15, 2016. We welcome interested parties to join us! You can find more details on the event at <http://rosindustrial.org/events/2016/7/15/ros-i-asia-workshop>

Traditional Robotics	Future Robotics
<ul style="list-style-type: none"> <li>• High fixed cost</li> <li>• Custom design / fixed position</li> <li>• Deployed for specific purpose</li> <li>• Knowledge intensive for creation</li> <li>• Long lead time for implementation</li> <li>• Inflexible supply chain and manufacturing process</li> <li>• Wire connection</li> </ul>	<ul style="list-style-type: none"> <li>• Cost effective</li> <li>• Flexibility / mobility</li> <li>• More Robot variation with learning capability</li> <li>• Simpler configuration and programming by user</li> <li>• Ease of setup and repurpose</li> <li>• Reconfigurable for new processes</li> <li>• Ubiquitous connectivity</li> </ul>

**BUDGET 2016**  
Why It Matters To You

**BUSINESS**

**\$450 million**

To be spent on National Robotics Programme over next 3 years

SOURCE: MINISTRY OF FINANCE



**Nicholas Yeo**  
**Technical Director**  
**Advanced Remanufacturing and Technology Centre (ARTC), A\*STAR**  
*ARTC is a newly formed research centre in Singapore focusing on advancing manufacturing technologies for industry applications*



# The research outlook

## Public and private R&D funding converging into a single platform

Robotics is at a crossroads. Progress is rapid and public expectations are at an all-time high. However, translation of scientific breakthroughs into impactful economic innovations is still slow, too slow. The road ahead has two possibilities. Either the expectation gap increases too quickly, possibly leading toward a “robotics winter” similar to earlier “AI winters”. Alternatively, technology transfer picks up pace and society enjoys a rapid increase of the benefits of robotics, especially in industrial efficiency and better healthcare solutions. ROS-Industrial is a powerful tool for the second road.

In the past decade, ROS has contributed strongly to collaboration between robotics groups in academic research. The skills and expertise that fresh robotics graduates develop in university labs can now be enjoyed and directly transferred into their products by commercial employers, thanks also to an initiative such as ROS-Industrial. Open-source software can thus form a formidable basis for both researchers, who can prototype new exploratory R&D, and commercial software suppliers, who in turn can provide trusted industrial solutions.

ROS and ROS-Industrial can therefore serve as a shared technology platform where public and private funding converge, maximizing the impact and reach of both. To test in a concrete setting our very own research efforts, such as those developed within the Factory-in-a-Day project, and to demonstrate how ROS-Industrial can enable their transfer into practical applications, we entered the 2016 edition of the Amazon Picking Challenge (June 29–July 3, Leipzig, Germany). We recently demonstrated our APC entry to visitors during RoboBusiness Europe in Odense, Denmark.

In addition to further expanding the demonstrator applications, the focus will shortly move toward state-of-the-art quality verification methods. This development, together with the world-class level of EU-funding for public-private collaboration, will soon lead to step changes in the intelligence of industrially applied robot systems. I am confident that we take the second road. Robotics has too much to offer.



*Team Delft (TU Delft + Delft Robotics) demonstrating its entry to the Amazon Picking Challenge during RoboBusiness Europe 2016 in Odense, Denmark.*



