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Abstract	This annual report describes main activities performed regarding communication and dissemination as part of the OFERA project and in relation to the micro-ROS platform.

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1 Introduction

1.1 Summary

In the first year of the project, not much communication and dissemination could be done as the project was still on an early stage.

In order to maximize impact derived from communication, resources linked to this task have been planned for the second and third year of the project. Major effort has been put in defining target KPIs.

With respect to dissemination of results, efforts during 2018 have been focused on participation in technical conferences and workshops, since rest of activities required to have concrete and tangible results (e.g., software) out of the project. Target KPIs in this regard have been met, actually raising quite substantial awareness among the ROS Community.

On the kick-off face-to-face meeting in Germany, OFERA agreed to plan the coming face-to-face meetings sharing time and space with a relevant event of target users. Following such an idea, the second face to face was organised in the frame of FIWARE Summit. In such event, one of the partners, eProsima, had two speeches where they presented their own products, but made mentions to the project and consortium working on it.

The third and last face-to-face meeting of this reporting period took place in Madrid, in the context of ROSCon, the most important ROS community event. OFERA proposed a micro-ROS talk as a consortium that was refused by the organisation due to the high number of submissions. Nevertheless, two of the partners of the project, Bosch and Acutronic Robotics, gave talks where they did special mentions on the OFERA project and micro-ROS.

In this last event, ROSCon Madrid 2018, OFERA drove the creation of a special interest group on embedded ROS 2. This interest group attracted a surprisingly high number of interested community members. Following this interest group creation, a post and open discussion were kicked, from micro-ROS side, in the official ROS2 forums. This discussion leads to an online meeting with people interested in bringing ROS2 to embedded devices. OFERA lead that meeting and plan to keep up regular meetings to get the community active and collaborative with a ROS 2 embedded alternative.

On this same direction of direct interaction with ROS2 community, OFERA has kicked-off and open design document for possible ROS2 embedded, which inherited most of the design and architecture defined for this project. In this open forum, our position and proposed design and architecture are the same as the one in this project. Ideally, this design ends up being a part of the official ROS 2 design becoming the “official” implementation of ROS 2 for embedded devices.

1.2 Partners involved

Short name	Full name	Contribution
FIWARE	FIWARE Foundation e.V.	Leading author
PIAP	Industrial Institute for Automation and Measurements	Contributor
Bosch	Robert Bosch GmbH	Contributor
ALR	Acutronic Link Robotics AG	Contributor
eProxima	Proyectos y Sistemas de Mantenimiento SL	Contributor

1.3 List of acronyms

Acronym	Meaning
API	Application Programming Interface
DDS	Data Distribution Service
ROS	Robot Operating System
RTOS	Real Time Operating System
RTPS	Real Time Publish Subscribe

2 Communication activities

2.1 Scope

Communication activities are intended to provide targeted information to multiple audiences, including the media and the public, in a strategic and effective manner. With communication activities we intend to call the attention of multiple audiences about our research (in a way that they can be understood by non-specialists) and address the public policy perspective of EU research and innovation funding, by considering aspects such as contributing to competitiveness and to solving societal challenges.

They map into activities related to active presence in social networks, writing of featured blog posts on relevant portals or articles within relevant newsletters, etc.

2.2 Branding strategy

An initial decision in the project was that of separating the name of the main technology which is going to be produced as result of the project, namely the micro-ROS technology, and the name of this EU funded project which is bringing initial funding to activities linked to development of the micro-ROS technology, namely OFERA.

There are several reasons why this decision was taken, concretely:

- Projects are, by definition, limited in time while we aim at delivering the key message that micro-ROS is a technology planned to stay there for a long period, without being subject to the temporal constraints of concrete projects. OFERA, in this respect, is just the project that brings initial funding to activities of micro-ROS. It is important that target audiences (developers, system architects) approach the technology without the negative connotation of approaching something that is planned to end someday, a feeling that is unavoidable when we are talking about a project. We aim at bringing the message that continuation of micro-ROS is not an incognita and it is not bound to the duration of projects.
- EU funded projects are inevitably connected to research activities in the European context while we intend to emphasis the market-oriented and global dimensions of micro-ROS. By keeping the concept of the project separate from the technology, we are able to place activities and results in the right context (e.g., WPs, tasks and deliverables with their corresponding coding just under the umbrella of the OFERA project).
- Contributing to a funded project, which inherently comprises concrete partners funded for the purpose and bound by a contract, raises higher barriers for contribution from third parties which is an ultimate goal in micro-ROS. Contributing to development of a technology managed as an open source product on GitHub raises less suspicion. By distinguishing the two spaces using two different names, we separate the contract under which a number of partners are collaborating and the space for a more open, agile and flexible collaboration.

