Distributed REal-time Architecture for Mixed criticality Systems

Standardization Report
D 9.2.1

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Contact Person	Andreas Eckel	**Organisation**		TTTech Computertechnik AG	
Phone	+43 585 34 34-16	**E-Mail**		andreas.ecke@tttech.com	

Contributors

Name	Partner
Mohammed Abuteir	TTT
Arjan Geven	TTT
Miltos Grammatikakis	TEI
Gautam Gala	TUKL
Marcello Coppola	ST
Kevin Chappuis	VOSYS
Pierre Lucas	VOSYS
Daniel Perez	TRT
Ton Trapman	ALSTOM
Cristina Zubia	IKL
Gernot Klaes	TUV

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1 Introduction

This document is the deliverable D9.2.1 of the DREAMS project. It is the deliverable of task *T9.2 – Standardization* of work package *WP9 - Community building and standardization*. This task has the goal to provide support for all standardization efforts of activities and results emerging from the DREAMS project. The work of this task is devoted for providing internal standardization support to the DREAMS partners on one hand, and to establish a unified external interface from the project to standardization bodies on the other hand. The spent efforts will ensure adequate communication and exchange with external stakeholders, and will be used to align project efforts concerning standardization with prior projects and standards.

1.1 Position of the Deliverable in the Project

The goal of work package WP9 is to steer and increase European research and technology awareness in the area of distributed mixed-criticality and embedded computing systems. Work package WP9 comprises of three tasks: T9.1, T9.2 and T9.3. Task *T9.1 – Community building* aims at building a sustainable community focusing on the results of the DREAMS project and other projects on mixed-criticality systems. Task *T9.2 – Standardization support* aims to provide support towards all standardization efforts emerging from all activities and results of the DREAMS project. Task *T9.3 - Innovation roadmap* aims to help align the academic and industrial research by developing a research and innovation roadmap on the topic of mixed criticality to achieve critical mass and facilitate breakthrough innovations in the medium and long- term. This deliverable relates to task T9.2 focusing on the standardization activities deployed, and will result in intermediate releases in periodic reporting of the project.

The confidentiality level of this deliverable is **public (PU)** and it will be published on the DREAMS website, once approved by European Commission.

2 Goals of Standardization Activities

2.1 Background and Goals

The technological and market oriented leadership of safety critical applications is based in the Europe having investment in both small and large enterprise domains. Expenditures related to R&D are up to five times higher in Europe as compare to US especially in the areas of critical applications[1], due to which there is enormous pressure on European industry. Because of this context, a strong collaborative effort is required in order to extent the safety critical domain during the next few decades.

As the EU FP7 work programme notes, "*Driven by use cases addressing the grand societal challenges in Europe, the objective is to combine and expand Europe's industrial strengths in embedded and mobile computing and in control of networked embedded systems*". It is important to deal efficiently with these challenges and not to re-invent the wheel every time. It is better to base new innovations on the grounds of knowledge and research that is already available along with these three concepts:

- Connect, share and learn from previous experiences
- Make technology accessible
- Strong and focused European Community

The major impact achieved by mixed-criticality systems is to provide support for systems combining multiple and different criticality levels (multi-core and networked platforms) while maintaining reliability, safety and security guarantees require "by design". DREAMS will significantly enhance the efficiency of the overall system architectures used across a diverse range of industrial sectors that employ critical systems.

The Standardization activities in DREAMS are aimed at supporting these targets by means of standardization in the following two main lines of work:

- **Technology (building block) standardization** – relates to the technological contributions in the project that support mixed-criticality systems.
- **Safety standardization** – relates to the adoption and support of computing architectures in certification of safety-critical systems.

2.2 Technology (building block) standardization goals

Technology (building block) standardization relates to the technological contributions in the project that support mixed-criticality systems. The uptake of new processes, methods and tools for mixed-criticality systems are facilitated through technology standardization and public interaction. These standards are typically technology/engineering-specific and hosted by large standardization bodies like IEEE, IEC, SAE or OMG. Evolution in technological standards requires a strong industrial commitment and alignment and is therefore relatively slow.

In the context of DREAMS an evaluation of technological building blocks that have relevance for standardization is performed.