**Prof. Dr. Martijn Wisse**  
*Scientific Advisor to the ROS-Industrial Consortium Europe*  
TU Delft



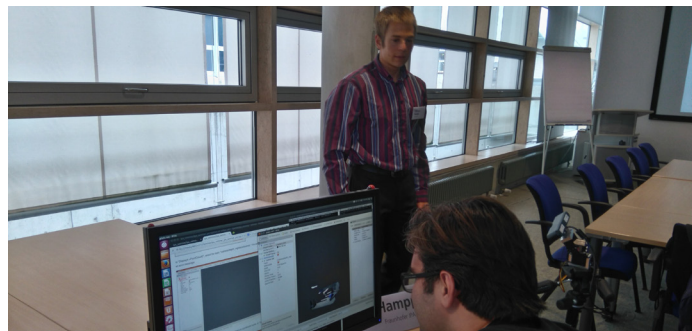


# ROS-Industrial training

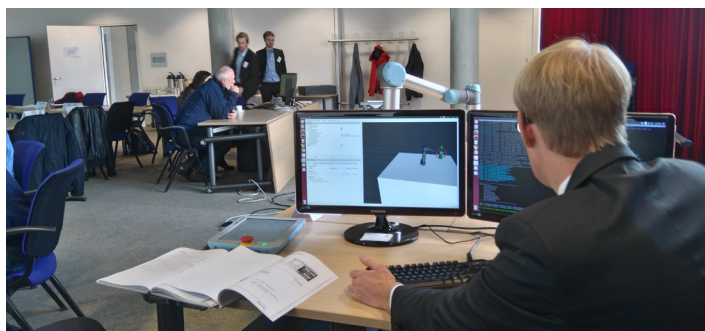
## 5th ROS-I training at Fraunhofer IPA

At the 5th edition of the ROS-Industrial training on workshop (in October 2015), held at Fraunhofer IPA in Stuttgart, Germany, attendees from both industry and academia were given a general introduction to the ROS concept, structure and tools, and then received hands-on training on three separate sessions covering perception, manipulation, and navigation.

The workshop was followed by an overview of current activities of the ROS-Industrial Consortium Europe. We are happy about the feedback that we received, and as ROS(-Industrial) awareness and usage spreads, we are preparing for more in-depth training workshops to be delivered in 2016. To this end, we are partnering with FH Aachen, which has extensive experience in providing ROS training as you can read below.



*Learning how to use the PCL for perception tasks.*



*The manipulation hands-on session.*

## ROS Summer School at FH Aachen

The University of Applied Sciences Aachen (FH Aachen) is using ROS and ROS-I since 2011 in research and education. In 2012 the MASCOR institute (Mobile Autonomous Systems and Cognitive Robotics) hosted the first official ROS training, a "Summer School", for students. Prof. Dr.-Ing. Stephan Kallweit (Faculty of Mechanical Engineering and Mechatronics) and Prof. Dr. Alexander Ferrein (Faculty of Information Technology) shared the vision of creating hands-on lectures, tutorials and workshops to teach ROS and inspire students for advanced robotics. In groups of three, the participants make mobile robots perceive, localize, communicate, navigate and solve higher level tasks in a two weeks' time frame. Things evolved rapidly! Today, participants join from over 17 countries worldwide and FH Aachen provides computers and an RC car chassis with multiple sensors, like e.g. a SICK laser scanner, for up to 25 groups or 100 members. In addition, the first international Summer School was successfully launched at Tshwane University of Technology in South Africa in April 2016.



Future engagement will include further annual international trainings in South Africa, Australia and India. Also beginning in August 2016 we will introduce a second hardware platform, a low-cost robot arm, into the ROS Summer School to intensify industrial robotics training, to be delivered in cooperation with RIC-Europe.

### Upcoming events

- 6<sup>th</sup> ROS Summer School, August 15–26, 2016, FH Aachen
- 1<sup>st</sup> UAV workshop, August 2016
- 2<sup>nd</sup> ROS Training, November 2016, TUT



# RIC-Europe Annual Members Event

## Tech Demo & 2016 Members Meeting

On Jan 28–29, Fraunhofer IPA welcomed more than 50 participants to the annual RIC-EU members meeting. ROS technology continues to mature and find its way into commercial products and industrial applications, which was shown during a technology demonstration session.

Participants had the chance to see for themselves what ROS technology can do in terms of easing robot programming; extending the applicability of commercial software platforms through standard interfaces; allowing for hardware-independent intuitive touch interfaces; and powering next-generation robot hardware.

