

# *ARTIST2 – Year 1 Review*

*Grenoble, October 3rd-4th, 2005*

*Activity*

*Execution Platforms*

## Communication-Centric Systems

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# Outline of the Presentation

## **Industrial Needs and Experience**

## **Participants + Objectives**

## **Year 1 Activities**

- Interaction Between Partners
- Achievements
- Management Perspective
- Spreading Excellence

## **18 Month Perspective**

- Ongoing Work
- Significant events or achievements expected

# Industrial Needs and Experience

## ❖ **Artist2 interaction with industry**

- TU Braunschweig with Volkswagen AG: Early architecture analysis and exploration
- TU Braunschweig with Robert Bosch GmbH: Evaluation and analysis of a complex ECU design
- ETH Zürich with Netmodule: Adoption of tools developed at ETH Zürich for the design of components for internet communication equipment

## ❖ **Industrial needs formal real-time methods for**

- Software integration
- Architecture design
- Design verification

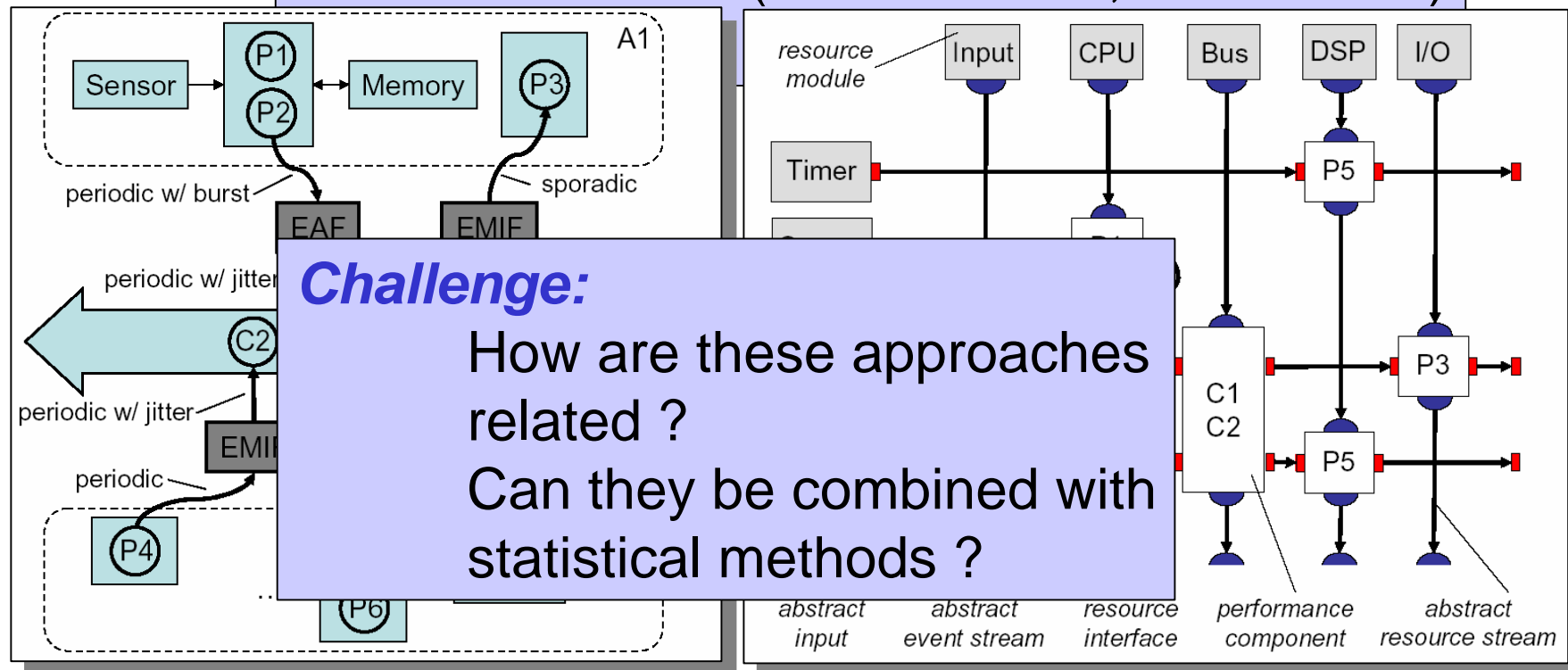
## ❖ **Possible Global Impacts of Research Results**

