ARTIST 2
Network of Excellence

IST-004527 ARTIST2:
Embedded Systems Design

Spreading Excellence

Artist2 Technical Coordinator:
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with inputs from all NoE participants

The visibility of the ARTIST2 research effort in embedded systems design is worldwide. This is progressively creating a European embedded systems design community, and spreading the "artist culture" in all major research institutions.

To ensure that the next generation of researchers will continue in this direction we, as a consortium, devote a great deal of effort to Spreading Excellence, in both academic and industrial circles. Furthermore, we are actively setting up structures for permanents links between industry and public research, leveraging on existing partner collaborations with major industrial players in the area.

ARTIST2 has a strategic impact on the integration of multiple academic research communities, which are necessary to establish the new area of embedded systems design. The NoE will contribute to the construction of a framework for integration, which reflects the complexity of the topics involved and the different communities.

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1. Vision and Strategy for Spreading Excellence

Our actions for Spreading Excellence are at 2 levels:

- Targeted towards affiliated partners
- Targeted towards the scientific and technical community at large

1.1 Affiliated partners

Affiliated partners are not core members in the consortium, but receive support for travelling to Artist2 meetings, and actively contribute to the implementation of the Joint Programme of Activities (JPA). These affiliated partners include industrial, SME, academic, and international affiliates.

The NoE has 14 large industrial affiliated partners, 12 SMEs, 23 academic, and 14 international affiliated partners. Almost all of these partners have participated in one or more of our technical events over the course of the Year 1. We have also had a very large number of participants from the wider research and industrial communities, who are not listed officially.

1.2 Scientific and Technical Community in the Large

This is achieved mainly bottom-up through the organisation of scientific events, publications, distribution of tools and components, industrial partnerships (not funded by Artist2), education; and through the Artist2 web pages.

Our sponsoring policy aims specifically at enforcing integration of existing scientific events in the area. This is sought in particular through the creation of Embedded Systems Week, in which we have played a crucial role. The ambition is that Embedded Systems Week federates an increasingly large number of existing scientific events within a single week. Another concrete example is our action within the DATE conference, in which we are working to shift the emphasis towards becoming the central European conference on embedded systems design.

Regarding Scientific events, we distinguish between conferences and workshops, schools, and high-level events mainly for International Collaboration.

The ARTIST2 community effectively plays an important role and leads the initiatives for organizing the most significant conferences in the area. In Europe, it has a very strong presence in the DATE conference, which is becoming the main conference on embedded systems within Europe. Over the past 3 years, the chairs of DATE have all been leading Artist members. Also for the past 3 years, we have organized 1-day Artist workshops within the DATE framework, on cutting-edge topics and including presentations from both Artist participants, and other world-class speakers.

Artist members have a leading role in the organisation of the Euromicro conferences. This year, we have sponsored the 31st Euromicro Conference - Special session on Model Driven Engineering (MDE).

In international conferences, the ACM's flagship conference, EmSoft, has been initiated by leading members of Artist2. These researchers now chair the steering and executive committees. Artist partners are also in leading positions for conferences as RTSS (Real-Time Systems Symposium), CODES/ISS, Workshop on Languages, Compilers, and Tools for Embedded Systems (LCTES). Further details regarding sponsoring, as well as specific events and publications are given in this document.

Artist partners are also active members of the ACM's SIGBED, and the IEEE's upcoming Special Interest Group on Embedded Systems currently being set up. Artist members actively work for structuring international events on embedded systems.

This year and for the first time, ACM and IEEE have organized an Embedded Systems Week, including EmSoft and CODES/ISS. This was a major success, and they will be organizing a similar event next year in Seoul (Korea), and the following year in Salzburg (Austria).

Overall, Artist2 has sponsored world-class 12 scientific events including workshops, seminars, and conferences.

Regarding schools and seminars, ARTIST2 has successfully organized the Artist2 Summer School in Sweden (http://www.artist-embedded.org/FP6/ARTIST2Events/SummerSchools/Artist05.html).

1.2.1 High Level Events for International Collaboration

High-level Events are intended to gather together the very best world-leading experts from academia and industry, to discuss progress on the state of the art, relevant work directions. In the first year, we have organized 2 co-located workshops on "Component-based Engineering for Embedded Systems" and "Transatlantic Research Agenda on Future Challenges in Embedded Systems Design" (http://www.artist-embedded.org/FP6/ARTIST2Events/PastEvents/IST-NSF/). These events were very successful, and our web statistics show that these continue to be widely used as references.

Three Artist2 members are on the steering board for the ARTEMIS European Technology Platform. In this capacity, they participate in working groups for defining the overall European long term strategy in the area.

1.2.2 Publications

The Artist2 community has been very active in publishing in scientific journals and conferences, as attested by the list of publications provided in this document. Clearly, this represents a huge amount of work. Publication of research is a bottom-up process, which may seem chaotic – but this is intrinsic to research.

1.2.3 Tools and Components

The Artist2 community plays a leading role in the distribution of software tools and components, on verification/validation tools. Some tools are distributed free of charge, such as UPAAL, IF. Others are commercialised, such as AbsInt, SymTA/S. For many other tools used in the platforms, and shared between the Artist partners, a common dissemination policy has not yet been defined.

Over the course of Year 2, the NoE will discuss the dissemination, and clarify the policies for distribution.

1.2.4 Industrial Liaison

Artist2 has a wide array of affiliated industrial and SME partners (see the Periodic Activity Report). Most of these partners have participated in some way in the Artist2 technical meetings and the overall effort. There is strong, high-level industry participation through the various Spreading Excellence events organised by Artist2. Our active involvement in the European Technology Platform ARTEMIS also could have a significant and long-term impact.

In addition, each Artist2 partner has an outstanding track record for interaction with industry. Globally, the Artist2 consortium has a very strong impact on European R&D in embedded systems, through participation in the three main Integrated Projects: DECOS, ASSERT, and RUNES. This impact is visible via the achievements in these Integrated Projects, related to time-triggered architectures and modelling and validation at the architectural level.

We believe that the strong involvement of four main Artist2 partners in the recently accepted SPEEDS Integrated Project will also have a very positive impact on progress in the state of the art, in component-based embedded systems engineering.

1.2.5 Spreading Excellence Actions Planned for Year 2

As was the case for Year 1, the majority of Spreading Excellence events will be decided over the course of Year 2. The following is a partial sample of the various initiatives currently under consideration.

Affiliated Partners
As planned, the Artist2 consortium will continue to increase its affiliated partners. It should also be noted that some affiliated partners are now core partners (Tidorum and Ace).

Decisions regarding affiliated partners (new affiliates, participation, etc) are almost exclusively bottom-up. Thus, as in Year 1, many Spreading Excellence actions are decided over the course of the year.

ARTIST 2006 Summer Schools

- We will repeat the successful experience of the Artist2 2005 Summer School in Sweden, in the same location and with the same organizers. We will undoubtedly update the topics, but this is still under discussion.
- We will organize a Spring School in Xian, China Models, Methods and Tools for Embedded Systems, in collaboration with the United Nations University (UNU-IIST) in Macau. This is described in detail in this document.
- Jan Madsen is considering setting up a summer school on System Modelling for Communication-centric Systems, in conjunction with a workshop (in June/July 2006) on the same topic.