After introductory talks, the attendees enjoyed individual presentations, and were able to interact with the presenters and fellow attendees during an open-floor format. The day ended with a social event.

The members' meeting held Jan 29 is an annual gathering of members for an overview of activities during the previous year and current initiatives. Presentations about efforts similar to ROS-I targeting other domains were given. The

SiLA initiative aims at similar standardization efforts, but for lab automation equipment; the Machinekit project, which is undergoing interesting development, can make in the future Machinekit+ROS a full stack covering all of your robotics-related needs, from bare metal up to the user interface. This "sister" project raised considerable interest for its potential, especially for hardware designers in need of a means to interface with ROS. More updates will be available on [rosindustrial.org](http://rosindustrial.org), as integration efforts continue.

Attendees enjoyed presentations from RIC-EU's scientific advisor, Martijn Wisse from TU Delft, and Mirko Bordignon from Fraunhofer IPA on ROS infrastructure and further development for industrial use thanks to public funding. Ingo Luetkebohle from Bosch, which is a full member of RIC-EU, provided an overview of ROS activities at his organization, while Paul Evans, a Director from the Southwest Research Institute, briefed the attendees on the North American ROS-I Consortium.

The meeting ended with an open discussion, which provided inputs for the ongoing technology roadmapping activity.

*Impressions from the Tech Demo Session at Fraunhofer IPA.*



# Legal aspects and best practices of open-source

On April 19–20, 2016 Fraunhofer IPA hosted an event organized in collaboration with euRobotics AISBL on the best practices and legal aspects of Open-Source Software (OSS) in robotics and automation. The rationale behind the event was that while OSS is an established and accepted factor in "software-heavy" business domains like enterprise IT systems and smartphones, its inner workings are less understood in industries where software is now shifting from a component with ancillary role to one with high added-value. With the changes poised to happen in industrial robotics and automation by the advances in robotics science on one hand (just think of the progress in autonomous driving and its underpinning achievements in perception, planning, control) and by government-mandated initiatives like Industrie 4.0 on the other, the ROS-Industrial team believes that OSS is a great opportunity to accelerate this process. However, to foster its adoption we understandably need to identify and clear also non-technical obstacles such as possible legal, economic and regulatory aspects.

During the event the speakers described to the audience how OSS is already part of established business practices at large companies in the industrial domain; how digital economies are being shaped thanks also to OSS; which regulatory and legal aspects we need to take into account in terms of safety standards, licensing and compliance processes.

Takeaway messages that we want to highlight as they are instrumental in removing unfounded but long-standing critiques of OSS for industrial robots and machinery are:

- The kind of functionalities that ROS is typically used for, and which sit at the OS/middleware and the application software levels, can be carried out by non-certified software as they live in a "sandbox" protected by the underlying safety-compliant foundation and which includes the electrical/mechanical and safety device/PLC level layers. As I like to say, we do not necessarily aim to replace the software in your robot's control box with ROS (although the software to do that is available), but rather to provide higher-level functionalities like perception-driven, online trajectory generation to let the robot operate in dynamic environments, thing not possible (or very difficult to perform) with the limited sets of preprogrammed motions typical of current automation.
- OSS has a long history of adoption in industrial automation; Linux (especially Linux RT) is a good example of this, and shows that using OSS in commercial products is not only possible, but also beneficial.

- Having a compliance process in place (e.g. OpenChain) can ensure that licensing matters are properly dealt with.

Given the interest and the feedback collected after the event, we plan on following-up on these topics at the ROS-Industrial Conference next fall.



Carsten Emde, OSADL.



Ilkka Lakaniemi, Aalto University.



Mirko Bordignon, Fraunhofer IPA.



# ROS-Industrial and industrial-grade platforms

## RIC-EU collaborates with HARTING to bring ROS on the MICA platform

As ROS-Industrial matures in terms of functionalities and code quality and gathers acceptance among users, the next step will be better, possibly out-of-the-box support on industrial-grade platforms. The RIC-EU is collaborating with the HARTING Technology Group to explore the possibility of first class ROS-I support on its MICA platform. The two platforms have already a lot in common, starting from their leverage of open-source software. Further convergence within advanced robotics and Industrie 4.0 scenarios is currently being explored within HARTING.

