A Modular and Scalable Application Platform for Testing and Evaluating ITS Components (MoSAIC)

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Short Introduction – DLR and Institute TS
German Aerospace Center

Areas of Research

- Aeronautics
- Space
- Transport
- Energy

DLR in numbers

- Budget:
  - 2006 1.168 M Euro
  - 2007 1.224 M Euro
Locations and Employees

5,600 employees work at 28 research institutes and facilities at 13 locations (■ + □).


Institute of Transportation Systems (■)
Institute of Transportation Systems

Residence: Braunschweig and Berlin
Since: March 2001
Director: Prof. Dr.-Ing. Karsten Lemmer
Employees: Currently 100 employees from various scientific disciplines

Range of tasks
- Basic research
- Creating concepts and strategies
- Prototype development

Fields of Research
- Automotive
- Railway Systems
- Traffic Management
MoSAIC – Motivation and Introduction
Motivation and Introduction

The determination of requirements for cooperative assistance and automation based on Vehicle-to-X technologies emphasize research questions on different levels – for example:

- Reliability / availability
- Interaction between human and machine
- Interoperability of assistance and automation systems / security
- Different penetration rates and their influence on the function of the system, traffic safety/-efficiency, driver behavior and acceptance
Motivation and Introduction

- Modular and Scalable Application-Platform for ITS Components
  - Laboratory infrastructure to determine requirements for cooperative assistance and automation in a context of urban traffic scenarios and their real-virtual instantiation

- Design and development tool for real-virtual assistance and automation systems
Motivation and Introduction

Requirements for MoSAIC are presented based on the addressed technology-driven and the human-centered fields of research:

**Technology**
- Conformance testing
- Interoperability testing
- HMI (What can/shall be depicted/presented?)
- Robustness (e.g. String Stability)
- Technical evaluation (e.g. interoperability testing of systems provided by different manufacturers)

**Development of cooperative assistance and automation**

**Human**
- Acceptance studies
- Usability
- HMI (How shall it be depicted/presented?)
- Human Factors (e.g. impact on driver behavior)
- Psychological motivated evaluation (e.g. negotiation strategy between traffic participants)

Study
Motivation and Introduction
MoSAIC – DOMINION
DOMINION

- Developed by DLR
- Follows the paradigm of service-oriented architecture (SOA)
  - A service represents a delimited and defined performance, which is produced by an application module and consumed by other application modules
  - The service interface and the functional specification is strictly defined between using and providing application module
  - Services are able to collaborate – services from different context could be integrated within a new overall context (orchestration)
  - The loose coupling offers a high level of autonomy to service developers and providers
DOMINION

- Continuous development and runtime environment in all laboratories
- Formal description of services through VSDL (in-Vehicle-Service-Description-Language) derived from WSDL (WebService-Description-Language)
- Standardized, database supported collection of (test) data
- No expert knowledge about the research facilities necessary for the developer
- Fast development cycles on multiple platforms
- Different RTE
MoSAIC – Architecture Approaches
Architecture Approaches
Boundary Conditions

- Research facilities are spatial separated
- Each research facility has to be useable within MoSAIC and self-sufficient without huge efforts
- Maintenance effort should be kept on the same level
Architecture Approach I

- All research facilities are in the same communication sub-network
- One instance of DOMINION for all research facilities
  - Only one instance for Traffic, Communications simulation etc.
  - More than one instance for Driver Assistance Applications
- Only one MAIN Control station
Architecture Approach II

- Every research facility has its own communication sub-network
- Every research facility uses its own DOMINION instance
- DOMINION\textsubscript{MAIN} to connect the instances and to run "unique" applications
- Distributed Control Station concept
MoSAIC – Test Scenario and Results
Test Scenario and Results
Test Scenario and Results

The results show that both approaches are applicable for certain setups.

Architecture Approach I
- For spatial non-separated setups like in the test scenario
  - More difficult for stand alone operation of simulators → one sub-network for all simulators
- For less complex setups
  - Less modularity compared to Approach II
  - Easier data collection

Architecture Approach II
- For spatial separated setups with higher complexity
  - Easy for stand alone operation of simulators → separated sub-networks for each simulator
  - Higher modularity compared to Approach I
  - Distributed data collection is more difficult
Conclusion and Next Steps

➤ Both architecture approaches are possible for the realization of MoSAIC

➤ Finally there will be a combination of both approaches
  ➤ Approach I as first step for non-spatial separated studies
  ➤ Approach II for spatial separated studies

➤ Methodology for the control and evaluation of driver studies with more than one real human driver (EU-Project – D3CoS)
➤ Solution for distributed data logging for Approach II
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