2.3 Future work

Since only after the end of first year the project has produced its first relevant results, communication activities have been planned to focus on the second and third year of the project. The intend is to distribute the planned resources in a way that maximizes impact.

The following table establishes main communication activities in which we will bring focus in 2019 and 2020.

Activity	Target goal	Defined actions	target KPIs
Active presence on social networks	Raise awareness on Social Media	Regular posts through FIWARE channels and by partners of the consortia	>3 posts/month (Twitter, LinkedIn, Facebook) 1 video/year on YouTube >10 average likes /share per post
Featured blog posts	Social awareness	Blog posts or articles within FIWARE website or other websites	> 10 posts/year > 1000 visits/year
Production of marketing material	Promotion	Flyers, brochures, promotional material	1 flyer 1 brochure 1 poster 1 infographic
Press releases	Awareness among decision and policy makers	Official communications	>=2 / year
One-to-one communication	Awareness on target audiences	Newsletters Mailings	Featured article every two FIWARE newsletters >1 featured mailings/year

3 Dissemination activities

3.1 Scope

Dissemination activities comprise sharing the concrete research results of this project, linked to the micro-ROS platform, with potential users - peers in the research field, industry, the ROS Community, industry players and policy makers.

3.2 Relevant Websites for dissemination

As a result of the defined [branding strategy](#), results of activities carried out within the OFERA project are being made visible through two separate websites:

- The OFERA.eu website: <http://www.ofera.eu/>

This website provides basic information about the EU funded project, including a description of the project and partners involved. It also provides the repository where public deliverables of the project are made available.

- The micro-ROS space on GitHub: <https://github.com/microROS>

GitHub is by large the most widely known space where open source projects are hosted and their results made available to the wide community of developers. Therefore, the project has created a dedicated space on GitHub, which has been structured following best-of-breed practices in management of open source projects within that space. Within this space, access is provided to the micro-ROS main repo (<https://microros.github.io>).

3.3 Active presence in events

3.3.1 CPS-Week 2018

CPS-Week is one of the premier events on Cyber-Physical Systems and Internet-of-Things research, bringing together several renowned conferences from those two areas.

In 2018, CPS-Week took place in Porto (Portugal) from 10 to 13 April. The first day (Tuesday) was reserved for workshops and tutorials. Moreover, two competitions, the F1/10 autonomous 1:10 racing car challenge (f1tenth.org) and the Microsoft Indoor Localization Competition, were carried out in the first two days. This CPS-Week hosted four conferences from Wednesday to Friday. These were

- HSCC - 21st ACM International Conference on Hybrid Systems: Computation and Control,
- ICCPS - 9th ACM/IEEE International Conference on Cyber-Physical Systems,
- IPSN - 17th ACM/IEEE International Conference on Information Processing in Sensor Networks, and

RTAS - 2018 IEEE Real-Time and Embedded Technology and Applications Symposium.

The Robot Operating System (ROS) played an important role in several talks and events. Most important, ROS is used in the F/10 challenge. The organizers provide a ROS-based reference stack (by the mLab of the University of Pennsylvania) for the racing car platform, using Hector-SLAM for mapping and localization.

On the first day, on invite of the organizers, Ralph Lange from Bosch provided a full-day tutorial on ROS and ROS 2. For the hands-on sessions during the tutorial, the Cloud-based ROS learning platform [robotignite Academy](#) by [The Construct](#) was used. The contact to The Construct's CEO Ricardo Téllez had been mediated by the OFERA partner Acutronic Link Robotics.

In this tutorial, Ralph Lange also presented an overview to the micro-ROS endeavour and the OFERA project. As most attendees of CPS-Week have a strong background in embedded systems research, micro-ROS and OFERA drew a lot of interest among the audience.

3.3.2 FIWARE Summit

Born in Europe but with global ambition and currently strongly supported by both the European Commission and by leading companies in the ICT sector, the FIWARE community has as its mission the building of open source software that will become a universal standard for the development of services and smart applications in the new digital era. The FIWARE Foundation is the legal independent body that promotes the development, distribution and adoption of FIWARE technologies, providing support to the growing community that is behind it.

