D7.9
Annual Report on Standardization - Year 3

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Abstract	This report gives an overview of the standardization activities in the OFERA project. In particular, it summarizes the consortium's monitoring of and contribution to relevant standardization activities.

Changes compared with the last annual report

#	Section	Changed By	Description
1	**2.3**	**eProsima**	**Updates latest DDS-XRCE standard specification version.**
2	**3.1**	**eProsima**	**Updated the diagram of the TC 299 of ISO to represent current status.**
3	**3.3**	**eProsima**	**Updated info on WG2, WG4 and WG6 (focus on ISO 22166-1: Modularity).**

Abbreviations

Term	Definition
DDS	Data Distribution Service
DDS XRCE	DDS for extremely resource-constrained environments
IMU	inertial measurement unit
MCU	microcontroller
rcl	ROS 2 client support library
rmw	ROS 2 middleware interface
ROS	Robot Operating System
RTOS	real-time operating system

1 Introduction

In the ROS ecosystem, standards compliance has traditionally been left to the companies using it, because on the generic framework level, ROS forms its own de-facto standard, and the other levels are typically product or market specific. However, with the move towards embedded devices, a significant market which shares important characteristics is being addressed. Therefore, the OFERA consortium believes that monitoring and where necessary contributing to the relevant standards bodies furthers the project's overall goals.

Most importantly for this project, interoperability and modularity are greatly enhanced by a standards-based approach, and we are contributing to this by working with standards body OMG on the XRCE-DDS communication protocol standard. This activity will be presented in section 2.

Furthermore, all products are affected by national and international standards for their respective domains and a considerable amount of effort is expended by manufacturers to ensure standards compliance. For physical products, standards on safety, resource (such as power) use, environmental impact and performance are particularly relevant. In addition, for framework software, standards (including de-facto standards) relating to modularity and interoperability are important as well. Therefore, this project monitors relevant standards at the ISO (section 3) and IEC (section 4) level.

2 OMG DDS-XRCE

2.1 Structure and process

The Object Management Group (OMG) follows a strict process to accept and adopt new specifications. These new technology adoptions revolve around the RFP, or Request for Proposals. Basically, after passing a series of votes on a technical committee (TC), the RFP becomes the requirements document for a future specification.

From that RFP, initial submissions from OMG members are accepted. Once the initial submissions deadline is met, OMG members read those initial proposals and comment on them during an OMG technical meeting week. From this meeting and taking the comments from other OMG members, submitters have the chance to publish subsequent revised versions of their submission. Once the deadline for these revised submissions is met, and the OMG members agree on the viability and validity of these submissions, a series of votes begins.

In the next OMG meeting from the revised submission deadline, the voting series is started, and as a result of that, an official OMG Adopted Specification is chosen. Once an official OMG specification is officially accepted, a Finalization Task Force (FTF) is formed, which will resolve all the issues submitted to the OMG regarding the new specification. After an FTF revised version of the specification is issued a series of votes starts again to accept and provide it with a release number. Typically, the time the specification gets a release number is also the time in which the products reach the market. From this

point, the specification enters a maintenance cycle where reports and revisions are issued on a regular basis.

This entire process is endeavour by OMG members. The members play one of two primary roles during the process:

- A large group of OMG members participate in writing the RFP, evaluating the submissions that arrive in response, and voting on the results. We'll call this group the voters.
- A smaller group writes and edits the submissions. We'll call this group the Submitters. The members of this group are identified on OMG's web page for each standards effort. All submitters are automatically also voters, but not all voters are submitters.

2.2 Participation and Relevance

In the case of OFERA and more concrete in the case of Micro XRCE-DDS. Micro XRCE-DDS is the OMG DDS-XRCE specification implementation provided by OFERA consortium member, eProsima.

DDS-XRCE specification is a response to the OMG RFP “eXtremely Resource-Constrained Environments DDS (DDS-XRCE)” (mars/2016-03-21). This OMG RFP asks the submitters for a client-agent protocol, targeting extremely resource-constrained environments. These extremely resource-constrained environments are those devices with aggressive sleep cycles requirements, small MTUs, low bandwidth and computational power capabilities.

OFERA member eProsima is a member of OMG, and as such, participates in the OMG standardizations processes. The role of eProsima in the standardization of DDS-XRCE is double, submitter and voter function (in the previously explained OMG process). The DDS-XRCE specification is the result of a joint effort between Gerardo Pardo-Castellote, PhD (lead) CTO, Real-Time Innovations, Inc., Clark Tucker, CEO, TwinOaks Computing, Inc. and Jaime Martin-Losa, CTO, eProsima.

