Chapter 33
SafeTRANS: Safety in Transportation Systems

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33.1 Introduction

SafeTRANS[1] is a German not-for-profit association,[2] comprising stakeholders from various sectors of the transportation domain: Avionics, Automotive, Rail, and Maritime. SafeTRANS' members are OEMs, suppliers, and system operators in the transportation domain—such as Daimler, Airbus, Deutsche Bahn Netz, Siemens, AVL, Bosch, Hella, and Safran Engineering—, tool vendors and software houses, which support the development process for electronic components and systems in the transportation domain—such as AbsInt, BTC Embedded Systems, Esterel, Symtavision, and TTTech—, and research organizations and universities with a track record of technology transfer in this area—such as DLR, Fraunhofer Institutes, and OFFIS Institute for Compute Science.

SafeTRANS provides a communication and knowledge exchange platform for pre-competitive research and development activities of its members. Main activities initiated and conducted by SafeTRANS are:

- Initiation of theme-oriented round tables and working groups, identifying cross domain needs and objectives in pre-competitive R&D areas, leading to common R&D strategies and roadmaps harmonized between organizations and across domains.

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[2]Organized as a "gemeinnütziger eingetragener Verein" under German law.

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- Dissemination of harmonized R&D strategies and roadmaps, thus providing a harmonized view of R&D priorities to public authorities, national and European funding programs, and the community.
- Project incubation: Support the implementation of harmonized R&D strategies by initiating suites of R&D projects conducted by member organizations.
- Support sustainability of project results by paving the way for follow-up projects and by pushing standardization activities.
- Leverage these activities to a European level, harmonizing roadmaps with European partner cluster organizations, disseminating R&D strategies on European level, and initiating large-scale European R&D projects.
- Provide knowledge sharing facilities like workshops and conferences, newsletters, etc., allowing members from each transportation domain to learn from each other.

SafeTRANS is funded to a major part by its members. In addition, SafeTRANS participates in public funded projects, mostly on the level of Support Actions, e.g., on roadmap development and similar.

33.2   R&D Strategies and Roadmaps

In 2009, SafeTRANS coordinated the creation of the "National Roadmap Embedded Systems" [1], a strategy document detailing on how Embedded Systems technology can and will contribute to solving the big societal challenges Europe faces. This document was, and still is, one of the major reference documents of the funding program *Embedded and Cyber-Physical Systems* of the Federal Ministry of Education and Research BMBF [2]. The roadmap conceived in there has found its way into European Funding Programs like the Joint Undertakings ARTEMIS [3] and ECSEL.

Based on this roadmap, SafeTRANS significantly contributed to the Integrated Research Agenda Cyber-Physical Systems [4], a strategy document by acatech, the German National Academy of Science and Engineering, which in turn has been one major input to the "Industrie 4.0" Initiative of the BMBF [5].

In 2015, SafeTRANS, together with the *Gesellschaft für Informatik* GI and the *Verband der Automobilindustrie* VDA, published the Automotive Roadmap Embedded Systems [6]. In a scenario driven approach, where the scenarios are derived from analyzing future challenges and opportunities in the automotive industry as well as market trends and societal changes, gaps between the current capabilities of Embedded Systems technology and the capabilities needed to overcome these challenges are identified and the corresponding R&D needs characterized. This analysis is complemented by a corresponding survey focusing on the design process of Embedded Systems in automotive applications.

Roadmapping and the corresponding project incubation also are a major part of SafeTRANS' European activities. As a founding member of EICOSE, the European

Institute for Complex Safety Critical Systems Engineering, SafeTRANS cooperates with major clusters all over Europe, especially the French Pôle de Compétitivités Systematic-Paris-Region and Aerospace Valley and the Austrian ARTEMIS Austria Embedded Cluster. Together, these clusters have provided major input to the Strategic Research Agenda of the Joint Undertakings ARTEMIS and ECSEL as well as to the Horizon 2020 ICT programme and the Eureka programme ITEA3.