The FIWARE Summit, organized by the FIWARE Foundation every six months, is the major event where members of the FIWARE Community (defined as the members of the FIWARE Foundation) meet together and with organizations and individuals that are part of the FIWARE ecosystem (defined as those who are using FIWARE). It is also a major instrument of dissemination of FIWARE and FIWARE-related activities towards individuals and organizations interested in FIWARE. It used to be organized along two full-days, gathering 500+ attendees from multiple countries not only in Europe but beyond (particularly Asia and Latin America).

3.3.2.1 FIWARE Summit in Porto 2018

The 4th FIWARE Summit took place in Porto (Portugal) from 8th to 9th May 2017 in collaboration with Porto Digital and collocated with the [Start and Scale Porto](#). The event was organized upon 4 main tracks: Smart Cities, Smart Industry, Smart AgriFood and Developers, unfolding across 51 tech and business sessions, with use cases, keynotes and panel discussions. The event also offered an Exhibition Area to showcase Powered by FIWARE smart services and solutions. In addition, training and matchmaking took place in the form of parallel activities like the Open Camp, organized by FIWARE Mexico and FIWARE Mundus, and the 'Doing Business' space, welcoming more than 30 startups whilst accommodating brokerage events and f2f meetings with investors and cities.

During the second day of the Developers' track, Jaime Martin-Losa (eProsima) made a presentation about Fast RTPS since this technology is currently an Incubated FIWARE GEs. During his presentation, Jaime introduced micro-ROS and brought some hints regarding potential integration of micro-ROS results with FIWARE.

Slides:

<https://www.slideshare.net/JaimeMartin-eProsima/fast-rtps-workshop-at-fiware-summit-2018>

An [article](#) about presence on the FIWARE Summit was posted by eProsima on their website.

3.3.2.2 FIWARE Summit in Málaga 2018

On the 27th and 28th of November 2018, the Trade Fairs and Congress Centre of Málaga (FYCMA) hosted the 5th edition of the FIWARE Summit. Industry and Cities representatives, corporates, entrepreneurs, startups, developers and investors exchanged experiences and catch up with the latest advancements in FIWARE technology and evolution of the community. This Summit introduced a new session devoted to the new Smart Energy domain to discuss about the demand for reference architectures in this domain, Open Source architectures for Energy transition and sustainable Energy Ecosystem. The support of the FIWARE Foundation for the adoption of de-facto standards of open source, reusable components that implement common APIs and interfaces for portability and interoperability of applications is now amplified to the Smart Energy domain that sums to Smart Cities, Smart Industry and Smart Agrifood.

6 Breakout sessions covered new cross topics like Blockchain, Robotics, AI, Data Economy, Edge Computing and IoT within the context for Smart Cities, Industry 4.0, Smart Agrifood and Smart Energy.

Once again, Jaime Martin Losa (eProsima) made a presentation about Fast RTPS during the second day of the Developer's track.

Besides that, a presentation of the micro-ROS project was performed by Jaime Martin Losa during the track on Robotics.

Slides:

<https://www.slideshare.net/JaimeMartin-eProsima/fiware-robotics-ros2-microros>

An [article](#) about presence on the FIWARE Summit was posted by eProsima on their website.

3.3.3 ROSCon

ROSCon (<https://roscon.ros.org>) is the most important event of the ROS community. It is being organized by the Open Robotics Foundation, which maintains the core of ROS as well as the Gazebo simulator.

ROSCon has grown remarkably in the last years. In 2018, the conference was sold out already during the early registration phase. 500 developers and researchers from all over the globe attended ROSCon 2018 in Madrid. More than 1000 watched the live stream. The

acceptance rate for full talks got down to 23%, even less than the acceptance rates of the two large scientific robotics conferences IROS and ICRA.

Due to the important of ROSCon for the micro-ROS endeavour and the OFERA project, a number of representatives of the OFERA partners attended the conference and delivered talks and demonstrations. Also, three of the partners - Erle Robotics (Acutronic Robotics), eProxima, and Bosch - sponsored the conference.

