



**ACROSS -  
A reference  
architecture  
for  
embedded  
systems**



## Welcome

We are pleased to welcome you to the 2<sup>nd</sup> edition of the ACROSS newsletter.

With September 2011 the ACROSS project has already passed half of its project duration. Thus, we would like to take the opportunity to give you insight in our present technical achievements that have been positively evaluated during the first project review in May 2011. Further, we would like to point out how these results will be further implemented and how the awareness for the ACROSS approach is raised.

We would also like to draw your attention to the ACROSS workshop that is introduced on page 5 of this newsletter and look forward to welcoming you there.

Dr. Christian El-Salloum & Sibylle Kuster, MBA

ACROSS Project Coordination Team

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## Results & Outlook

Pursuing the overall ACROSS project goal to develop an ARTEMIS cross-domain reference architecture for the automotive, avionics and industrial control domain, the major results achieved from the design phase are:

- Design & development of ACROSS modular building-block components
- Design of middleware & system components
- Development of model-to-model transformation & code generation tools
- Design of automotive, aerospace and industrial control specific services.

These results build the cornerstone for the ongoing implementation phase of ACROSS.

Actually the following implementation activities are conducted within ACROSS:

- Implementation of the ACROSS MPSoC and the core services on a prototype board

- Implementation of generic optional services on top of the core services
- Implementation of the aerospace, automotive and industrial control specific services to enable industrial application
- Refinement of the development process with respect to the domain-specific and generic models, model-to-model transformations, configuration of ACROSS services and implementation and integration of tools

For further details on our project work, please check our project homepage where public deliverables have been listed.

<http://www.across-project.eu/>



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Bundesministerium für  
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Technologie (Austria).*

## Impact of the ACROSS architecture

ACROSS will contribute to mastering emerging architectural challenges and will thereby enable European industries across different application domains to foster their technological leadership.

On the following pages you will read about the impact and benefit of the ACROSS architecture for three selected application domains. For the industrial control domain Siemens and Danube Mobile Communications Engineering (DMCE) provide an evaluation of the influence ACROSS will have. SELEX Sistemi Integrate describes the situation for the aerospace domain. AVL List gives a perspective for the automotive domain.

### Industrial control domain & ACROSS architecture

## SIEMENS

Commercial off-the-shelf platforms for embedded realtime systems address the everlasting demand for compute performance with tightly coupled symmetric multiprocessing architectures without any spatial separation of cores. Regulations like IEC 61508 for functional safety require a strict separation on functionalities without any interference. Virtualization, partitioning and hypervisor techniques satisfy those requirements for

separation only to a certain extend. ACROSS introduces a spatial and temporal segregation as a key architectural property which supports the separation of safety relevant functions strictly from non-safety relevant ones.

Since also most applications in the field of industrial control typically support a further decomposition into tasks with efficient communication between these tasks, the deterministic time triggered communication infrastructure which is a fundamental part of the ACROSS platform is a very beneficial approach to meet these communication requirements.



DMCE, as an expert in wireless communication, is contributing to the ACROSS project in order to evaluate its capabilities to incorporate in the wireless communication industry. The emphasis of the work is to evaluate the possibility of using the ACROSS platform as a baseband (BB) component in a wireless system. Therefore, it is of a great interest to know that the ACROSS platform could sustain the hard real time requirements of modern wireless systems concerning the bandwidth and timing. The time-triggered technology of the ACROSS platform is a magnificent paradigm offering determinism on the said parameters. For all industries having real-time requirements this is of course significantly convincing hence a powerful phenomenon. Furthermore, it is also very important to evaluate the shortcomings of existing BB architectures and how the ACROSS platform copes with them. Modern BBs are often distributed computing systems, implemented on an MPSoC, which are becoming more complex in order to provide more computing power. Additionally, the support of contemporary

multi-band and multi-standard communication approaches (e.g., GSM 2G/3G and LTE) significantly increases their complexity. Traditionally, the interconnection in a BB MPSoC is a bus system. The increased complexity of the BB results in a substantial increase in the load of communication. Therefore, the bus interconnection naturally turns out to be a bottleneck in the system. The ACROSS TTNOC approach not only resolves this issue but also enhances the scalability of the system. It provides a deterministic communication with higher data rates between the components. Furthermore, it offers an easier integration and disintegration of components in the system which facilitates the realization of flexible and customizable solutions. Moreover, in multimode BBs (supporting multiple communication standards) components working on one communication standard operate independently and hardly know about the operations of components working on another standard. In such a case using dedicated and encapsulated communication channels (provided by the ACROSS TTNOC) can be evidently beneficial. With all these capabilities we believe that the ACROSS technology can embrace an integral place in the wireless communication industry.

## Aerospace domain & ACROSS architecture



### The Network-Centric Paradigm

Nowadays, the concerns related to emerging operational needs raises complex design problems, which require a new generation of systems, usually referred to as System-of-Systems (SoS), where the interoperability becomes a primary requirement. These systems are composed of an organised set of both, new and legacy components which need to interoperate on-demand.

The network-centric design approach is a promising tool for a system designer due to its focus on the system organization. Following the network-centric approach, the system is defined as an integrated whole, whose properties directly stem from the relationships among its components.

The system complexity still implies a hierarchy where a given system can act as a part of a higher level system. Different networks may relate to each other in order to form a heterogeneous network-of-networks. It is worth noting that the network-centric organisation does not imply a hierarchy of networks, but a set of networks, which interact via networks. It is more correct to think about networks whose nodes are networks themselves. This results in the system design guideline to adopt the network scheme down to the lowest architectural level, i.e. the chip level. Thanks to its deterministic Network-on-Chip (NoC) solution, the ACROSS Platform (i) tackles upcoming challenges (e.g., temporal determinism) in emerging network-centric systems and (ii) provides a tool to the system designer to iteratively adopt the network paradigm in defining the architecture.