Organisation and Sponsoring of Conferences and Workshops
The Artist2 community will continue its policy of organizing and supporting leading conferences in the area. Our action will focus on two main directions:

- Reinforce our participation in Date, and contribute to make this the main event European event on embedded systems. In 2006, we have a workshop at Date, on **Design Issues in Distributed, Communication-Centric Systems**
  http://www.artist-embedded.org/FP6/ARTIST2Events/Events/Date06/

- Contribute to the organisation of the **Embedded Systems Week** in Seoul in October 2006, and subsequently in Salzburg in October 2007. The objective is to create the main scientific event on embedded systems worldwide.
- **MARTES workshop** at Models'2005 conference
  Main Artist2 Partner: CEA-List, Verimag
  Contact: S. Gérard, S. Graf
  Rough budget: 2000€
  Approximate dates: October 4, 2005
- **MoDeVa workshop** at Models'2005 conference
  Main Artist2 Partner: CEA-List, INRIA
  Contact: C. Gaston, P. Baudry
  Approximate dates: October 4, 2005
- **IDM'2005**
  Main Artist2 Partner: CEA-List
  Contact: S. Gérard
  Rough budget: 1500€
  Approximate dates: June 30 & July 1, 2005
- **System Modelling for Communication Centric Systems**
  Main Artist2 Partner: DTU, TUB, UoB, TUL
  Contact: Jan Madsen
  Rough budget: 2.000 euro
  Approximate dates: June/July 2006
- A number of workshops will be organized on specific key topics within the major international conferences on real-time and embedded systems, such as ECRTS, RTSS, DATE, and EMSOFT. Contact: Gerhard Fohler

New courses
The Artist2 community regularly develops new courses. In Year 2, these will be disseminated via the web site, although it will be difficult to ensure structuring or any kind of completeness. The following is a very small sample.

- **MISIC – Master on complex system engineering in association with Politechnique High** School, University of Orsay and CEA-INSTN
  Main Artist2 Partner: CEA-List
  Contact: F. Terrier
  Approximate dates: set up during 2005 for a start in 2006.
- **MOPS – Master on Modelling, Programming and Optimisation at U, of Evry**: new module for last year oriented to research, on component based modelling of systems.
  Main Artist2 Partner: CEA-List
  Contact: H. Dubois
  Approximate dates: set up during 2005 for a start end of 2005.
- **Real-Time Systems course**, including new version of Bound-T WCET analysis tool for Renesas H8/Lego Mindstorm
  Main Artist2 Partner: Mälardalen University
  Contact: Andreas Ermedahl
- **Graduate Course on Real-Time and Control**
  in collaboration with the Control cluster
  Contact: Luis Almeida (Univ. of Aveiro) and Giorgio Buttazzo (SSSA-Pisa)

- **Distributed Undergraduate Course on ARTS**
  contact: Gerhard Fohler
- **Advanced digital design course at EPFL in Sept/Oct 2006**
  Contributors: Benini, Leupers, Marwedel
  Budget: unknown
  Approximate dates: Sept/Oct 2006

International Collaboration

We are currently discussing with our counterparts in the USA, for a follow-up of the workshops organised in Paris, in June 2005. We are very pleased that the National Science Foundation (USA) is financing collaboration between Artist members (Pierre Wolper and Tom Henzinger), and US researchers involved in NSF projects.

In the coming year, we will focus on collaboration with China (Artist2 Spring School) and Korea taking advantage of the Embedded Systems Week in Seoul.

Using and Disseminating Knowledge

Within Artist2, the main focus in Year 1 has been on cluster-level and NoE-level integration, in harmonizing work directions, integrating tools, increasing awareness about the state of the art within the consortium.

It should be clear that an NoE has limited means for implementing a strategy for use of knowledge, and does not have strong levers for enforcing policies. Our action in this area is restricted to creating opportunities for links between partners and users of our results.

These opportunities are essentially in setting up joint industrial projects, and events of interest to industrial partners.

For dissemination through usual means, there is a very good level of activity. There remains to be defined and implemented a web-based dissemination policy. The web site is currently minimal, and targeted more towards the Artist2 community than towards the community in the large. To achieve this, we need to develop a specific infrastructure, that we have already started implementing. This will be achieved over the course of year 2.

We are currently discussing and defining our strategy, to be implemented by the end of the 2nd Year.

2. International Collaboration : High-Level Events

International Collaboration events has initially been developed with the USA, but is now extending to China, Korea, India. This is an ongoing process, with varying degrees of maturity depending on the International Collabroation partners involved.

- With the USA, we have a mature relationship that builds on extended ties and capital set up in Artist FP5. Here, the objective is to exchange information through high-level meetings on strategic research directions, education and training, and other selected topics.
  A second direction for collaboration with the USA is through collaboration between Artist partners and NSF projects opened through specific international calls set up by the NSF (100k$/project). There are existing collaboration projects between Verimag and Vanderbilt, TU Vienna and Berkeley, and others.
  This year, Artist2 has organized the high-level events: parallel workshops on Component-based engineering, and IST-NSF. See below.
- We have opened prospective collaboration actions with China and India. With China, our contacts are mainly organized through the United Nations University in Macau. The tangible results from this is the organization in April 2006 of a joint Artist2/China Spring School (link).
  Contacts have also been set up with India, mainly through Indian universities, and TCS (Tata Consultancy Services) research lab, which organizes an international seminar in January 2006. Several Artist2 members have been invited.
- Finally, for Korea, contacts have been taken leading academic and industrial teams. Artist2 will organize a major workshop in Seoul in the framework of the Embedded Systems week, in October 2006.

Our vision

Collaboration between international organisations and institutions that are the main players in the area is a strategic action line for Artist2. Based on the International Collaboration experience from ARTIST1 (http://www.artist-embedded.org/IntlCollab/), we exchange of information, and identify opportunities for common initiatives. These initiatives will concern joint R&D projects, working groups for standards, international roadmapping and strategic work directions in the area.

The main international collaboration activity this year has been the US EU Workshops held in Paris, July 7th and 8th : http://www.artist-embedded.org/FP6/ARTIST2Events/PastEvents/IST-NSF/ .

2.1 Component-based Engineering for Embedded Systems (July 7th 2005)

The aim was to gather together leading researchers from academia and industry, to discuss research challenges and emerging industrial trends on component-based engineering. The ultimate goal is to identify complementarities and synergies in standardization to respond to the needs for a more cross-sectoral approach to embedded systems.

All slides from the workshop are provided in the links below.

Component-based Engineering for Embedded Systems

USA - EU Workshop
July 7th, 2005 - Paris

Organisers: **Joseph Sifakis** (VERIMAG and ARTIST2 NoE) and
Janos Sztipanovits (Vanderbilt University - ISIS)

Part I **Industrial Needs and Projects**

Don Winter - Director, Network Centric Operations; Boeing Phantom Works
"Embedded Systems Challenges at Boeing"

Don Wilson - Senior Fellow, Raytheon Co.
"Industry Challenges in Embedded Systems Software Development"

Steve Vestal - Fellow, Honeywell Labs
"Models, Abstractions and Architectures in Component-Based Engineering"

Gert Döhmen – Airbus
"Processes and Methods for Integrated Modular Avionics"

David Lesens - EADS Space Transportation
"Code Generation and Simulation from Heterogeneous Models"

Véronique Normand (replacing Serge Salicki) - Architecture & Engineering Department, Thalès Research and Technology Software Research Group
"Model Driven Engineering and solutions for Software Intensive Systems"

Part II **Position Statements**

- András Tóth - Ericsson AB, Corporate Research
- Eric Conquet - European Space Agency
- Philippe Kajfasz - Head of Advanced Architecture Lab, Thalès Land & Joint Systems
- Gabor Karsai - Vanderbilt University
- George Pappas - University of Pennsylvania
- Claire Tomlin - Stanford University
- Albert Benveniste - INRIA