In sum, three talks related to micro-ROS and OFERA were provided:

- Iñigo Muguruza Goenaga (Erle Robotics), Juan Flores Muñoz (Erle Robotics), Víctor Mayoral Vilches (Erle Robotics), Loïc Dauphin (INRIA), Emmanuel Baccelli (INRIA), Cedric Adjih (INRIA): Towards ROS 2 microcontroller meta cross-compilation.

Abstract: We introduce an extension of ament that proposes a new way of porting ROS 2 packages without modifications to microcontrollers. Our prototype cross-compile packages into RTOS-specific projects that can later be compiled for the target platform. This work leads towards a ROS 2 meta cross-compilation setup that enables the use of microcontrollers as first-class participants of the ROS ecosystem while configuring their structure to meet the requirements by selecting through a variety of aspects such as RTOS, middleware, etc. We demonstrate this arrangement for two RTOSs, namely RIOT and NuttX, with microcontrollers as tiny as 32Kb RAM and 256Kb Flash.

Slides:

https://roscon.ros.org/2018/presentations/ROSCon2018_Towards_ROS2_uC_meta_crosscompilation.pdf

Video: <https://vimeo.com/293305909>

- Ralph Lange (Bosch): Mixed Real-Time Criticality with ROS2 - the Callback-group-level Executor (lightning talk).

Abstract: Robotic systems typically comprise different applications with varying real-time and predictability requirements - even within ROS nodes. Therefore, we propose an enhanced Executor concept named Callback-group-level Executor for ROS 2 allowing to schedule callbacks on a fine granularity based on annotations with real-time profiles. We present the API of the enhanced Executor class of the rclcpp package. Furthermore, we show experimental results from a small test bench.

Slides: https://roscon.ros.org/2018/presentations/ROSCon2018_Lightning1_4.pdf

Video: <https://vimeo.com/292707644>

- Irati Zamalloa (Erle Robotics): HRIM - The Hardware Robot Information Model (lightning talk).

Abstract: Built around ROS, HRIM is an information model for robots that facilitates interoperability among modules from different vendors of robot hardware.

Offering a common interface, it simplifies reconfigurability and flexibility, an innovation the robotics industry strongly demands.

Slides: https://roscon.ros.org/2018/presentations/ROSCon2018_Lightning1_13.pdf

Video: <https://vimeo.com/292710359>

micro-ROS and OFERA received a lot of attraction at ROSCon. The OFERA team established contact to several developers working on the integration of microcontrollers in ROS 2. Therefore, on initiative of several OFERA partners, ROSCon 2018 was also the birthplace of the ROS 2 Embedded Special Interest Group, as detailed in deliverable D7.4 on collaboration.

3.3.4 ROS Industrial Conference Europe

The ROS-Industrial Conference (hereafter RICC) is a yearly three-day meeting organized by the ROS-Industrial Consortium Europe (hereafter RIC-EU), taking place in Stuttgart, Germany. It features presentations, tutorials and discussions on topics related to industrial automation, primarily but not only using ROS-Industrial tools.

ROS-Industrial is one of the most important ROS-based communities, enjoying great success particular for novel applications that are not well served by existing solutions. Thus, it is a natural place for dissemination. Moreover, automation is an important domain with a long history of technical excellence, so the expectations are high, and the meeting is always a great source of inspiration for future work.

The primary audience for the meeting is European, but there are also always representatives and participants from the ROS-Industrial Consortia in North America and Asia-Pacific present.

3.3.4.1 ROS Industrial Conference 2017

The event took place between December 12th and 14th, 2017. There were 120 registered attendees, 29 talks and two demos sessions. General information on RICC 2017 is available at:

<https://rosindustrial.org/events/2017/12/12/ros-industrial-conference-2017>

From the project consortium, Jaime Martin Losa from eProsima, Víctor Mayoral Vilches from ALR and Ingo Lütkebohle from Bosch have been present.

While the project had not officially started by then, due to good contacts to the RICC organizers, we could arrange a sneak peek at the project. Jaime Martin Losa gave a talk entitled micro Robot Operating System: ROS for highly resource-constrained devices, focusing particularly on the novel middleware approach (see https://rosindustrial.org/s/07_Losa.pdf).

Moreover, during his talk on the Hardware Operating System, Víctor Mayoral Vilches from ALR also mentioned the Hardware Robot Information Model and the project-related

activities towards its further development (see https://rosindustrial.org/s/21_Mayoral_Vilches.pdf).