33.3 Working Group on Highly Autonomous Systems: Safety, Testing, and Development Process

SafeTRANS has installed a Working Group on *Highly Autonomous Systems: Safety, Testing, and Development Processes* (AK HAS) at the beginning of this year. In this working group, experts from member and nonmember organizations—airplane, car and maritime OEMs, System Integrators, Suppliers, research organizations—exchange knowledge and best practices on how to develop, analyze, test, and certify highly automated systems, with a special focus on safety aspects, testing activities, and development processes and its tool support. For selected aspects, the working group will develop concepts for generic solutions and initiate appropriate R&D projects. These aspects include situation awareness and situation interpretation by automated systems; user/operator modeling for highly automated systems; (generic) system architectures and execution platforms/middleware; and methods, processes, and tools for designing such systems, spanning the whole range from the requirement phase to testing and deployment. Special consideration is given to the following challenges

- Which artifacts of the environment have to be detected with which level of confidentiality? How can systems project the future evolution of a traffic situation with a high enough level of confidentiality? How can we ensure the integrity of such "internal world models" and which modeling techniques are appropriate?
- How can we cope with uncertainty caused by sensor limitations and different trust levels assigned to information stemming from other traffic participants or from the cloud? How can we ensure safety even though internal world models contain uncertainties?
- Which verification, validation and test methods can be used to cope with the enormous complexity and evolution of the system's context/environment, ensuring functional safety of highly automated systems?

As a cross-cutting challenge common for all domains and applications, *modelling of the system environment* has been identified as a high priority research need. Such models have to cope with four types of cooperations and interactions, namely (a) system to environment, (b) system to system, (c) system to human, and (d) system to information networks (cloud), and consider evolutions of the environment over time as well as uncertain knowledge.

As any SafeTRANS Working Group, AK HAS is open to members and non-member organizations.

33.4   Sustainability and Standardization

SafeTRANS is dedicated to ensuring sustainability for results of R&D projects that have been identified as having a key impact on safety critical systems engineering. One such result is the establishment of a so-called Interoperability Specification (IOS), which is a standard for ensuring interoperability of tools used in the development process.

A Reference Technology Platform (RTP), as it is understood here, is a "tool-box" for the development, analysis, and test of embedded and cyber-physical systems in various application domains. It contains processes, methods, meta-models, and interoperable (IOS-based) software tools, which describe and support the complete development process for critical embedded systems. These components can be combined to form domain- and application-specific development processes supported by software tools according to specific methods and adhering to specific standards, as needed for the particular domain and the particular application. The RTP for Critical Systems Engineering has been created in a long standing strategic public–private partnership on a national and European level, combining more than 25 global companies in the domains Aerospace, Automotive and Railway Systems, as well as various Tool Venders and Research Organizations, with an effort of more than 100 Mio Euro.[3]

To further drive the formal standardization of the IOS, SafeTRANS together with major IOS stakeholders has initiated and coordinates a project called CP-SETIS (towards Cyber-Physical-Systems Engineering Tool Interoperability Standardization) under Horizon 2020, which will support the existing and future IOS/RTP-projects in establishing the IOS as a formal standard. The main objectives of CP-SETIS are

- The alignment of all IOS-related forces within Europe to support a common IOS Standardization Strategy, aiming at a formal standardization process of the IOS.
- The definition and implementation of sustainable IOS Standardization Activities supporting both, formal standardization of "stable" IOS versions as well as extensions of IOS, if possible within existing structures that survive the lifespan of single projects.

Thus, CP-SETIS will drive the formal standardization of the IOS, and—even more important—align all IOS stakeholders, derive processes for handling IOS

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[3]Amongst others in Projects CESAR (JU ARTEMIS, 60 Mio Euro Effort), IPs SPEEDS (FP 6), Sprint, DANSE (FP 7), MBAT (Artemis), SPES-XT (BMBF), CRYSTAL (ARTEMIS), most of which have been incubated by SafeTRANS members.

standardization and extensions in a project-independent way, and implementing these processes within existing structures (i.e., nonprofit organizations, like the ARTEMIS Working Groups, EICOSE, or SafeTRANS).

33.5   Conclusion

SafeTRANS is the major information and knowledge exchange platform for Safety Critical Systems Engineering in Transportation in Germany. Its main activities are the initiation of round tables and theme-oriented working groups, roadmap development, and project incubation, as well as supporting sustainability measures for project results and providing the link to similar clusters in Europe, to European funding programs and to national public authorities.

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