[1] 2010 EU Industrial R&D Investment Scoreboard

The goal of the DREAMS standardization activities with respect to the technology standardization is:

- Ensure that results are in-line with existing and emerging relevant standards
- Align the DREAMS specifications and developments with standardization goals and roadmaps

2.3 Safety standardization goals

Safety standardization relates to the adoption and support of computing architectures in certification of safety-critical systems. These standards are typically domain-specific (e.g. automotive, aerospace, industrial, healthcare) and are focused to ensure safety in all cases. Evolution in safety-standards requires the careful consideration to potential safety related concerns and is therefore relatively slow.

3 Participation in standardization bodies

In order to facilitate the uptake of project results, the partners actively engage in standardization efforts with regards to temporal and spatial segregation mechanisms, virtualization approaches, as well as domain-specific certification in the avionics, industrial and healthcare domains.

3.1 TTTech Standardization Involvement

Stds. Organisation/ WG/project	***Scope/Topic***	***Involvement/role/interest of TTTech***
SAE AS-2D Committee	The SAE AS-2 Embedded Computing Systems committee addresses all facets of embedded computing systems–design, maintenance, and in-service experience. It focuses on the philosophy, requirements, definitions, and user issues associated with embedded computing systems. The AS-2D Subcommittee specifically targets Time Triggered Systems and Architectures.	Contributor, focus on standardization of time-triggered systems, i.e. TTP, TTEthernet.
IEEE 802.1 WG	The IEEE 802.1 Working Group develops standards and recommended different practices in the areas: LAN/MAN architecture, internetworking among LANs, MANs and other wide area networks, Security, overall network management, and protocol layers above the MAC & LLC layers.	Contributor focus on to standardization of time-triggered architectures.
IEEE 802.3 WG	IEEE 802.3 is a working group aiming to define the physical layer and data link layer's media access control (MAC) of wired Ethernet.	Contributor, Standardization of Time-Triggered Ethernet.
VITA	VME International Trade Association (VITA) is the organization driving technology and standards for the bus and board industry. Particular VITA standards address e.g. VMEbus, PCI Mezzanine Card (PMC), VXS and VPX.	VPX Working group member
AUTOSAR	AUTOSAR (AUTomotive Open System ARchitecture) is a worldwide development partnership of vehicle manufacturers, suppliers and other companies from the electronics, semiconductor and software industry.	Premium member
AUTOSAR Safety WG	AUTOSAR (AUTomotive Open System ARchitecture) is a worldwide development partnership of vehicle manufacturers, suppliers and other companies from the electronics, semiconductor and software industry.	Contributor
GENESYS	Methodology for Model and Quality Driven Embedded Systems Engineering	Co-author
EUROCAE	The European Organisation for Civil Aviation Equipment is a non-profit organisation dedicated to aviation standardisation .	Limited Member
Open Alliance	The OPEN Alliance SIG is a non-profit, open industry alliance to promote Ethernet-based networks in automotive networking applications.	

3.2 IKL Standardization Involvement

Stds. Organization/ WG/project	*Scope/Topic*	*Involvement/role/interest of IKL*
AENOR AEN/CTN 200	Spanish Commitee AEN/CTN 200 (safety standards) at ISO International Organization for Standardization	Member
ETC	EtherCAT Technology Group; it is an official partner of the IEC.	Member
IETF / IRTF NWCRG	Network Coding IRTF Research Group	Contributors
Open Alliance	(One-Pair Ether-Net) Special Interest Group (SIG) is a non-profit, open industry alliance to promote Ethernet-based networks in automotive networking applications.	Member
NetWorld2020	European Technology Platform for communications networks and services	Member
ARTEMIS-IA	Advanced Research & Technology for EMbedded Intelligence and Systems – Industrial Association	Member Chamber B * Former Steering Board member
EICOSE / WG1	European Institute for Complex Safety Critical Systems Engineering. WG1 - "Methods and Processes for Safety Relevant Embedded Systems"	Member *