Part III **Discussion and Synthesis**

Panel members:

- **David Corman** - Technical Fellow, Boeing
- **Dominique Potier** - Scientific Director for Software Technologies, Thalès
- **Joseph Sifakis** - Director, Verimag Laboratory and ARTIST2 Scientific Coordinator
- **Janos Sztipanovits** - Distinguished Professor at Vanderbilt University, Director

of Institute for Software Integrated Systems

- **Michael Winokur** - Corporate R&D and Business Development Manager of Embedded Computer Systems at Israel Aircraft Industries

2.2 Transatlantic Research Agenda on Future Challenges in Embedded Systems Design (July 8th 2005)

Transatlantic Research Agenda on Future Challenges in Embedded Systems Design

IST - NSF Workshop
July 8th, 2005 Paris

Organisers: **Helen Gill** (National Science Foundation), **Alkis Konstantellos** (European Commission), **Shankar Sastry** (UC Berkeley), **Joseph Sifakis** (VERIMAG and ARTIST2 NoE), **Janos Sztipanovits** (Vanderbilt University - ISIS), Mateo Valero (Technical University of Catalonia)

Part I **Towards a Joint IST-NSF Research Agenda in Embedded Systems Design**

US Keynote Presentation *Helen Gill*
NSF - Computer and Network Systems Division, Program Director

EU Keynote Presentation *Kostas Glinos*
European Commission - IST, Embedded Systems Unit Head

Collaborating Projects :
Early Experiences and Assessment of EU-US Collaboration
Co-chairs: Alkis Konstantellos and Helen Gill

Hipeac - Rutgers, Princeton
Olivier Temam (IRISA), Nacho Navarro (UPC),
Liviu Iftode (Rutgers University), Margaret Martonosi (Princeton University)

DECOS - University of California, Irvine / Vanderbilt University
Roman Obermaisser (TU Vienna)

RUNES - Berkeley, Caltech
András Tóth (Ericsson)

ARTIST/ARTIST2 – Berkeley/Vanderbilt University
Joseph Sifakis (Verimag&Artist) / Janos Sztipanovits (ISIS-Vanderbilt)
Claire Tomlin (Stanford University & Chess-Berkeley),
Mary Margaret Sprinkle (Chess-Berkeley: The Trust Project)

Part II **Views on Challenging Topics / Priorities**

Security: Catherine Meadows, Head of the Formal Methods Section - Center for High Assurance Computer Systems - Naval Research Laboratory
"Computer Security: the Good, the Bad, and the Ugly"

Component-based Design: Joseph Sifakis, Scientific Coordinator of the Artist2 NoE, and Director of Verimag Lab
"Directions in Component-based Design"

Networked Embedded Systems: Margaret Martonosi (Princeton University),
"Networked Embedded Systems and the ZebraNet Project: Experiences and Challenges"

Mechanisms for EU-USA International Collaboration:
Helen Gill (NSF), Alkis Konstantellos (European Commission)

Discussion (chaired by Janos Sztipanovits)

Part III

Thematic and Organisational issues
Means for Synchronisation, Announcement, Evaluation
Chair: Bruno Bouyssounouse (Verimag)

Informal synthesis by Tariq Samad (Honeywell) and Brian Krogh (CMU)

2.3 List of Participants

This workshop was by invitation only, and gathered a particularly impressive set of industrial experts from both the USA and Europe:

Airbus	Gert	Döhmen	Mr.
Boeing Company	David	Corman	Technical Fellow
	Don	Winter	Director - Ntework Centric Operations
UC Berkeley - CHESS	Jonthan	Sprinkle	Dr
	Mary Margaret	Sprinkle	Project Manager for TRUST (Team for Research in Ubiquitous Secure Technology)
Carnegie Mellon University	Bruce	Krogh	Professor
Polytechnic of Catalonia	Nacho	Navarro	Professor

CEA-DRT	Jean-Luc	Dormoy	Software & Cognitive Systems Manager
CEA-List	Francois	Terrier	Professor
CNRS	Françoise	Lamnabhi-Lagarrigue	Dr
EADS Space Transportation	David	Lesens	Dr
Ericsson AB, Corporate Research	András	Tóth	RUNES Coordinator
Embedded Systems Institute (Netherlands)	Ed	Brinksma	Prof.Dr.
European Commission	Kostas	Glinos	Head of Embedded Systems Unit
	Alkis	Konstantellos	Dr
European Space Agency	Eric	Conquet	ASSERT Project Manager
Ford Research (Aachen, Germany)	Rainer	Schloer	Dr
Honeywell Labs	Tariq	Samad	Corporate Fellow
	Steve	Vestal	Fellow
INRIA	Albert	Benveniste	Dr
	Jean-Marc	Jézéquel	Prof
	Paul	Le Guernic	Research Director
	Olivier	Temam	Directeur de Recherche
ISIS, Vanderbilt University	Janos	Sztipanovits	Professor
	Gabor	Karsai	Assoc. Prof. of EECS
	Sandeep	Neema	Dr.
I-Source Gestion	Pierre	Fiorini	Partenaire et CTO
Israel Aircraft Industries	Michael	Winokur	Director - Corporate R&D

Naval Research Laboratory - Center for High Assurance	Cathy	Meadows	Head, Formal Methods Section
NSF	Helen	Gill	Program Director
OFFIS	Ralf	Reussner	Jun.-Prof. Dr.
Philips Research	Sjir	van Loo	Principal Systems Architect
Porto Advanced Engineering Institute (ISEP)	Alfredo	Martins	Dr
Princeton University	Margaret	Martonosi	Professor
Rolls Royce UTC	Haydn	Thompson	Professor
Raytheon Co.	Don	Wilson	Senior Fellow
Rutgers University	Liviu	Iftode	Professor
Saarland University	Reinhard	Wilhelm	Prof.
Stanford University	Claire	Tomlin	Associate Professor
Thalès	Philippe	Kajfasz	Head of Advanced Architecture Lab.
	Véronique	Normand	Architecture & Engineering Department
	Dominique	Potier	Scientific Director for Software Technologies
University of California, Berkeley	Shankar	Sastry	Professor, Director of CITRIS
University of Pennsylvania	George	Pappas	Associate Professor
Uppsala University	Bengt	Jonsson	Professor

VERIMAG	Bruno	Bouyssounouse	Artist2 Technical Coordinator
	Joseph	Sifakis	Director
Vienna University of Technology	Roman	Obermaisser	Dr
Volvo Technology Corp.	Henrik	Lönn	Dr

3. ARTIST Summer Schools

3.1 IFAC Summer School in Prague 2005

3.1.1 Abstract

The objective of the school is to provide an overview of the main principles and technologies for supporting the development of embedded control systems.

3.1.2 Intended Audience

The school is aimed at graduate students, PhD students and engineers with some background on control engineering, computer science and real-time communications. No specific knowledge is required to understand the course, since all new concepts are explained and illustrated with concrete examples.