### The HARTING IIC MICA

Good, affordable platforms for embedded development in the hobby sector have been available for a number of years now – such as the Raspberry Pi, the € 35 learning computer that started a revolution on the maker scene. But after prototyping comes migration, requiring solid hardware and software compatible with industrial utilizations. HARTING has developed a modular hardware and software platform for this and many other internal and external projects with an ideal design for both rapid development and industrial application in medium quantities. Particular attention was paid to three aspects:

- Hardware for industry that can be installed in new and existing machines and vehicles in a few easy steps
- Configurable hardware with specific customer capabilities can be added quickly and easily without changing form factor or protection class
- A stable and robust open software environment enabling both production and IT developers to complete projects quickly

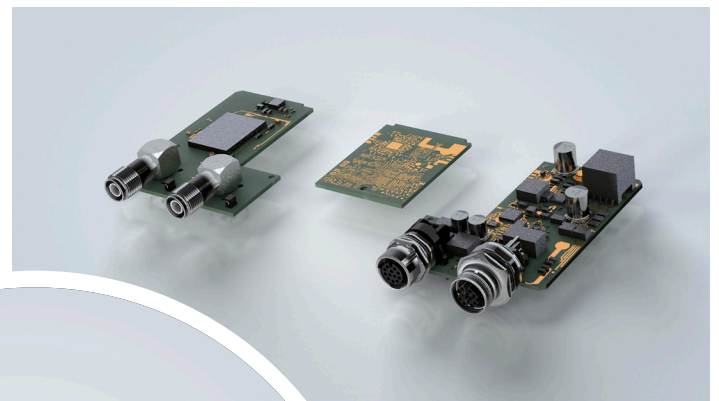
This resulted in a platform suitable for a number of interesting tasks, such as:

- Virtual industry computing, leveraging lightweight virtualisation with Linux containers. Package dependencies and incompatibilities are now taken care of, together with other menial housekeeping tasks
- Process optimization, thanks to gathering data and transferring it to ERP systems through I4.0-compatible protocols such as OPC UA
- Predictive maintenance, by retrofitting legacy machinery with MICAs

Having ROS-powered capabilities as one more feature that the MICA can add to machinery is a very promising possibility that HARTING is actively exploring within the scope of projects centering on human machine cooperation.



*Lars Hohmuth  
Product Manager Industrial  
Computing  
HARTING Technology Group*



*HARTING IIC MICA.*



# ReApp

## Fast and easy robot application development and deployment

The goal of the research project ReApp, funded by the German Federal Ministry for Economic Affairs and Energy (under grant no 01MA13001A), is to provide Reusable Applications for flexible robot-based Automation Systems using ROS-Industrial. One of the core concepts of ReApp is a model-based toolchain – the ReApp Engineering Workbench – for the development of ROS-I hardware drivers, higher-level software components, application-oriented skills and complete robot-based automation solutions. The different elements of the toolchain are linked via several ontologies reflecting technical, domain, and capability knowledge. These ReApp ontologies map hardware types and capabilities to standard ROS topics, services and actions, such that compliance to ROS-I standards can be enforced implicitly. The Engineering Workbench is thus a programming environment that enables component manufacturers and system integrators without any ROS expertise to create and use ROS-based software, respectively.