3.3 TUV Involvement

Stds. Organisation/ WG/project	*Scope/Topic*	*Involvement/role*
DKE GK 914 IEC/EN 61508 IEC/EN 61511	Functional safety of electrical/electronic/programmable electronic safety-related systems for the protection of people and environment	member
DKE K232 EN 50156	Electrical equipment for furnaces and ancillary equipment	member
DKE UK 931.1 IEC 62443	IT-Security in Automation	member
DKE UK 225.2 TC44 / MT 61496 EN 61496	Safety of machinery - Electrotechnical aspects Electro-sensitive protective equipment	member
CNB-M VG11	Co-ordination of Notified Bodies Directive 2006/42/EC + Amendments Vertical Group 11 Safety Components (Annex IV: 19, 20, 21)	member
PLCopen TC5	Programmable controllers - Part 3: Programming languages	member
DKE UK914.1 EN 61784-3	Functional safety fieldbuses – General rules and profile definitions	member
DKE UK 226.0.3 EN 61800-5-2	Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional	member

CEN TC10/WG1/AH6 EN 81-20 and -50	Safety rules for the construction and installation of lifts	member
NASG/NAM/DKE NA 095-01-03 GA EN ISO 13849	Safety of machinery – Safety-related parts of control systems	member

3.4 ST Standardization Involvement

Stds. Organisation/ WG/project	*Scope/Topic*	*Involvement/role/interest of ST*
JEDEC	JEDEC brings manufacturers and suppliers together to participate in more than 50 committees and subcommittees, with the mission to create standards to meet the diverse technical and developmental needs of the industry. JEDEC's collaborative efforts ensure product interoperability, benefiting the industry and ultimately consumers by decreasing time-to-market and reducing product development costs.	Focus on standardization of DDR and the impact in mixed critical systems i

3.5 Alstom Standardization Involvement

Due the high volume of standardization involvements that Alstom has only the ones as relevant or having relationship with Dreams will be listed as well as the ones used for the development of the Alstom domain regarding the Dreams project.

Stds. Organisation/ WG/project	*Scope/Topic*	*Involvement/role/interest of Alstom*
IEC 61400	Wind turbine related requirements (design, features, performance testing, communication systems, etc)	Partner
IEC-61400-25	Wind turbine communication system requirements	Partner
ISO-13849	safety standard which deals with safety-related design principles of employed control systems	User
2006-42-EC	DIRECTIVE 2006/42/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 May 2006 on machinery, and amending Directive 95/16/EC	User
EN 50308	Wind turbines – Health and safety requirements for design, operation and maintenance	Partner

3.6 TEI Standardization Involvement

Stds. Organisation/ WG/project	*Scope/Topic*	*Involvement/role/interest of TEI*
IEEE Std. 1666-2011 (SystemC)	**SystemC** is a set of C++ classes and macros which provide an event-driven simulation interface (see also discrete event simulation). These facilities enable a designer to simulate concurrent processes, each described using plain C++ syntax.	Past contributions to SystemC channel entities via IPSIM library (year 2000-2001)
HSA	The HSA Foundation (HSAF) was formed as an open industry standards body to unify the computing industry around a common approach.	Contributor, focus on standardization of queueing and dispatch mechanisms.

Within DREAMS, TEI has worked on a new real-time co-simulation methodology for validating correctness and performance characteristics between a hardware IP (DUT) prototyped on an FPGA development board as a full system and its equivalent executable system-level specifications (SystemC). The framework and prototype can be delivered as open source, targeting a presentation or demo at FDL or DVCon conference.

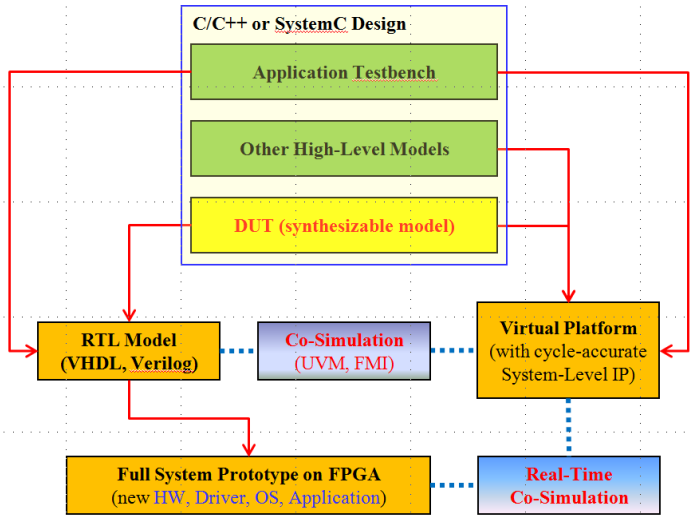

Figure 1 Traditional co-simulation vs real-time co-simulation technique.