3.1.3 Structure

The school is divided in 5 courses, one per day, of 6 hours each:

Analysis and Control of Temporal Behaviour in Distributed Embedded Systems
Software systems are becoming larger and more complex. At the same time, they are being deployed in applications where performance assurances are increasingly important. Traditional approaches for providing such assurances that rely on a priori knowledge and detailed models are not effective for a large class of software systems. This tutorial describes recent advances in software performance control that leverage two theoretical foundations. The first foundation lies in the development of new utilization-based schedulability analysis techniques that apply to aperiodic task systems and allow quantifying the ability of such systems to meet end-to-end timing constraints. The second lies in the application of control theory in the field of performance control in complex software applications such as web servers, multimedia control, storage centres, power control in CPUs, and sensor networks. In this tutorial, we illustrate the computation of feasible regions that describe the real-time capacity limits of software. Within those limits, we demonstrate the formulation of software performance assurance problems as those of feedback control. We describe modelling the software system by difference equations, present a taxonomy of software control problems, and provide examples of performance control in contemporary servers. We conclude with important challenges that face the application of control and schedulability analysis techniques to future performance assurance problems in distributed software systems.

Real-time Networks for Embedded Systems: a Focus on Operational Flexibility

Technological advances in hardware made possible the embedding of both processing and communication functions in highly integrated, low-cost components. This high availability of these components fostered the use of a distributed approach in many application fields, from process control to factory automation, embedded systems, office automation, etc. Some applications in these domains present hard real-time constraints, having a strong impact on human lives either directly, e.g. transportation systems, as well as indirectly, e.g. highly automated factories or crucial processes (energy supply, chemicals, …). In these application domains, an underlying computer network is used to support the exchange of process data among several computing nodes that cooperate to achieve control over the environment in a desired way. For the control to be predictable, either monitoring as well as actuation must be subject to precise time constraints. These, in turn, are reflected not only on the computations performed on the computing nodes, but also on the information transfer over the network. Following the concept of encapsulating different functionality in separate intelligent nodes (e.g. intelligent sensors and actuators), the number of nodes in distributed real-time systems kept increasing, leading to higher connectivity and scalability requirements. However, it also resulted in higher system complexity, even with simpler individual nodes, and led to a stronger impact of the network on the global system properties. The network, or generally the communication system, determines, to a great extent, the support for properties such as composability, timeliness, flexibility and dependability as well as determines the efficiency in the use of system resources. In particular, this latter topic is gaining more interest given its potential to reduce costs, either design or deployment, but it implies a high level of operational flexibility necessary to support adaptation to instantaneous resource requirements. This course will present an introduction to computer networks from a real-time systems perspective, only. It aims at:

1) Transmitting the concept of network in a distributed real-time system as an independent component, i.e. the communication system
2) Analyzing existing technologies, techniques and protocols to support timeliness in the communication system
3) Establishing a relationship between those technical solutions and the system macroscopic properties
4) Analyzing the particular case of operational flexibility and its interplay with other properties, such as efficiency, timeliness and safety.

The course layout includes an initial presentation of general concepts in networks and then focuses on the physical and data link layers, devoting particular attention to the medium access control. Then, the course will address the issue of traffic scheduling and its relationship with medium access control, showing typical schedulability analysis that can be used to derive a priori guarantees of traffic timeliness. Four paradigmatic protocols will then be presented and analysed, WorldFIP, TTP/C, CAN and Ethernet. Finally, the course will analyse the impact that the options taken at the data link level have on the macroscopic network behaviour and will conclude presenting some trends in this field concerning the introduction of higher operational flexibility for efficient resource usage, without relinquishing timeliness and safety.

Real-Time Ethernet: Standards and PROFINET
After more than ten years of experience with applications of field bus in automation technology, the industry starts to develop and adopt Real-Time Ethernet (RTE) solutions. There already exists now more than ten proposed solutions. IEC standards are trying to give a guideline and selection criteria based on recognized indicators for the user. One of the RTE solutions is PROFINET proposed by the PROFIBUS International organization. PROFINET is already now available in different technologies like Component Based Automation (PROFINET CBA) and Input/Output (PROFINET IO) oriented structures. The different requirements of the automation applications are fulfilled with different existing protocols like DCOM, RPC, HTTPT etc. To reach the requirements of Real-Time also for Motion-Control applications new protocol and Ethernet-Switching technology had to be defined. This lecture gives a short overview of the proposed RTE standards and the PROFINET system architecture. Examples of PROFINET CBA are explained. The new Ethernet protocols for Real-Time (RT) and Isochronous Real-Time (IRT) developed for PROFINET are explained and as far as possible also demonstrated on industrial products.

Real-Time Safety-Critical Systems: Fundamental Concepts,
Design Principles, and Software Development
The objective of this lecture is to provide practical guidelines on software development and analysis techniques for control engineers engaged in designing software-intensive, real-time, safety-critical systems. Software is the critical component of all industrial, military, and commercial systems. For most of software intensive real-time applications in military, aerospace, aviation, nuclear and medical systems, safety and reliability are essential, thus related time criticality and determinism are of an equal importance. Real-time software interacts with the environment and must meet specific timing and safety criteria. The development of such systems requires skills and knowledge often exceeding the standards offered by colleges and universities in many computer science, computer engineering and control engineering programs. This full-day lecture will address selected practical aspects of real-time safety-critical software development. The lecture will be structured in a top-down manner and will include the following modules:

- basic real-time terminology and safety-critical concepts;
- designing software for safety;
- programming language issues related to timeliness and safety;
- real-time kernels and low-level programming, and
- selected issues of designing computer interconnects and data buses.

The individual topics include: development lifecycle, real-time and safety-critical architectures, real-time programming, task structuring, selection of appropriate operating system, elements of scheduling analysis, and analysis of computer buses. The lecture is designed to give the control and system engineers an additional perspective on the software component of a typical real-life system with timing constraints and safety implications. It will emphasize the lessons learned and pitfalls of real-time software development and will include views on the current state of practice in real-time safety-critical software based on instructors' experiences with developing software products for aviation, nuclear, and medical industries.

Quality of Service in Real-time Distributed Systems and Process Control Applications
This lecture is oriented on the problems of the implementation of industrial applications and more precisely process control applications (i.e. which have a closed loop structure) on distributed systems (computers connected through a communication network) which must be real time in order to guarantee the performances of these applications (stability in particular). The Quality of the service provided by the distributed system depends particularly on the exchanges of the messages between remote tasks (scheduling of the messages through the transmission resource , data transfer) and on the scheduling of the tasks in the computers. The design of such systems must be based on an integrated view which must operate at the distributed system level (Computer and Communication science view) and at the process control application level (Automatic control view). It is a multi-disciplinary work and the goal of this lecture is to show it. The following points will be emphasized (Mechanisms of real time local area networks (like FIP, CAN, ARINC 629 CP..) and Data transfer, Evaluation of the Quality of Service(QoS) using Petri-nets based models, Influence of this QoS on the stability of a closed loop Process Control application, Linking Process Control parameters to Network parameters.

3.2 ARTIST Summer School 2005 in Sweden

The ARTIST2 Summer School was held at Nässlingen, Sweden, September 29 - October 2, 2005, in conjunction with the 3rd International Conference on Formal Modelling and Analysis of Timed Systems (FORMATS'05). The Summer School offered a number of foundational tutorials accompanied by a selection of exiting new emerging technologies, all given by absolute leading scientific experts of the community.

It was targeted for young researchers working or wanting to work in the fields of modelling, validation and performance analysis of embedded systems as well as engineers from industry with practical background in design and testing of embedded systems.

The Summer School was organised with strong contributions from three of its research clusters: Modelling & Components, Testing & Verification and Compilers & Timing Analysis. The school was open for participation for any interested parties. However, some previous training and/or experience in fundamentals of computer science as well as knowledge of computer architecture were required.