In the past two years, the following results were achieved:

- The **ReApp-Store** is available to host reusable apps
- The **ReApp domain ontologies** define terms for expressing characteristics and features (skills or capabilities) of hardware and software components developed for ROS using W3C's Web Ontology Language (OWL 2 DL). They are publicly available and open for contributions: <http://ipe-id.fzi.de/ontologies/reapp/>
- The ReApp Engineering Workbench to model and deploy ROS-based software components and applications is in the beta testing phase and will be released soon:
  - **Component Modeling Tool (CMT)**
  - **Skill and Solution Modeling Tool (SSMT)**

### Recent Activities

Hannover Fair, April 25–29, 2016



*Mobile Soldering Assistant developed with ReApp apps, Hannover Fair, April 2016.*



*Dr. Ulrich Reiser  
Group Leader  
Software engineering and  
system integration  
Fraunhofer IPA*

## Factory-in-a-day

### Plug & work robots

The EU funded project Factory-in-a-day started at the end of 2013. Its main goal is to reduce the installation time of a new hybrid robot-human production line, from the weeks or months that current industrial systems now take, down to one day. Our project is now in the second half of its project duration. What have we achieved so far? From a technical point of view, we demonstrated a first learnable skill, which was also our Milestone 2. Other results are the dynamic path planning with obstacle avoidance and also the integration of some key technologies on robot TOM, whose arms and grippers are now covered with artificial skin sensors developed by our partner Technical University of Munich (TUM). Many of the key technologies were developed within the Factory-in-a-day project, for example the latest version of the robotic skin sensors developed at TUM, including a new inter-cell connector, new firmware for both the skin cells and the Tactile Section Units as well as a new skin library. Additionally, preliminary results have been obtained on a robust skin connection that supports failures in the skin cell network. Also, a method to fuse the skin cells

signals for motion control, based on joint torques, has been designed. All of these features are also implemented in ROS. "ROS is used in the core of the project Factory-in-a-day. We aim to increase the speed of development and installation of industrial robots for SMEs. Therefore, it is important to create intelligent, flexible robots", explains Prof. Martijn Wisse, coordinator of Factory-in-a-day. A video of the demonstration is available here:

[https://youtu.be/UiK0twJ\\_aHM](https://youtu.be/UiK0twJ_aHM)



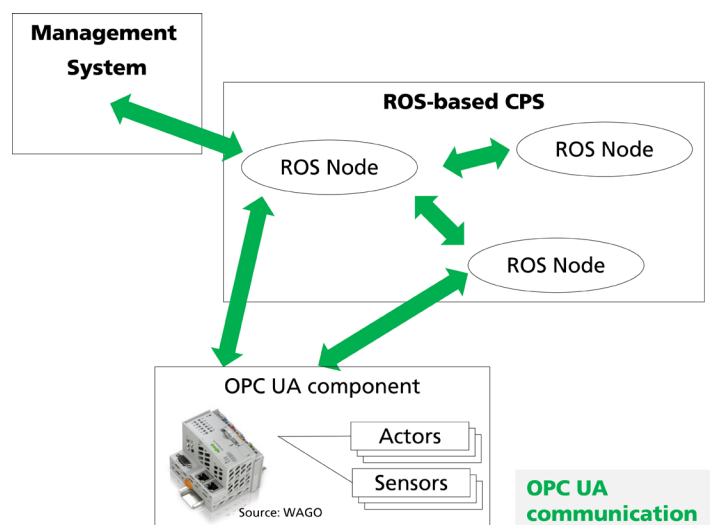
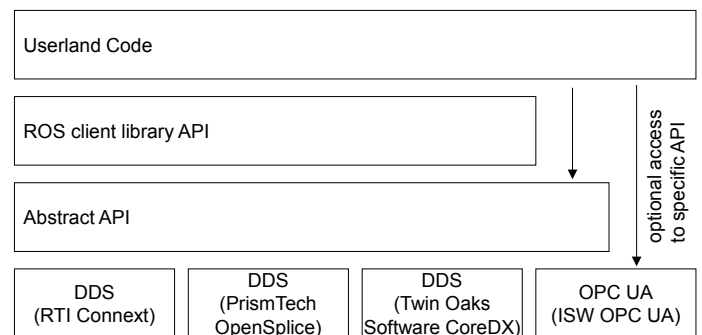
*Wibke Borgesser  
Dissemination Manager  
for Factory-in-a-day*