More specifically, as shown in Figure 1, TEI develops a real-time co-simulation methodology for validating correctness and performance characteristics between a hardware IP (design under test, DUT) prototyped on an FPGA development board as a full system and its equivalent executable system-level specifications [1, 2]. Our proposed approach is non-disruptive in comparison to current methodologies and tools and unlike previous methods does not consider co-simulation of RTL models of the design under test (DUT) with corresponding system-level model usually implemented in a virtual platform [3, 4], but between the hardware DUT implemented as a full system on FPGA ((with CPU, on-chip interconnect, memory, drivers, and OS) and its equivalent system-level IP. This concept is particularly important for co-verification during rapid prototyping and relies on standards, such as FMI Functional Mock-up Interface (FMI) for tool interfacing via push/pull model [5] and SystemC- Universal Verification Methodology (UVM) via co-simulation [6].

3.7 Virtual Open Systems Standardization Involvement

Stds. Organisation/ WG/project	*Scope/Topic*	*Involvement/role/interest of VOSYS*
ISO 26262 – Road vehicles- Functional Safety Standard	ISO 26262 is an international standard for functional safety of electrical and/or electronic systems in automotive. The goal is to provide an automotive safety lifecycle in order to define a risk-based approach for determining risks and related mitigation actions.	Apply the ISO 26262 standard during the development lifecycle of VOSYSmonitor (see below for more information)
NFV	Network Functions Virtualisation aims to transform the way that network operators architect networks by evolving standard IT virtualisation technology to consolidate many network equipment types onto industry standard high volume servers, switches and storage, which could be located in Datacentres, Network Nodes and in the end user premises. It involves the implementation of network functions in software that can run on a range of industry standard COTS server hardware.	Limited Member
Open Virtualization Alliance	The Open Virtualization Alliance (OVA) is an organization comprised of industry leaders in virtualization, data center, and cloud solutions, focused on increasing awareness and adoption of Kernel-Based Virtual Machine (KVM). The goal is to help strengthen the ecosystem of third-party solutions based on KVM, encourage interoperability, and promote best practices.	Supporting Organization

ISO 26262 – Road vehicles – Functional Safety Standard

In mixed-criticality domains, the term “functional safety” has become an important terminology. Indeed, “functional safety” generally means that malfunctions of the operating system, which contain mission-critical tasks that may leads to any kind of threat or even catastrophic incident have to be avoided or mitigated. Therefore, it is fundamental in the field of functional safety to identify and understand potential risks and failure reasons of a system. If ideally all potential failure causes are known and the consequences are understandable it is possible to define countermeasures. Thus, failures are detected before a catastrophic event occurs and with the needed functional safety reaction, the safe state is initiated. The safe states can vary according to the final application as well as the injuries which might cause by the system failure without countermeasures. As every application is different and has its own specifications and thus potential failure causes and related safe states that’s why the functional safety analysis is challenging. In this context, many functional safety standards have been established to define the main requirements to fulfil during the development of critical systems in order to ensure a high level of reliability in the critical systems. The main functional safety standard is the IEC/EN 61508 that defines the basis for functional safety developments for E/E/EP (electronics, electronic or programmable electronic) applications. In addition, the IEC/EN 61508 is expanded by additional industry sector specific standards, such as the ISO 26262 – Road vehicles – Functional Safety which has been specially defined for the automotive domain. Indeed, the automotive industry is rapidly evolving towards the connected autonomous vehicle which will considerably increase the hardware/software complexity, while functional safety will be a topic of keen importance since critical features will be controlled by electronics components (e.g., autonomous driving, etc.). In this context, the ISO 26262 defines a functional safety lifecycle for each automotive product development phase, ranging from the hazard analysis

and risk assessment to design, implementation, integration, verification, validation and production release.

In the scope of DREAMS, VOSYS has developed a secure monitor firmware layer (known as VOSYSmonitor which is its product name) for ARMv8-A architecture in order to consolidate several software applications with different levels of criticality on a single heterogeneous multi-cores platform. Since Virtual Open Systems strategy is based on developing a first VOSYSmonitor product for automotive sector and critical systems must be compliant with the ISO 26262 standard, VOSYSmonitor has to be certifiable with the same Automotive Safety Integrity Level (ASIL) than the critical system running on top of it.