The school attendance was full, with approximately 60 participants.

Scientific Programme

Thursday September 29

TUTORIAL: UML and UML 2.0,
Ileana Ober, IRIT Université Paul Sabatier, Toulouse, France.

UML for Real Time Systems,
Sebastien Gerard, CEA, Paris, France.

Verification of UML models,
Susanne Graf, VERIMAG, Grenoble, France

TUTORIAL: Language Engineering for Model-Driven Software Development,
Reiko Heckel, University of Leicester, UK.

Applications of model transformations
PA Muller, ESSAIM, Mulhouse univ. France.

Friday September 30

TUTORIAL: Modelling of Heterogeneous Systems in Metropolis,
Alberto Ferrari, PARADES, Rome, Italy

TUTORIAL: Components & Modelling with Priorities in IF,
Joseph Sifakis, VERIMAG, Grenoble, France

TUTORIAL: Controller Synthesis and Code Generation,
Jean-Francois Raskin, Universite Libre de Brussels, Belgium

Saturday October 1

TUTORIAL: Foundations of Static Analysis,
Hanne Riis Nielson, IMM, Technical University of Denmark

Static Analysis for Secure ES,
Flemming Nielson, IMM, Technical University of Denmark

Worst Case Execution Time Analysis,
Reinhard Wilhelm, Saarbrücken, Germany

TUTORIAL: Foundations of Testing,
Ed Brinksma, Twente University, The Netherlands

Test Generation using Model Checking,
Thierry Jeron, IRISA, Rennes, France

On-line Testing for Real-time Systems,
Brian Nielsen, Aalborg University, Denmark

Sunday October 2

TUTORIAL: Foundation for Timed Systems,
Patricia Bouyer, ENS Cachan, France

Real-time Model Checking using UPPAAL,
Gerd Behrmann, Aalborg University

Fault-Diagnosis for Real-time Systems,
Stavros Tripakis, Verimag, Grenoble, France

TUTORIAL: Foundations for Stochastic Systems,
Joost-Pieter Katoen, RWTH Aachen University, Germany

Applications of Stochastic Model Checking,
Holger Hermanns, Saarland University, Germany

PRISM a Tool for Stochastic Model Checking,
David Parker, University of Birmingham, England

3.3 ARTIST China School - Spring 2006 (International Collaboration)

This school is organized in Xian China, in collaboration with the United Nations University in Macau (UNU-IIST), following a visit by Joseph Sifakis. It is on Models, Methods and Tools for Embedded Systems.

Artist2 will pay for travel for 4 lecturers, and the Chinese co-organizer will cover living and school organization expenses. The lecturers are: Peter Marwedel, Joseph Sifakis, Lothar Thiele, and Wang Yi.

This is an event that is open in priority to Chinese students. We believe that this will open opportunities for collaboration with Chinese research teams.

http://www.artist-embedded.org/FP6/ARTIST2Events/Events/ChinaSchool/

Contents
The School offers a 2-week course consisting of four tutorials on state-of-the-art techniques for the design and analysis of embedded systems given by leading scientific experts.

Dates
The school will be held April 3rd-15th, 2006, in Xi'an, China.

Objective
We aim to provide a forum for young professors, lecturers, researchers, postgraduates (advanced master and PhD students) working in the fields of modelling, design, implementation, validation and performance analysis of embedded systems as well as engineers from industry with practical background with the development of embedded systems.

Targeted Audience
The school is open for participation for everybody, however, some previous training and/or experience in fundamentals of computer science as well as knowledge of computer architecture is required. Participants will be selected according to their CVs submitted to the organization committee.

Programme

Week 1: Design, Architectures and Implementation
Lothar Thiele and Peter Marwedel

Monday
8.30- 9.00 Opening
9.00-12.00 **Introduction to Embedded System Design** (Lothar Thiele)
13.30-16.30 **Architectures of Embedded Systems** (Lothar Thiele)
16.30-17.30 Student session/Discussion

Tuesday
9.00-12.00 **Software for Embedded Systems** (Lothar Thiele)
13.30-16.30 **Design Space Exploration of Embedded Systems** (Lothar Thiele)
16.30-17.30 Student session/Discussion

Wednesday
9.00-12.00 **Performance Analysis of Distributed Embedded Systems** (Lothar Thiele)
13.30-16.30 **Importance of Efficient Embedded Code, and Source to Source Transformations** (Peter Marwedel)
16.30-17.30 Student session/Discussion

Thursday
9.00-12.00 **Exploitation of the Memory Hierarchy** (Peter Marwedel)
13.30-16.30 **Compression, VLIW Optimizations and Address Optimizations** (Peter Marwedel)
16.30-17.30 Student session/Discussion

Friday

9.00-12.00 **Lexical Analysis & Tools and Instruction Selection & Scheduling** (Peter Marwedel)
13.30-16.30 **Register Allocation, Phase Coupling, and Retargetable Compilation** (Peter Marwedel)
16.30-17.30 Student session/Discussion

Week 2: Modelling, Validation and Verification
Joseph Sifakis and Wang Yi

Monday
8.30- 9.00 Opening
9.00-12.00 **Modelling of Real-Time Systems** (Joseph Sifakis)
13.30-14.30 **Duration Calculus** (Zhou Chaochen)
14.30-16.30 **Component-Based Construction: Interaction Models and Composition** (Joseph Sifakis)
16.30-17.30 Student session/Discussion

Tuesday
9.00-12.00 **Component-Based Construction: Scheduler Modelling and Composability** (Joseph Sifakis)
13.30-14.30 **The Duration Calculus and Model Checking** (Zhou Chaochen)
14.30-16.30 **Correctness by Construction: Timed Systems with Priorities** (Joseph Sifakis)
16.30-17.30 Student session/Discussion

Wednesday
9.00-12.00 **The IF toolset and the BIP framework** (Joseph Sifakis)
13.30-16.30 **Verification of Untimed Systems: Basic Algorithms** (Wang Yi)
16.30-17.30 Student session/Discussion

Thursday
9.00-12.00 **Semantics of Timed Systems: Timed Automata** (Wang Yi)
13.30-14.30 **A Component Model for Objects-Oriented Systems** (Liu Zhiming)
14.30-16.30 **Symbolic Verification of Timed Systems: Regions, Zones and DBM's** (Wang Yi)
16.30-17.30 Student session/Discussion

Friday
9.00-12.00 **The UPPAAL Model Checker** (Wang Yi)
13.30-14.30 **Verification of Real-Time Fault-Tolorant Systems** (Liu Zhiming)
13.30-16.30 **The TIMES tool: Models to Programs** (Wang Yi)
16.30-17.30 Student session/Discussion

3.4 ARTIST Summer School 2006

We will repeat the successful experience of the Artist2 2005 Summer School in Sweden, possibly in the same location and with the same organizers, or in Bertinoro. We will undoubtedly update the topics, but this is still under discussion.

4. Funding for Events and Interaction

4.1 Artist Workshops at DATE

In order to increase the awareness of other communities, ARTIST2 has organized a workshop held during DATE (http://www.artist-embedded.org/FP6/ARTIST2Events/PastEvents/Date05/), the largest conference on electronic design automation in Europe, and by the number of paper submissions, worldwide. The first workshop – initiated within Artist FP5 - provided a broad introduction to embedded and real-time systems to the DATE community. Due to the success of this workshop at DATE 2004, a second workshop was held on March 11th, 2005. The second workshop focussed on hard and soft real-time computing. The technology presented included the timing verification methodology used for Airbus software.