# ROS-based CPS in Industrial Environments using OPC UA

In search of a standardized communication protocol for "Industrie 4.0" applications, OPC UA is evolving towards its de facto standard. Leading European manufacturers in industrial automation committed to it, and it is also explicitly mentioned in [the document](#) published on January 2016 by the Industrie 4.0 Platform joint project between Bitkom, VDMA and ZVEI titled "Implementation Strategy Industrie 4.0". OPC UA enables the communication between components from the enterprise level to the field level, independently from the manufacturer and operating system.

ROS provides high-level and low-level functionalities for image processing, autonomous navigation and mobile manipulation for robotic systems according to the latest state of knowledge and research. Especially mobile robots are of great importance in industrial environments for handling and logistics within the production systems of the future. In the context of "Industrie 4.0", the focus is on cyber-physical systems (CPS). ROS with its great range of functionalities is well positioned to provide these functionalities for CPS. For the seamless integration of ROS-based CPS into production networks, as well as the integration of OPC UA devices into the ROS-based systems, a ROS communication infrastructure based on OPC UA can be the solution to bridge these two worlds. The Institute for Control Engineering of Machine Tools and Manufacturing Units (ISW, University of Stuttgart) in cooperation with the Fraunhofer Institute for Manufacturing Engineering and Automation IPA is working on an enhancement of ROS with the OPC UA communication protocol, aiming for such integration to power the production networks of the future. Using OPC UA, the communication in-between flexible and dynamic productions systems is possible – e.g. manufacturing and assembly systems, transport and assistance systems, control and management systems.

As the new version of the Robot Operating System (ROS 2.0) decouples the communication infrastructure, such modular framework concept allows adding OPC UA as an option to the existing communication mechanisms based on other middleware such as DDS. Synchronous and asynchronous communication, function calls as well as publisher and subscriber patterns are supported by the specification. The objective is to enable OPC UA components to have direct integration into the ROS Communication Graph. This will ensure a horizontal and vertical integration of ROS-based CPS into industrial environments with respect to production networks, robot systems and components. A prototype implementation of this mechanism targeting ROS 2.0 is under active development at ISW: we encourage interested parties to contact RIC-EU Consortium Manager Mirko Bordignon at Fraunhofer IPA to notify their interest and subscribe for updates.



*Christian Scheifele*  
ISW Stuttgart



*Matthias Keinert*  
ISW Stuttgart



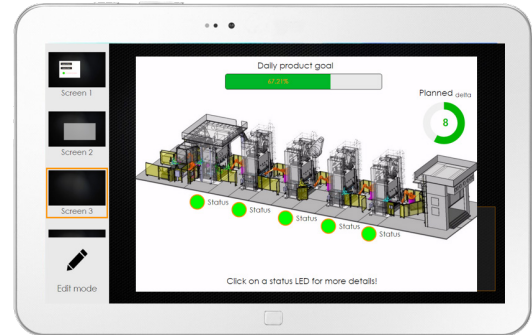
# ROS-Industrial is used in commercial products and in exploratory R&D

Here are examples from some of our member institutions:

## FlexGui, PPM AS

This technology provider from Norway recently moved its main GUI offering to the ROS technology stack, providing it as both an open-source package available in the ROS-Industrial repository, as well as a commercial version with extra features.