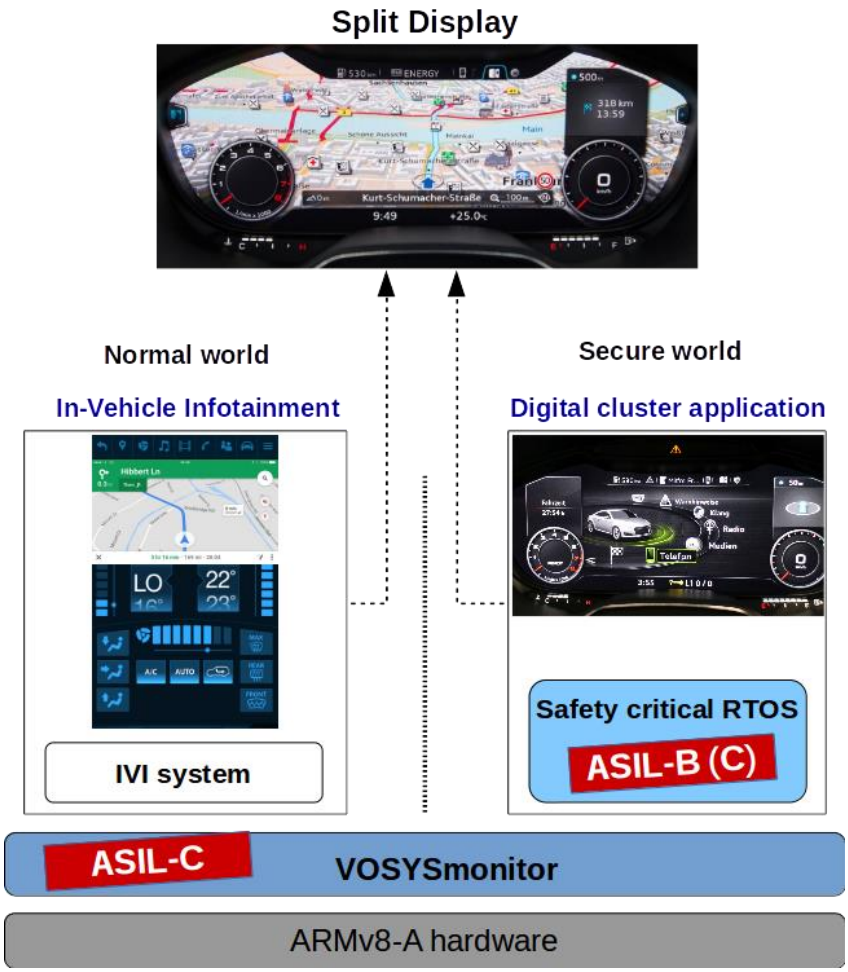

Figure 2: VOSYSmonitor automotive short-term application

The short-term use-case identified in Automotive is to develop functionalities related to the ECU consolidation of the digital instrument cluster and the In-Vehicle Infotainment system. Since the digital instrument cluster contains critical information, such as warning icons and speedometer, the ASIL required by car manufacturers is usually ASIL-B or ASIL-C. Therefore, VOSYSmonitor has to target the same certification level in order to safely execute digital instrument cluster on top of this software component.

Although the short-term use-case has been identified, VOSYSmonitor can be used for different types of ECU consolidation. Therefore, VOSYSmonitor is considered as a generic software element, which can be used for different applications by several customers. In this context, some assumptions are needed about the requirements and the design, including the safety requirements that are allocated to VOSYSmonitor by higher design levels. In the ISO 26262 standard, such element can be developed

by treating it as a Safety Element out of Context (SEooC) which is a safety-related element that is not developed in the context of a particular vehicle.

Assuming this, the safety lifecycle is initiated by distinguishing between either a new development or a modification of an existing solution. Since VOSYSmonitor has been designed and developed from scratch in the context of DREAMS, this software component is considered as "Newly developed", therefore the ISO 26262 – Part 6: Product development at the software level must be respected during the development lifecycle.

