

INTEROPERABILITY SPECIFICATION – QUO VADIS?

*Supporting Tool and Data Interoperability Standards
for CPS development*

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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

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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.

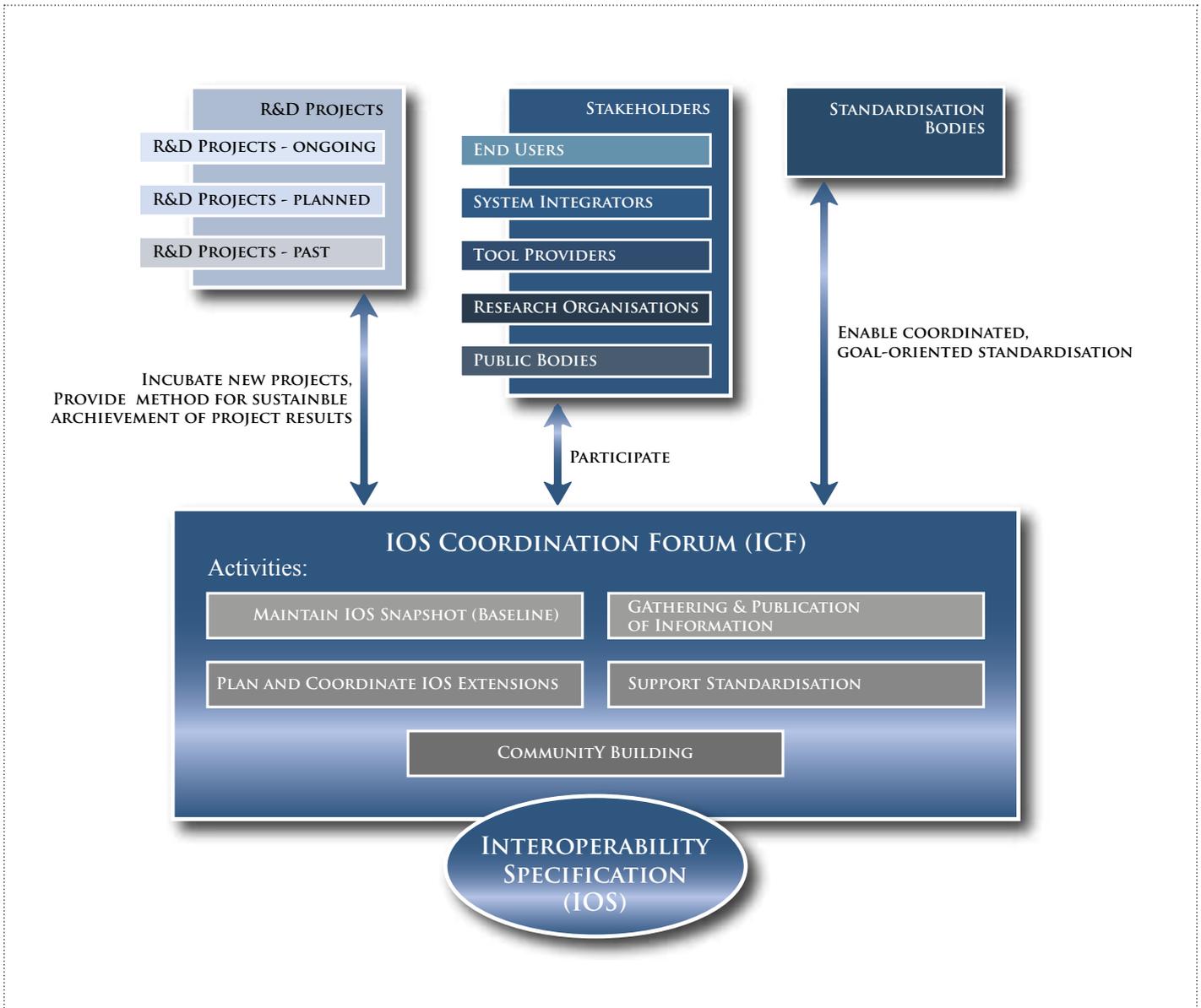
Handling a complex structure like the IOS, with its relations to many different existing standards, with its additional specifications which might or might not become (part of) a formal standard in the future, with its cross-standard Bridges, and with new Engineering Concerns and corresponding specifications 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>

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