About 80 attendees were present at the workshop. The goal of the workshop was reached.

FRIDAY WORKSHOPS - Introduction General Chair: Bashir N. Al-Hashimi, Uni. of Southampton, UK *Fri* **Embedded Systems Design: An Emerging Unified Discipline** [W3]
Organisers: Albert Benveniste, INRIA, FR
Bruno Bouyssounouse, VERIMAG Laboratory, FR
Giorgio Buttazzo, Pavia U, IT
Peter Marwedel, Dortmund U, DE
Reinhard Wilhelm, Saarland U, DE

Description: The workshop's objectives are to strengthen the links between the ARTIST2 and the DATE communities, through a presentation by prominent members of selected topics which may be of interest. The ARTIST2 Network of Excellence on embedded systems software design aims to strengthen European research in Embedded Systems Design, and promote the emergence of this new multi-disciplinary area. To achieve this, ARTIST gathers together the best European teams from the composing disciplines, and aims to forge a scientific community. This interdisciplinary effort in research is mandatory to establish Embedded Systems Design as a discipline combining competencies from electrical engineering, computer science, electronic engineering, applied mathematics, and control theory. The ambition is to compete on the same level as equivalent centres in the USA (Berkeley, Stanford, MIT, Carnegie Mellon), for both the production and transfer of knowledge and competencies, and for the impact on industrial innovation. The workshop will present overviews of strategic challenges and work directions faced in selected topics within ARTIST, including work on Hard Real-Time systems, Testing and Verification, Timing Analysis, and System-on-Chip. In addition, the workshop will provide an opportunity for discussion around structuring the embedded systems research area in Europe.

Target Audience: Prominent members of the ARTIST2 NoE and DATE communities, wishing to know more about topics common to both, and to extend contacts and establish long-term links.

Program

Welcome and Introduction

Information Society Technologies in the 6th Framework Programme
IST Work Programme 2005-2006

Tom Clausen, European Commission

ARTIST2 NoE on Embedded Systems Software Design: Structuring the Research Area in Europe
Bruno Bouyssounouse, Verimag Laboratory, FR

Heterogeneous Systems Modelling and Design
Alberto Sangiovanni-Vincentelli, UC Berkeley, US

From Synchronous Designs to Delay-Insensitive Components
Benoit Caillaud, INRIA, FR

Modelling Real-Time Systems
Joseph Sifakis, Verimag Laboratory, FR

Using Rich Component Models in the Development of Automotive and Avionics Applications
Werner Damm, OFFIS, DE

Adaptive Task Scheduling
Giorgio Buttazzo, Pavia U, IT

Do Safely-Critical Systems Really Need to be Static?
Luis Almeida, Aveiro U, PT

Towards a System Modelling Platform
Jan Madsen, TU Denmark, DK

Timing Analysis of Hard Real-Time Systems
Reinhard Wilhelm, Saarland U, DE

Timing Analysis: New Directions After the Breakthrough
Andreas Ermedahl, Malardalen U, SE

4.2 Workshop on Embedded Systems Education 2005 (International Collaboration)

Main Artist2 Partner: Verimag
Contact: P. Caspi
Rough budget: 2000 Euros
Approximate dates: September 2005

It is widely recognized that the embedded system domain is a multidisciplinary one, requiring a large variety of skills from control and signal processing theory, electronics, computer engineering and science, telecommunication, etc., as well as application domain knowledge. This has motivated a recent but ever growing interest in the question of educating specialists in this domain and this has also been recognized as a particularly difficult problem. This first workshop on the subject aims to bring researchers, educators, and industrial representatives together to assess needs and share design, research, and education experiences in embedded systems.

Topics and Focus

Particular topics of interest include but are not limited to:

- Industrial needs regarding embedded systems education
- Embedded systems curricular design and implementation
- Control and signal processing issues
- Computer science issues
- Real-time computing issues
- Distributed systems issues
- Extra-functional properties evaluation and optimization
- Architecture and design issues
- Hardware/software co-design
- Hands-on experiences and labs
- Teaching embedded systems

Program Committee

- Moon Hae Kim (Konkuk University, Korea)
- Bruce Krogh (Carnegie-Mellon University, USA)
- Yann-Hang Lee (Arizona State University, USA)
- Giuseppe Lipari (Scuola Superiore S.Anna, Pisa, Italy)
- Gregory D. Peterson (University of Tennessee, USA)
- Kenneth Ricks (University of Alabama, USA)

Program

9:00 Opening

9:15 Invited Session

- **Alberto San Giovanni-Vincentelli**: *Embedded System Education: A New Paradigm for Engineering Schools?*

10:30 Curricula and Contents

- **Suehee Pak, Eunha Rho, Juno Chang and Moon Hae Kim:** *Demand-Driven Curriculum for Embedded System Software in Korea*
- **Masaki Yamamoto, Hiroyuki Tomiyama, Hiroaki Takada, Kiyoshi Agusa, Kenji Mase, Nobuo Kawaguchi, Shinya Honda and Nobuyuki Kaneko:** *NEXCESS: Nagoya University Extension Courses for Embedded Software Specialists*
- **Peter Marwedel:** *Towards laying common grounds for embedded system design education*
- **Jogesh K. Muppala: Experience with an Embedded Systems Software Course**

14:00 Invited session

- **Martin Grimheden and Martin Torngren:** *How should embedded systems be taught? Experiences and snapshots from Swedish higher engineering education*

14:45 Teaching Experiences

- **Bettina Weiss, Günther Gridling and Markus Proske:** *A Case Study in Efficient Microcontroller Education*

- **Voin Legourski, Christian Trödhandl and Bettina Weiss:** *A System for Automatic Testing of Embedded Software in Undergraduate Study Exercises*

16:00 Labs and Platforms

- **Stephen A. Edwards**: *Experiences Teaching an FPGA-based Embedded Systems Class*
- **Kenneth G. Ricks, David J. Jackson and William A. Stapleton:** *An Evaluation of the VME Architecture for Use in Embedded Systems Education*
- **Falk Salewski, Dirk Wilking and Stefan Kowalewski:** *Diverse Hardware Platforms in Embedded Systems Lab Courses: A Way to Teach The Differences*

17:30 Panel: *Embedded Systems Education: Future Directions, Initiatives, and Cooperation*

4.3 Workshop in Leiden on Distributed Embedded Systems

21 Nov 2005 through 24 Nov 2005

In the area of embedded systems, we are facing the following major changes:

- Embedded Systems are becoming more and more distributed and networked;
- They are comprised of many co-operating individual components.

Examples of such systems are networks of sensors and actuators, home and car networks, communication networks, distributed radio telescopes, personal health care networks, environmental monitoring networks, ubiquitous and pervasive computing networks, and more.

There are several fundamental problems that make the design of Distributed Embedded Systems and Software difficult:

- Handling non-functional and resource constraints,
- Design under conflicting dependability criteria,
- Trade-off between average performance and predictability.

To master these problems, it has been found that conventional computer science and engineering methods are at their limits. In fact, moving from traditional component-level design to multi-component distributed systems demands for a paradigm shift in both modelling and design methods. The workshop will address specific challenges in this emerging paradigm shift. They are

- Modular design strategies for distributed embedded systems (composable analysis methods; rich component concepts, design methodologies),
- Predictability and Efficiency (exploitation of the trade-off; approaches to predictability vs. efficiency from hardware platforms to software systems)
- Design Space Exploration and Application Scenarios (applications in automotive, sensor and actuator networks, mechatronics; multi-objective optimization and bio-inspired exploration methods)

To promote a convergent way of interaction, the first two days of the workshop will be devoted to talks and discussions, ordered according to the 4 topics given above. The remaining two days will have a true workshops format to actually going ahead dealing with performance analysis, focusing on benchmark problems, and classification and comparison of proposed and available methods.