Classification of software component	Part 6 in context of an item	Part 8 – 12 Qualification of SW component	Part 6 as safety element out of context	Part 8 – 14 Proven in use argument
Newly developed	Suitable	Not suitable	Suitable	Not suitable
Re-use with change	Suitable	Not suitable	Suitable	Suitable
Re-use without change	Not suitable	Suitable	Suitable (if developed as SEooC)	Suitable

Figure 3: ISO 26262 Part 10 - Classification of the software components

However, it is important to notice that the ISO 2626 – Part 4: Product development at the system level has to be partially applied in order to specify the interaction between VOSYSmonitor with the hardware components which impacts the safety-related features of the software layer.

Finally, VOSYS has decided to outsource the functional safety assessment of VOSYSmonitor by an external certification company according to the level of dependency induced by the ASIL C target. The final audit is planned for mid of September 2017, however it is important to notice that the ISO 26262 – Audit phase 1 related to the VOSYSmonitor concept phase has already been achieved without any major non-compliances raised by the auditor.

3.8 Thales Standardization Involvement

Stds. Organisation/ WG/project	*Scope/Topic*	*Involvement/role/interest of Thales*
EUROCAE & SAE ED79-A/ARP4754-A	ED79A/ARP4754-A discusses the development of aircraft systems taking into account the overall aircraft operating environment and functions. This includes validation of requirements and verification of the design implementation for certification and product assurance. It provides practices for showing compliance with the regulations and serves to assist a company in developing and meeting its own internal standards by considering the guidelines herein.	Co-author
EUROCAE & SAE EDxxxx-A/ARP4761-A (in preparation)	This standard describes guidelines and methods of performing the safety assessment for certification of civil aircraft. The concept of Aircraft Level Safety Assessment is introduced and the tools to accomplish this task are outlined. The overall aircraft operating environment is considered. When aircraft derivatives or system changes are certified, the processes described herein are usually applicable only to the new designs or to existing designs that are affected by the changes. In the case of the implementation of existing designs in a new derivation,	Co-author

	alternate means such as service experience may be used to show compliance	
EUROCAE/RTCA ED12C/DO178C	This document provides recommendations for the production of software for airborne systems and equipment that performs its intended function with a level of confidence in safety that complies with airworthiness requirements. Compliance with the objectives of ED-12C is the primary means of obtaining approval of software used in civil aviation products.	Co-author
EUROCAE/RTCA ED80/DO254	The RTCA DO-254 / Eurocae ED-80 document provides guidance for design assurance of airborne electronic hardware from conception through initial certification and subsequent post certification product improvements to ensure continued airworthiness. The electronic hardware considered includes devices like Field Programmable Gate Arrays (FPGAs), Programmable Logic Devices (PLDs), and Application Specific Integrated Circuits (ASICs).	Co-author
SAE AIR6219/ER05	The purpose of the AIR6219 is to provide guidance for performing a neutron Single Event Effects (SEE) evaluation of an avionics system that can be used in conjunction with other systems analyses in the context of a complete systems safety analysis.	Co-author
SAE ARP5150/5151	The ARP5150 describes guidelines, methods and tools used to perform the ongoing safety assessment process for transport airplanes in commercial service (hereafter, airplane). The described process is intended to support an overall safety management program. It is associated with showing compliance with the regulations, and also with assuring a company that it meets its own internal standards. The methods outlined herein identify a systematic means, but not the only means, to assess ongoing safety. Likewise, ARP5151 describes guidelines, methods and tools used to perform the ongoing safety assessment process for GAR airplanes (like private airplanes) in commercial service.	Co-author
EUROCAE ED202-A/ED203	The ED202-A standard is a resource for Airworthiness Authorities (AA) and the aviation industry for certification when the development or modification of aircraft systems and the effects of intentional unauthorized electronic interaction can affect aircraft safety. It deals with the activities that need to be performed in support of the airworthiness process when it comes to the threat of intentional unauthorized electronic interaction (the “What”).	Co-author
MulCors	“The Use of MULticore proCessORS in Airbone Systems” (EASA Report) MulCors report suggests recommendations for multi-core processor introduction in avionic systems and suggests complimentary or modification to EASA guidelines.	Author
GENESYS	Methodology for Model and Quality Driven Embedded Systems Engineering	Co-author
EUROCAE	The European Organisation for Civil Aviation Equipment is a non-profit organisation dedicated to aviation standardisation .	Full Member (Thales Air Systems, Thales Avionics, Thales Avionics Ltd, Thales

		Communications)
RTCA	The Radio Technical Commission for Aeronautics is a private, not-for-profit association dedicated the safety and efficiency of the air transportation system.	Member

3.9 SINTEF Standardization Involvement

Stds. Organisation/ WG/project	***Scope/Topic***	***Involvement/role/interest of SINTEF***
OMG	Common Variability Language (CVL) (In DREAMS we are using BVR which is a continuation of CVL)	Organizing the standardization. The process is now unfortunately frozen due to IPR issues with an American patent holder.