Apart from participating in the joint submission and following revisions of the DDS-XRCE specification, currently, eProsima keeps active on the standardization process, identifying and submitting issues to the OMG private issue tracker system.

eProsima, Being an active member of the OMG and being one of the submitters and participants on the DDS-XRCE specification allows the OFERA consortium to get first-hand news and changes from the standardisation body. Apart from standard specification submission, eProsima provides the Micro XRCE-DDS implementation, which by the time of this report is the only publicly available implementation of the OMG DDS-XRCE standard.

2.3 Status and next steps

The latest standard specification version, and also the last specification driving Micro XRCE-DDS development, was officially released on February 2020.

As foreseen in the 2019 roadmap designed by the OGM, the DDS-XRCE specification currently has reached its first stable version, the *Version 1.0*. The relative documentation dates November 2019.

The public issues can be viewed in https://issues.omg.org/issues/task-forces/DDSXRCE11. However, no new issues have been recorded during the current year (2020).

2.3.1 Future OFERA proposals

From the side of the OFERA member eProsima, there is a set of changes implemented in 2019 that were meant to be proposed for the inclusion in the DDS-XRCE specification and in the DDS-XML specification, also from OMG, during 2020. As this wasn't accomplished, the proposal is going to be shifted to 2021.

To provide a proper way to develop services in micro-ROS, changes on DDS-XRCE should be made to provide similar mechanisms as the proposed in DDS-RPC (Remote Procedure Calls over DDS). eProsima will propose an addition to the DDS-XRCE specification allowing the creation of Requester and Repliers using DDS-XRCE protocol from the Client-side, mirroring DDS-RPC entities.

Also, eProsima found an issue in the current DDS-XML Standard. This issue does not allow creating Requesters or Repliers using XML profiles. This issue, also detected in 2019, wasn't reported to the OMG during 2020. As a consequence, it will be reported and proposed to be added in the next DDS-XML specification revision for 2021.

Finally, in 2020 eProsima implemented a set of changes in the serialization and fragmentation mechanisms of the data which allow to send messages bigger than those allowed by these mechanisms as they are in the specification. This alternative implementation might also be submitted to the OGM in order to be included in the DDS-XRCE specification.

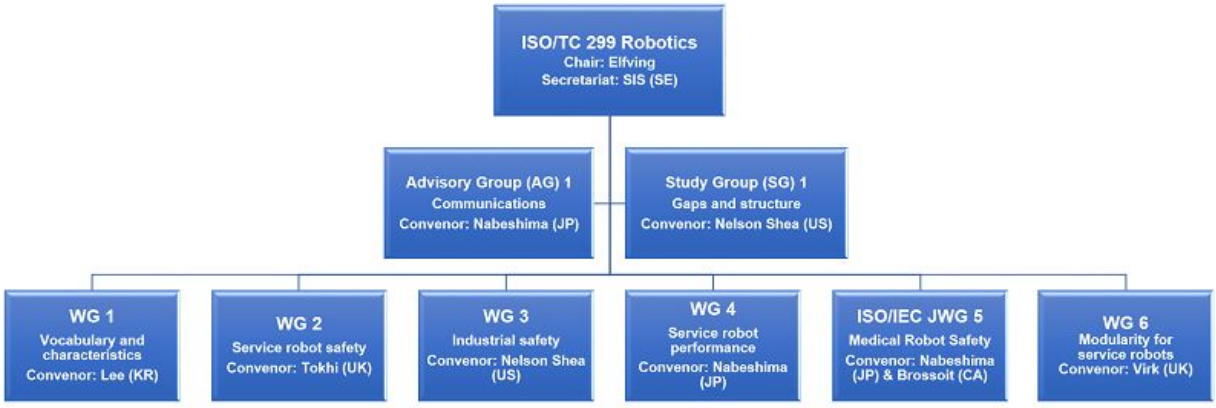
3 ISO TC299 "Robotics"

3.1 Structure

Technical Committee (TC) 299 of the International Standards Organisation (ISO) started in 1983, as sub-committee (SC) 2 *robots for manufacturing environments* of the TC 184 *industrial automation*. Safety has been the primary focus, and the scope was extended to safety for service robots in 2006. In 2016, the scope has again been widened to include performance and safety aspects, thus promoting it to a full TC.

Recently, a study group on gaps and structure has been formed, to again revisit and adjust the structure.

The current structure of the TC is shown in the following image.