In particular, a set of benchmark examples will be defined and existing methods such as real-time calculus, holistic methods, Symta/S, timed automata will be compared.

The workshop is supported by (a) the Lorentz Centre at Leiden University and (b) the honorary Pascal Chair of Leiden University and (c) the European Network of Excellence ARTIST2.

4.4 31st EUROMICRO CONFERENCE -Special session: Model Driven Engineering (MDE)

PORTO, Portugal, August 30st - September 3rd, 2005

Session Program Chair: Martin Törngren (KTH)

Session Programme Committee
Karl-Erik Arzen (Sweden), Jakob Axelsson (Sweden), Iain Bate (UK), Jan Broenink (Netherlands), Jim Cooling (UK), Jacky Estublier (France), Peter Fritzson (Sweden), Ulrich Freund (Germany), Sebastien Gerard (France), Chris Gill (USA), Wolfgang Halang (Germany), Hermann von Hasseln (Germany), Jean-Marc Jezequel (France), Bernhard Josko (Germany), Guiseppe Lipari (Italy), Dorina Petriu (USA), Pierre-Alain Muller (France), Ola Redell (Sweden), Joseph Sifakis (France), Francoise Simonot (France), Neraj Suri (Germany), Simin Nadjm Tehrani (Sweden), Michael Winokur (Israel), Wayne Wolf (USA, Wang Yi (Sweden)

Model driven engineering - or model based development as it is often called in traditional engineering disciplines - is an approach that promises to accelerate development, to improve systems quality, to reduce costs, and also to enable reuse. However, while the use of models and related computer aided engineering tools is very common in established engineering disciplines, MDE approaches are still rarely used in industry for the development of embedded systems. This is despite the realization that higher levels of abstraction are required to describe and analyze systems, large problems in systems integration, and despite numerous efforts in developing modelling languages, methods and tools. These deficiencies along with industrial needs have stimulated many research efforts to overcome the current situation.

Problems facing researchers and developers include the fact that the area of embedded systems is very large. It does not only cover many application domains and different requirements, but is also strongly characterized by multidisciplinarity, where each discipline has its own traditions, concepts, modelling languages and tools. Embedded systems are characterized by a multitude of relations and interactions between its constituent units and with the environment. Moreover, products including embedded systems typically have to be not only cost-efficient, but also dependable and flexible.

These facts to some extent explain the multitude of efforts in different directions, and the incompatibility between different modelling languages and tools. Other problems may be due to the nature of software, allowing unprecedented design flexibility and constituting an intermediate design representation that can be implemented in a variety of ways. Today, model based development is mainly used for developing subsystems and with little consideration or treatment of cross-cutting aspects such as dependability, real-time performance, and flexibility. On the other hand, taking a more optimistic view, learning from experiences made in more mature disciplines, and taking the strong industrial needs into account, there is plenty of room for innovative research efforts!

This session aims to gather researchers and engineers from different domains and disciplines, industry and academia, all focusing on different aspects of MDE, in order to stimulate cross-fertilization and thus further the development of successful model based development approaches for embedded systems.

4.5 Events within the Cluster: Modelling and Components

The Components and Modelling cluster has co-funded the following events, and

- FMCO 2004, Third International Symposium on Formal Methods for Components and Objects, November 2004, Leiden (http://fmco.liacs.nl/fmco04.html) no financial support from Artist
- organisation of SVERTS 04: International Workshop on Specification and Validation of UML models for Real Time and Embedded Systems , October, 2004 Lisbon, Portugal -- to be hold in conjunction with Seventh International Conference On UML, UML 2004, http://www-verimag.imag.fr/EVENTS/2004/SVERTS/
- organisation of MARTES 05: Workshop on Modelling and Analysis of Real-Time and Embedded Systems , Workshop held in conjunction with MoDELS/UML 2005, http://www.martes.org/
- A panel at ICCBSS 05 (http://www.iccbss.org/2005)
- A tutorial at ICSE 2005 (http://www.cs.wustl.edu/icse05/Tutorials/Tutorials.shtml#H2)
- A workshop on Software Engineering at Euromicro 2005 (http://www.idt.mdh.se/euromicro-2005)
- (J. Sifakis) Tutorial on Composition of Real-time Components, at International School on Model Driven architectures for Embedded Systems, Brest, France, September 2004.
- (J. Sifakis) Half day course on The IF toolbox, International School on Formal Methods for the Design of Real time Systems, Bertinoro, Italy, September 2004.
- (S. Graf, M. Bozga) Tutorial on the IF toolbox and validation of SDL and UML models, Int. conference SDLforum, Grimstaad, June 2005.

The artist Summer School is in Sept.-Oct. 2005, and is not considered for this reporting period.

4.6 Events within the Cluster: Execution Platforms

Prof. Ernst held a short key note at MpSoC (Relais Margeaux, France) highlighting recent advances in the optimization and sensitivity analysis of complex heterogeneous embedded systems based on fast formal analysis methods.

The working group of Prof. Ernst presented at Intel Academic Forum (IAF) 2005 (Gdansk, Poland) how formal performance models can be applied to the domain of communication processors. Also first approaches were presented integrating classical task level and system level analysis methods to tighten worst-case and best-case analysis bounds.

Presentation at Ford ESST Workshop: Real-Time Systems Modelling for Automotive Applications.

Prof. Ernst and his working group presented at several industrial workshops praxis relevant research results in the domain of analysis and optimization of complex embedded systems and their application to concrete industrial problems.

At Embedded World 2005 (Nuremberg, Germany) the application of the fast SymTA/S analysis engine for the early architecture exploration of heterogeneous embedded systems was demonstrated. At “Design und Elektronik Entwicklerforum: Kfz-Elektronik 2005” (Stuttgart, Germany) the benefit of using fast formal performance verification methods for the reliable integration of complex heterogeneous systems was outlined.

Marcel Verhoef of ESI presented joint work with ETH Zurich on the application of MPA to a car radio/navigation system at two events in the Netherlands with large industrial participation: the Second Boderc Symposium on 24 February 2005 and the Bits & Chips Embedded Conference on 21 April 2005.

Prof. Madsen held a short key note at MPSoC 2005 (Relais de Margaux, France) highlighting the need for cross-layer modelling and analysis, covering the application layer, middleware layer, and hardware layer. The system-level modelling framework called ARTS were presented, focusing on its capabilities to capture non-functional properties across layers when designing embedded systems targeted for heterogeneous multiprocessor platforms.

At the DATE 2005 Workshop on Embedded Systems research in Europe, Prof. Madsen presented the status and vision for developing a system modelling infrastructure. The presentation covered both formal and simulation based approached currently explored within the Execution Platforms cluster of ARTIST2.

The following descriptions are extracted from the activity descriptions, to provide a birds'-eye view of Artist2 Spreading Excellence within the individual clusters or activities.

4.7 Modelling and Components

4.7.1 Component Modelling and Composition

ARTIST2 teams of this cluster are involved in other national and international projects, where the issues addressed in this activity are central.

The modelling and components cluster is, together with two other clusters, organizing the ARTIST2 Summer school in 2005.