3.10 Partner University of Siegen

Stds. Organisation/ WG/project	***Scope/Topic***	***Involvement/role/interest of University of Siegen***
ISO/IEC JTC 1/SC 27 IT Security techniques	The ISO/IEC JTC 1/SC 27 IT Security techniques standardization subcommittee develops general methods, techniques and guidelines for both security and privacy aspects. The Projects, which are most interesting for DREAMS, are: modes of operation, entity authentication, MACs, digital signatures, hash functions, key management, random bit generation, prime number generation, encryption algorithms, authenticated encryption and lightweight cryptography.	National expert and project editor

4 Partner Involvement in related Research Projects and Platforms

4.1 TTTech Project Involvement

Project/Platform	Scope/Topic	Involvement/interest
D-MILS	Distributed Multiple Independent Levels of Security (FP7, 2012-2015)	Partner and active in standardization WP
SafeAdapt	Safe Adaptive Software for Fully Electric Vehicles (FP7, 2013-2016)	Partner and active in standardization WP
RETNET	The European Industrial Doctorate Programme on Future Real-Time Networks, (Marie Skłodowska-Curie, 2013-2017)	Full industry partner and active in standardization activities.
TAPPS	Trusted Apps for Open CPS (H2020, 2015-2017)	Partner and active in standardization WP
SAFURE	SAFety and secURity by design for interconnected mixed-critical cyber-physical systems (H2020, 2015-2018)	Partner and active in standardization WP
EMC2	Embedded Multi-core Systems For Mixed Criticality Applications In Dynamic And Changeable Real-time Environments(ARTEMIS, 2014-2017)	Partner and active in standardization WP
SafeCer	Safety Certification of Software-Intensive Systems with Reusable Components	Partner and active in standardization WP

4.2 IKL Project Involvement

Project/Platform	Scope/Topic	Involvement/interest
TECOM	Trusted Embedded Computing (ITEA2, 2007-2010)	Partner
GENESYS	GENeric Embedded SYStem Platform (FP7, 2008-2009)	Partner
TERESA	Trusted Computing Engineering for Resource Constrained Embedded Systems Applications (FP7, 2009 - 2012)	Partner
MultiPARTES	Multicores partitioning for Trusted Embedded Systems (FP7, 2011-2014)	Coordinator
PROXIMA	Probabilistic real-time control of mixed-criticality multicore and manycore systems (FP7, 2013-2016)	Partner

MONDO	Scalable Modeling in the Cloud (FP7, 2013-2016)	Partner
U-TEST	UNCERTAINTY TESTING (H2020 ICT1, 2015-2017)	Partner

4.3 TUKL Project Involvement

Project/Platform	Scope/Topic	Involvement/interest
ACTORS	Adaptive and control of resources in Embedded Systems (EU IST FP7)	Partner*
FRESCOR	Framework for real-time Embedded systems based on ContRacts (EU IST FP6)	Partner*
EMC2	Embedded Multi-core Systems For Mixed Criticality Applications In Dynamic And Changeable Real-time Environments(ARTEMIS, 2014-2017)	Partner*
INDEXYS	INDustrial EXploitation of the genesYS cross-domain architecture (EU ARTEMIS)	Partner*
BETSY	BEing on Time Saves energY (EU FP6 IST)	Partner*

4.4 STM Project Involvement

Project/Platform	Scope/Topic	Involvement/interest
TRESCCA	The TRESCCA project - TRustworthy Embedded Systems for Secure Cloud Computing Applications aims to lay the foundations of a secure and trustable cloud platform by ensuring strong logical and physical security on the edge devices, using both hardware security and virtualization techniques while considering the whole cloud architecture., FP7	Partner and active in dissemination and exploitation
TAPPS	Trusted Apps for Open CPS (H2020, 2015-2017)	Partner and active in several WPs
RESIST	Resilient Integrated Systems, CATRENE	Partner and active in several WPs
RELY	RELY - Design for RELIABILITY of SoCs for Applications like Transportation, Medical, and Industrial Automation, CATRENE	Partner and active in several WPs