The talks generated a great deal of interest, and questions focused on the communication approach, and on the sustainability of the activity after the project ends. We could communicate both the applicability of XRCE-DDS for small devices, as well as our general approach of improving an existing code base, thus improving sustainability, as well as the additional investment through new products based on it.

3.3.4.2 ROS Industrial Conference 2018

The event took place between December 11th and 13th, 2018. There were 150 registered attendees, 28 talks, a panel discussion on robotics and IT, and an exhibition/demo session. General information on RICC 2018 is available at:

<https://rosindustrial.org/events/2018/12/11/ros-industrial-conference-2018>

From the project consortium, Jaime Martin Losa from eProxima, Víctor Mayoral Vilches from ALR and Ingo Lütkebohle from Bosch have been present.

Víctor Mayoral Vilches gave a talk entitled *System Integration and Modularity in Robotics using ROS*, highlighting ALR's recent work and mentioning HRIM and micro-ROS. (See <https://www.youtube.com/watch?v=ZN2QRbNMq3c> for a recording of the talk).

Ingo Lütkebohle gave a talk entitled *ROS on Embedded Devices - Recent Developments*, motivating the project activity and presenting recent project results, with links to the web-site, repositories and the ROS 2 Embedded Special Interest Group. (See <https://www.youtube.com/watch?v=tARIVkxRZG0> for a recording of the talk).

Both talks received great interest and many conversations on the project ensued. Questions were focused on available platforms, real-time management issues and what are the next steps linked to micro-ROS.

3.4 ROS Developers Podcast

The ROS Developers Podcast was launched by The Construct's CEO Ricardo Téllez. On a weekly to biweekly basis, he publishes a half-hour interview with developers from the ROS community. More info can be found at:

http://www.theconstructsim.com/category/ros_developers_podcast/

In episode 25, from October 2018, Ricardo Téllez talked with Víctor Mayoral from Acutronic Robotics on ROS 2 and the Hardware Robot Operating System (or H-ROS), amongst others. Víctor introduced the importance of modularity and presented their current work with robot part manufacturers that aims to break the current lock-in in the robotics industry. Additionally, Víctor presented MARA, the first modular and collaborative industrial manipulator powered by ROS 2.

The audio file and corresponding links are provided at:

<http://www.theconstructsim.com/rdp-025-hardware-robot-operating-system-h-ros-victor-mayoral/>

In episode 29, from November 2018, Ralph Lange from Bosch was interviewed. He presented several results from the OFERA project to the world-wide audience, including the Callback-group-level Executor and the system modes concept from Work Package 4. Ralph Lange particularly emphasized the need for real-time execution mechanisms in ROS 2 and micro-ROS. Also, he gave an overview to the micro-ROS endeavour and the OFERA project as a whole.

The audio file and corresponding links are provided at:

<http://www.theconstructsim.com/rdp-029-bosch-ros-projects-ralph-lange>

3.5 Assessment of KPIs and Future work

The following table documents goals, defined actions and target KPIs regarding major dissemination activities. During 2018, focus has been made on participation in technical conferences and workshops, since rest of activities required to have concrete and tangible results (software) out of the project. Target KPIs in this regard have been met, actually raising quite substantial awareness among the ROS Community.

During 2019, presence at ROSCon and the FIWARE Summit is planned. Regarding presence at major fairs, presence at the IoT Solutions World Congress on October 29-31, 2019 in Barcelona and Hannover-Messe in 2020 is foreseen.

First submission of articles to relevant scientific journals and magazines is planned for 2019 as well as first presentation to customer / users.

Activity	Target goal	Defined actions	target KPIs
Participation in technical conferences and workshops	Raise awareness on technical and scientific community, particularly the ROS Community	Presence at ROSCon Presence at FIWARE Summit Presence at relevant ROS-Industrial conferences and workshops	(end of year 1 / year 2 / year 3) >5/15/20 technical presentations (uploaded on slideshare) >125/375/500 attendees in total >12/37/50 downloads from slideshare
On-site demonstrations and presentations to customers / users	Attract customers Raise awareness	Presentations and or demonstrations to target customers/users	50 proposed 35 responded 35 performed by end of project

Scientific publications	Scientific dissemination	Publication to journals and magazines	> 10 publications by end of project
Presence at major trade fairs	Market awareness, Go-To market	Presence with dedicated space within FIWARE's or some partner's booth	>=2 large trade fairs (Hannover-Messe Industry Fair, some other) by end of project