### The Real-Time Data Distribution Services

The network-centric scenario has considerably changed the scale of distributed systems. Distributed systems now involve thousands of entities — potentially distributed all over the world — whose location and behavior may greatly vary throughout the lifetime of the system.

“Real-Time Data Distribution Services” (RT-DDS) is an open-architecture for real-time middleware

specified by the Object Management Group (OMG). It is an innovative technology that implements a real-time publish-subscribe communication model and allows distributed processes to share data transparently among peer entities. It includes a complete set of Quality of Service (QoS) parameters for a complete control of service performance and resource allocation.

### The ACROSS benefits for Product Design and Development

SSI developed BEE™, a real-time middleware which is an implementation of the OMG's RT-DDS. BEE provides all of the RT-DDS functions specified by the standard, and it is specifically optimized for mobile, mission critical applications where predictability, dependability, and security are key system requirements.

Current processing platforms lack native support for predictability, dependability and security. In the frame of the ACROSS project, SSI performs the design and development of RT-DDS platform-specific layers and their QoS support for both, generic ACROSS and aerospace-specific platforms. The support of multiple application specific services on top on the same set of generic services allows for reuse of critical QoS solutions so improving both the portability and the interoperability of the BEE product.

Specifically, the BEE exploited ACROSS services to improve the OMG's suite of QoS parameters addressing:

- Timing requirements: multi-level resource management, predictable data distribution, data lifetime management, data delivery deadline, maximum/minimum transmission rate at both sender and recipient endpoints;
- Availability requirements: resilient data delivery, avoidance of any single-point-of-failure, data distribution service availability;
- Partitioning which allows splitting the system into different logical domains.

## Automotive domain & ACROSS architecture



Current and future automotive propulsion concepts are characterized by a growing complexity of interactions between different control subsystems such as HCU (hybrid control unit) and BMS (battery management system) for hybrid control strategies. The development and validation of these systems requires a tremendous effort to capture the relevant overall vehicle behavior which is a result of the interaction of all involved subsystems. These

challenges need to be respected in upcoming platforms.

The ACROSS MPSoC architecture establishes the AUTOSAR RTE (Run-Time Environment) within IP cores and ensures significant profit such as composability, predictability, timeliness and fault isolation. The partitioning and AUTOSAR environment (Platform-Independent Model) allows the effective reuse of approved subsystems in further projects.

The expected benefit of ACROSS MPSoC architecture focuses on the development and integration process and thus reduces the validation time and its associated costs massive.



ACROSS –  
the cornerstone for cross-domain applicability



Visit the **ACROSS** booth  
at the  
ARTEMIS and ITEA 2  
CO-SUMMIT 2011  
October 25-26, 2011,  
Scandic Marina Congress  
Center,  
Helsinki, Finland

# ACROSS Workshop – January 24, 2012



## “A cross-domain approach for mixed-criticality integration based on heterogeneous MPSoCs”

The cross-domain approach developed within ACROSS will be introduced at an ACROSS Workshop on “**A cross-domain approach for mixed-criticality integration based on heterogeneous MPSoCs**”. This workshop will be held in conjunction with the 7<sup>th</sup> International Conference on High-Performance and Embedded Architecture and Compilers (HiPEAC 2012) in Paris, France on January 24, 2012.

<http://www.hipeac.net/conference>

### Workshop Programme

- *Composability in the ACROSS MPSoC*, C. El-Salloum, TU Vienna
- *A platform for mixed criticality applications*, A. Eckel, TTTech
- *A cross-domain methodology for MPSoCs*, S. Barner, fortiss
- *ACROSS in the Automotive Domain*, M. Kang, AVL
- *ACROSS in the Aerospace Domain*, F. Fedi, SELEX-SI & B. Koppenhöfer (CASSIDIAN)
- *ACROSS in the Industrial-Control Domain*, H. Taucher & M. Ghameshlu, Siemens
- *RECOMP: Reduced Certification Costs for Trusted Multi-core Platforms*, P. Pop, Technical University of Denmark
- *ACROSS as a Component of a System-of-Systems*, H. Kopetz, em. o. Prof. TU Vienna
- Panel “One uniform architecture for multiple domains – technical challenge or impossible vision?”

### Workshop Details

Date: January 24, 2012

Time: 10:00 – 18:00

Venue: EuroSites George V,  
Paris, France

Registration: via  
[www.hipeac.net/hipeac2012](http://www.hipeac.net/hipeac2012)

Contact:  
[office@across-project.eu](mailto:office@across-project.eu)

### Workshop Scope

This workshop will introduce the cross-domain approach developed within ACROSS. In particular you will learn about:

- Challenges and solutions for mixed-criticality integration in heterogeneous MPSoCs
- Heterogeneous MPSoCs and guaranteed real-time performance
- Cross-domain development methodologies
- Industrial applications of the introduced technologies

### Target Audience

This workshop is targeted at OEMs, suppliers and researchers in the areas of:

- automotive
- aerospace
- industrial control
- other industries for safety-critical requirements such as medical, power generation, space domains,...

In the near future most processors will be based on multi-core technology, which poses fundamentally new challenges on many embedded application domains. In this workshop you will learn how to employ multi-core technology in embedded applications that are safety-critical and have stringent requirements on real-time properties and certification aspects.

For more details and updates please visit:

<http://www.across-project.eu/workshop2012.htm>



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## Project Details

Project partners: 17  
Project duration: 36 months (April 1, 2010 – March 31, 2013)  
Project funding: 7,6 Mio €  
Project budget: 15,9 Mio €



## Consortium