[www.ppm.no](http://www.ppm.no)



## RAGNAR, BlueWorkforce A/S

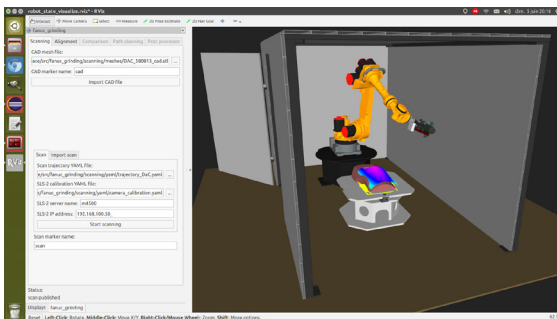
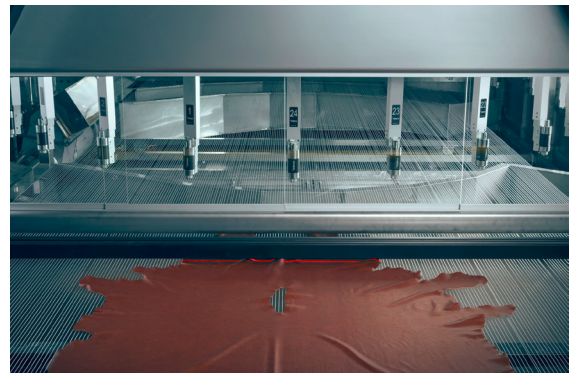
A lightweight and low-cost parallel kinematics robot at the core of a modular automation platform. The accompanying ROS driver is actively under development in collaboration between the manufacturer and the ROS-I Consortium.

[www.blueworkforce.com](http://www.blueworkforce.com)

## Various automation products, IT+Robotics srl

This system integrator from Italy, a spin-off of the University of Padova, successfully used ROS in various automation products and projects, such as a motion controller (in collaboration with Robox srl) and leather spraying machinery (pictured on the right, in collaboration with todesco srl). Its own commercial package for robot simulation and off-line programming also exposes ROS interfaces.

[www.it-robotics.it](http://www.it-robotics.it)



## Automated robot grinding application, Institut Maupertuis

This project, implemented as a ROS software package, aims to allow to automatically grind mechanical defects of parts given their CAD model. It makes use of the Bezier 6D tools path planner and its results are incorporated in the Gödel package, both publicly available as ROS-Industrial packages.

[www.institutmaupertuis.fr](http://www.institutmaupertuis.fr)

## Infrastructure-less autonomous navigation for industrial AGVs, Fraunhofer IPA and Bär Automation GmbH

The navigation stack of Fraunhofer IPA, which leverages the open-source ROS infrastructure, has been used on the AGVs of german manufacturer Bär Automation GmbH to provide infrastructure-free navigation. It is fully operational on the factory floor since early 2015 in the automotive manufacturing environment.

<http://baer-automation.de/en/>



Source: Bär Automation GmbH.



Current members of the world-wide ROS-I Consortium

## Future Events

July 14, 2016 – July 15, 2016

[ROS-I Asia Pacific event](#)

ARTC and NTU, Singapore

Aug 21, 2016 – Aug 23, 2016

[ARIAC Competition Kickoff at CASE Conference Training Class](#)

The Worthington Renaissance Hotel; 200 Main Street Fort Worth, TX USA

Oct 8, 2016 – Oct 9, 2016

[ROSCon 2016 - Hosted by OSRF](#)

Seoul, South Korea

Nov 2, 2016 – Nov 3, 2016

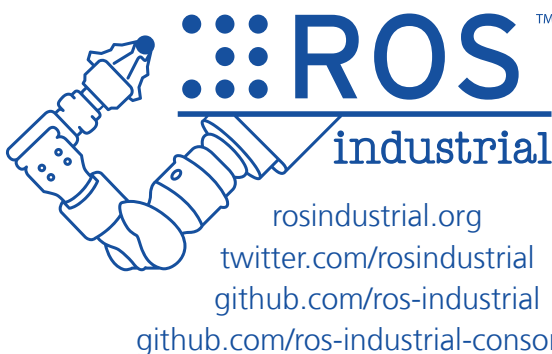
[ROS-I training](#)

Fraunhofer IPA, Stuttgart Germany

Nov 3, 2016 – Nov 4, 2016

[2016 ROS-Industrial Conference](#)

Fraunhofer IPA, Stuttgart Germany



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