3.2 Scope and Scope Exclusions

Despite the name, TC299 does *not* cover all areas of robotics. First and foremost, all electronic household appliances (such as robotic vacuums and lawnmowers) are standardized by the International Electrotechnical Commission, IEC.

For other machinery, relevant TCs, without claim of completeness, include the following:

TC	*Name*	*Robotics-related topic*
8	Ships and marine technology	Remotely Operated Vehicles Autonomous Underwater Vehicles
20	Aircraft and Space Vehicles	Unmanned Aerial Vehicles
21	Equipment for fire protection and fire fighting	Rescue Robots
22	Road Vehicles	Autonomous Road Vehicles
23	Tractors and machines for agriculture and forestry	Agricultural Robots
96	Cranes	Autonomous Cranes
110	Industrial Trucks	Driverless Industrial Trucks
127	Earth Moving Machinery	Autonomous Trucks / Excavators
254	Safety of amusement rides and devices	Amusement Robots

3.3 Participation and Relevance

Technical Experts from Partners Bosch and ALR are nominated for TC299, involved in WG's 2, 4 and 6. Moreover, partner Bosch is involved in the German national mirror committee for TC299, organized by the Association of German Machinery and Plant Manufacturers (Verband Deutscher Maschinen- und Anlagenbauer, VDMA) on behalf of the German Institute for Standardization (Deutsches Institut für Normung, DIN).

Currently, the work of working groups 2 and 4 is considered not to be of direct relevance for this project. WG2 deals with safety, which is beyond the scope of OFERA. WG4 is only concerned with performance

at the functional level, and its stipulations are so general as to be no particular issue for the framework level.

In 2019, both WG2 and WG4 have asked to change their name, to better reflect their actual activities. WG2 was called “Personal care robot safety” and has now changed to “Service Robot Safety”. As safety is out of scope for OFERA, this didn’t affect us. WG4, which was called “Service Robots” has changed its name to “Service Robot Performance”. This was only a clarification and didn’t affect us either.

WG6 has recently drafted ISO 22166-1, *Modularity for service robots, part 1: General requirements*, which is now under approval. It covers both hardware- and software-related modularity and is thus generally relevant for framework-level projects such as this.

3.3.1 Draft of ISO 22166-1: Modularity

At the time of the drafting of the ISO 22166-1, the working group was split in their view on the best way to continue. On the one hand, some of the WG6 members planned a great expansion of the activity, with sub-standards (similarly to OPC UA companion specifications). At the same time, some other member states, representing the majority of the robotics industry, were dissatisfied with the current standardization text and also the overall approach.

These differences within the working group have lead to at least a significant delay in standardization. Moreover, as explained in the last report, the content is largely overlapping with existing best practices and industry standards. Therefore, at this time, we do not consider ISO 22166-1 to have relevance for the work done in this project.

3.3.2 HRIM

In order to obtain acceptance of the Hardware Robot Information Model (HRIM, see D3.10 for details), former partner ALR has been actively working in WG6 of TC299.

This activity has been discontinued since partner ALR announced it’s liquidation, as no other partner has the resources to continue it.

4 IEC TC 116

The International Electrotechnical Commission's (IEC) Technical Committee (TC) 116 is in charge of *Safety of motor-operated electric tools*. In principle, safety is not in scope of this project, but Bosch has the opportunity to monitor this TC for requirements related to platforms. Bosch Lawn and Garden Ltd, a linked third party in this project, is active in this TC and has chaired Working Group (WG) 10 *Electric motor-operated lawn and garden machinery* for the past years, through Bosch associate Jeremy Duszynski.

In particular, most recently Bosch has contributed to IEC 60335-2-107 *Household and similar electrical appliances – Safety – Part 2-107: Particular requirements for robotic battery powered electrical lawnmowers*. This standard, amongst other things, also relates to "programmable electronic circuits" and their software.

In 2019, the TC has been active in two areas. The first is in creating a DIS for IEC 62841-1, the general standard that will succeed parts of the IEC 60335. This is a general development which is set to continue

for several more years. While it will eventually affect IEC 60333-2-107, due to the complexity of this standard, the TC has tentatively agreed to tackle it last. This means it will not be touched for several more years.

The second activity has been to draft amendments to IEC 60335-2-107. Most notably, the “kneeling child-foot protection” is now mandatory for autonomous lawn mowers to implement. Bosch, as one of the proposing members, has already included this function and any necessary hardware components (if any) in its lawn-mowers for some time now. Therefore, this change will not affect the project in any way.