- Increased design quality
- Higher reliability
- Easier integration / IP - reuse
- Design of robust systems

# Overview JPRA-Cluster: Communication-Centric Systems

## Approaches:

- SymTA (Ernst-Braunschweig)
- Perf. Netw. (Thiele-ETHZ)
- Holistic (Eles-Linkoping)
- Simulation (Madsen-DTU, Benini-UoB)

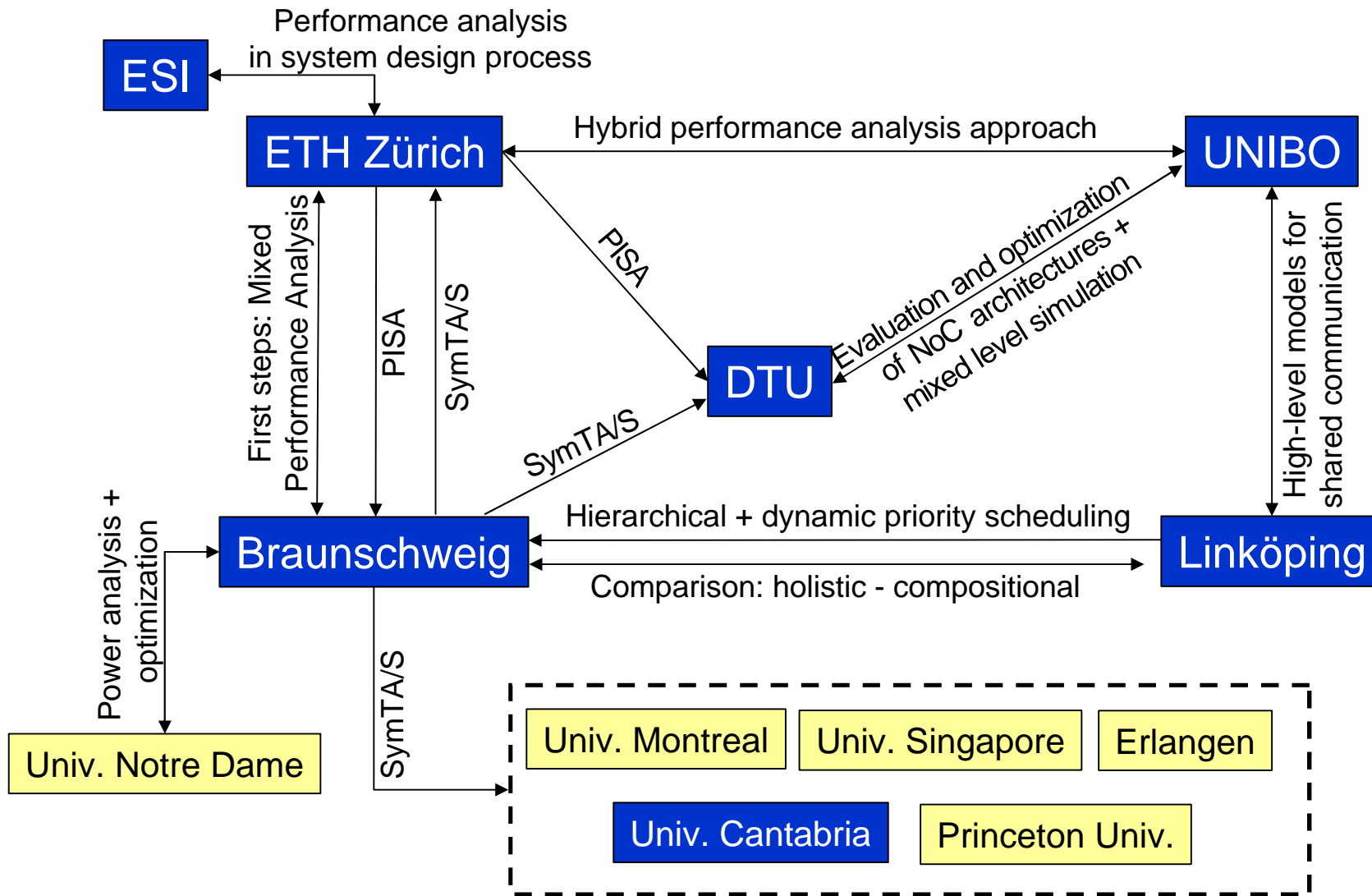


# Participants and Objectives

- ❖ **Participants** Thiele-ETHZ, Madsen-DTU, Eles-Linkoping, Ernst-Braunschweig, VW, Volvo, Eles-Linkoping, Madsen-DTU, Benini-Bologna, STM
- ❖ **Objectives**
  - new best-case/worst-case models for hard real-time systems and at combined statistical and interval models for QoS applications
  - environment for analysis and optimisation of scalable inter-process communication
- ❖ **Plan**
  - formal analysis model of Eles to be extended towards specifying the communication protocol in a formal way and to capture fault-tolerance
  - performance analysis models of Thiele and Ernst will be put on a common formal basis
  - the simulation-based approach of Madsen will be linked to formal analysis
  - analyze the sources of communication unpredictability in multi-task, multi-processor environment
  - abstract models of communication that closely match the available hardware a middleware, thereby enabling accurate high-level analysis and verification
- ❖ **M1-M18 - achieved**
  - prototype hardware architecture and middleware API for message passing support, working on several interconnect fabrics, abstract modelling and validation
  - assess the state-of-the-art in performance analysis and provide a common formal basis.

Year 1 activities

# Achievements: Our integration work



*Year 1 activities*

# Additional Achievements fostered by ARTIST

## ❖ **Linköping University**

- Timing analysis of the FlexRay communication protocol
- Analysis and optimization of distributed systems with fault tolerance requirements

## ❖ **Technical University of Denmark**

- Development of a clockless NoC architecture (MANGO)
- Development of a system-level NoC model for the multiprocessor simulation environment ARTS
- Integration of design space exploration in the ARTS environment for optimizing on-chip interconnections

## ❖ **University of Bologna**

- Development of a customizable NoC architecture for heterogeneous massively parallel single chip multiprocessor systems