4.5 Alstom Project Involvement

Project/Platform	Scope/Topic	Involvement/interest
MultiPARTES	Multicores partitioning for Trusted Embedded Systems (FP7, 2011-2014)	Partner

4.6 TEI Project Involvement

Project/Platform	Scope/Topic	Involvement/interest
SAVE	Development of software/hardware technologies (queue dispatching) for an efficient exploitation of *heterogeneous system architectures* (FP7, 2013-2016)	Partner active in standardization-related activities (using HSA-related concepts)

4.7 THALES Project Involvement

Project/Platform	Scope/Topic	Involvement/interest
SCARLETT	SCAlable & ReconfigurabLe Electronics plaTforms and Tools (FP7, 2008-2011)	Partner and active in standardization WP
GENESYS	GENeric Embedded SYStem Platform (FP7, 2008-2009)	Partner
INTERESTED	INTERoperable Embedded Systems Toolchain for Enhanced rapid Design (ICT, 2009-2011)	Partner
ACROSS	ARTEMIS CROSS-Domain Architecture (FP7, 2010-2013)	Partner
RECOMP	Reduced Certification Costs Using Trusted Multi-core Platforms (ARTEMIS, 2010-2013)	Partner and active in standardization/certification WP
SMECY	Smart Multicore Embedded systems (ARTEMIS, 2010-2013)	Partner
IFEST	*Industrial Framework for Embedded Systems Tools (ARTEMIS, 2010-2013)*	Partner
CERTAINTY	Certification of Real Time Applications designed for mixed criticality (FP7, 2012-2015)	Leader and active in standardization/certification WP
SAFURE	SAFety and secURity by design for interconnected mixed-critical cyber-physical systems (H2020, 2015-2018)	Partner and active in standardization WP
EMC2	Embedded Multi-core Systems For Mixed Criticality Applications In Dynamic And Changeable Real-time	Partner and active in standardization WP

	Environments(ARTEMIS, 2014-2017)	

4.8 VOSYS Project Involvement

Project/Platform	Scope/Topic	Involvement/interest
NGPaaS	Next Generation Platform as a Service (H2020, 2017-2020) - NGPaaS project aims to build a hardware accelerated reference stack for future 5G/NFV networks ready to be deployed for telco-grade use-cases.	Partner and Innovation manager to identify and foster innovation, standardization and commercialization of project's results.
SESAME	Small cEllS coordinAtion for Multi-tenancy and Edge services (H2020, 2015-2018) - SESAME project proposes a new multi-tenant 5G Small Cell that integrates a Linux/KVM based light datacenter (Light-DC), capable of running Virtual Network Functions (VNFs). The Light-DC hardware platform is designed upon ARMv8 processors and FPGA/ASICS hardware accelerators to execute an OpenStack edge computing infrastructure which provides high performance with optimized power consumption, system space and costs.	Partner and contributor to the OPNFV DPACC (Data Plane ACCeleration) standard architecture for NFV data plane acceleration.
TAPPS	Trusted Apps for Open CPS (H2020, 2015-2017) - TAPPS research project aims to extend and customize cyber-physical systems (CPS) devices with new 3rd party services and features within a Trusted Apps platform in an efficient, secure and most important trusted way.	Partner and active in WP related to virtualization paradigms.
SAVE	Self-Adaptive Virtualization-Aware High-Performance/Low Energy Heterogeneous System Architectures (FP7, 2013-2016) - SAVE proposes a new run-time self-adaptive operating system support software layer that is able by using an orchestrator to partition and distribute tasks (or virtual machine) execution on the available resources among CPUs, GPUs and DFEs. In addition, the research project targets hardware-assisted virtualization for GPUs and DFEs (Data Flow Engines) to improve performance.	Partner

5 Conclusions

This deliverable shows the impacts of the DREAMS results whereas it was part in various interoperability and standardization activities, e.g., to repositories of models, interface specifications or reference architectures/platforms/patterns. This achieved during liaising with the appropriate standardization bodies and initiatives. Additionally, this deliverable shows that the DREAMS results was implemented upon available and emerging standards and industry specifications to ensure interoperability and enable quick market take-up.

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