## ❖ **Technical University of Braunschweig**

- Modeling and timing analysis of MpSoC memory accesses
- Timing analysis of the ERCOSEK RTOS (automotive)
- Timing analysis of the CAN communication protocol

*Year 1 activities*

# Management Perspectives

**❖ What worked well**

- Close partner cooperation including exchange of research personnel would not have been possible without Artist 2

**❖ Difficulties encountered**

- Industry is cautious in practical application of new RT technologies
- Industrial responsibilities in supplier – OEM integration not well defined
- Slow integration of new tools in current industrial design processes



*Year 1 activities*

# Spreading Excellence

- ❖ **Numerous publications at leading international conferences:**
  - DATE, DAC, Codes-ISSS, RTAS, RTSS, ICCAD, ECRTS, etc.
  
- ❖ **Installation of the developed tools, e.g. SymTA/S, in several universities inside and outside Europe including:**
  - Singapore, Montreal, Notre Dame, Erlangen, Princeton, Cantabria, etc.
  
- ❖ **Evaluation and utilization of the developed tools by several companies including:**
  - Netmodule, ST, Bosch, Volkswagen, Samsung, etc.
  
- ❖ **Spin-off from TU Braunschweig**
  - *SymTAVision*
  - Consequence of the positive feedback from industry
  - participated in AUTOSAR timing model definition

*18 Month Perspective*

## Ongoing and Future Work

- ❖ **TU Braunschweig – ETH Zurich**
  - Development of interfaces between Real-Time Calculus and SymTA/S allowing a per component mixed performance analysis of heterogeneous distributed systems
- ❖ **ETH Zürich – University of Bologna**
  - Extension of the hybrid analysis approach to allow the analysis of more complex systems
- ❖ **ETH Zürich – Embedded Systems Institute Eindhoven (ESI)**
  - Comparison and evaluation of different performance analysis methods
  - Identification of strengths and weaknesses of various performance analysis methods
- ❖ **TU Braunschweig – University of Notre Dame**
  - Further development of realistic power models
  - Development of power optimization methods (stochastic and heuristic)
- ❖ **TU Braunschweig – Linköping University**
  - statistical time modeling

*19-36 Month Perspective*

## Significant Events or Achievements Expected

- Combine for QoS applications
  - **statistical methods**
  - **interval models** and
  - **simulation**
- Consider in particular highly distributed systems such as sensor networks and intra-car networks.