ARTIST2 members have organized several tutorials and workshops at conferences, including

- Tutorial "component-based approach embedded systems" presented at Automated Software Engineering (ASE) conference, Linz, Sept. 2007,
- Organisation of a panel "component-based development for embedded systems, held at Intl. conference for commercial components (ICCBSS, Bilbao, February 2005)

4.8 Adaptive Real Time

ARTIST2 is strongly represented in all the significant conferences and workshops in the area (including: EmSoft, EuroMicro, RTSS, DATE), through partners on their programme committees, steering committees, organization committees. ARTIST2 takes the measures and initiatives needed to promote a structured landscape of conferences, workshops and scientific events in the area.

ARTIST2 uses its influence on existing conferences, journals, and other scientific bodies to shape a coherent dynamic for dissemination and communication. This is possible because of the strong involvement its members in these bodies.

A very small sample ARTIST2's involvement includes:

- Giorgio Buttazzo is a member of the editorial of the “Journal of Embedded Computing”, by Cambridge International Science publishing, and a very active member of the RTSS community.
- Andy Wellings is the European editor in chief for the journal “Software Practice and Experience”.
- Alberto Sangiovanni-Vincentelli has organized the HSCC 2001 conference and a number of special issues for the IEEE Transactions. He will be working on a special issue for the IEEE Transaction on CAD on embedded system design. He is a member of the EmSoft steering committee, and a member of the governing board of SIGBED.
- Albert Benveniste is member of the editorial board of the Proceedings of the IEEE, IEEE Transactions of Automatic Control, and International Journal of Discrete Event Dynamical Systems, Theory and Applications. He will use these as vehicles for ARTIST2 dissemination.
- Joseph Sifakis is a member of the editorial board of the journal “Formal Methods” by Kluwer. He is a member of the EmSoft steering committee, and a member of the governing board of SIGBED.
- Reinhard Wilhelm is a member of the LTCES steering committee.

Furthermore,

- ARTIST2 researchers play a major role on: editorial boards of leading journals in the area, steering committees of scientific associations.
- ARTIST2 researchers publish widely in scientific journals, as well as media targeting a wider audience.

There is no event, journal, or other significant body in which ARTIST2 members do not play an important role.

4.9 Compilers&TA - Compilers

Members of the University of Dortmund and RWTH Aachen taught at ALARI in Lugano, Switzerland. Students at ALARI are going for a Master's degree in embedded system design. The program is organized in cooperation with industrial sponsors. The members also taught at EPFL, Lausanne. EPFL runs a continuing education program aiming at advanced PhD students and industrial participants. In both cases, research knowledge was transferred. P. Marwedel, head of the group at Dortmund, is also chair of the steering committee of the SCOPES workshop. SCOPES focuses on compilers for embedded systems. In 2005, the SCOPES workshop is being held in Dallas. In addition, an ARTIST workshop was held during DATE (Design, Automation and Test in Europe) 2005 in Munich. Furthermore, dissemination also includes the publication of the text book "embedded system design" by P. Marwedel. This book is being adopted by a growing number of Universities around the world and a cheaper paperback version will be published in 2005.

The group at Dortmund is also transferring research results via the local technology transfer centre ICD. ICD works on a contract basis for industrial customers.

Other new courses include:

- **COSY – Master "From Concepts to Systems" at University of Versailles**:
  new module for last year oriented to research, on component based development of embedded systems
  Main Artist2 Partner: CEA-List
  Contact: D. Servat
  Approximate dates: first trimester of 2005.
- **Seminar on UML modelling at ARTIST 2 Summer school, Sweden.**
  Main Artist2 Partner: CEA-List
  Contact: S. Gérard
  Approximate dates: September 28-30, 2005.
- **Seminar on UML modelling at ERT Summer school, Nancy.**
  Main Artist2 Partner: CEA-List
  Contact: S. Gérard
  Approximate dates: September 28-30, 2005.
- **Fifth International Workshop on WCET**
  Main Artist2 Partner: Saarland University (Workshop Chair)
  Contact: Reinhard Wilhelm
  Rough budget:
  Dates: July 5th, 2005

4.10 Cluster Integration - Real-time techniques in control system implementations

- A major event was the Valencia Graduate Course on Embedded Control Systems in April where the cluster members lectured and the course material was developed jointly. A report and evaluation of the course is available as an appendix to this activity report.
- RTC 2005, a workshop on real-time control and control of real-time computing systems was organized in association with ECRTS 05 at Majorca.
- An invited session on control over sensor networks and control of sensor network resources (co organized with RUNES) has been accepted for the IEEE Conf on Decision and Control and the European Control Conference, Sevilla, Dec 2005
- An invited session about the research in the cluster was organized at the IFAC World Congress, Prague, July 8.
- The IFAC Summer School on Control, Computing and Communication, Prague, June 27 – July 1 was co-organized by the cluster.
- A special session on Model Driven Engineering at Euromicro, Porto, August 30 – September 3 was organized by the cluster.
- A number of quality publications have been produced by the members of the cluster during the year. For example, Årzen and Cervin are co-authors of the RTSS 25 year anniversary article "Real-Time Scheduling: A Historical Perspective" (has appeared in the Real-Time Systems journal). Several of the cluster members are also authors of chapters in the recently published "Handbook of Networked and Embedded Control Systems" (Birkhäuser), with Årzén in the editorial board.
- The roadmap and the research agenda on Control for Embedded Systems are both open documents that will participate to the spreading of excellence.

4.11 Cluster Integration - Control in Real-time Computing

- Karl-Erik Årzén and Anders Robertsson were invited to participate as the only non-US participants at a workshop on the future of control of computing systems organized by NFS and held at IBM, May 3-4, 2005.
- RTC 2005, a workshop on real-time control and control of real-time computing systems was organized in association with ECRTS 05 at Majorca.
- An invited session on control over sensor networks and control of sensor network resources (co organized with RUNES) has been accepted for the IEEE Conf on Decision and Control and the European Control Conference, Sevilla, Dec 2005
- The roadmap and the Research Agenda on Control for Embedded Systems are both open documents that will participate to the spreading of excellence.
- An invited session about the research in the cluster was organized at the IFAC World Congress, Prague, July 8.

4.12 Cluster Integration - Design for Low Power

The partners involved in the project have been very active in publicly spreading the results and methods obtained as a result of the cooperation:

- Paul Popp from Linköping has given a talk on power-aware design at the CP&OR conference. In this way, a tight contact with the community working on advance optimisation technology has been established.
- Petru Eles and Luca Benini have given several invited talks on power-aware system-level design at several industrial and academic institutions, among which: STMicroelectronics, Freescale Semiconductors, Philips, University of South Wales, and others.
-

Furthermore, the involvement of the partners on several industrially sponsored projects on low power design further emphasizes the dissemination effort in this activity

4.13 Cluster Integration - Architecture-aware compilation

As the cooperation within the compiler cluster, based on common platforms, gives a lot of opportunities for exploring new avenues in compilers for embedded processors, it is expected that a number of joint publications will soon result, some of which are already in progress. Furthermore, there are common teaching activities. Members of the University of Dortmund, RWTH Aachen, and IMEC taught at ALARI in Lugano, Switzerland. Special arrangements were made with CoWare and ACE to provide group licenses for design software used during hands-on sessions. Students at ALARI are going for a Master's degree in embedded system design. The program is organized in cooperation with industrial sponsors. The members also taught at EPFL, Lausanne. EPFL runs a continuing education program aiming at advanced PhD students and industrial participants. In both cases, research knowledge was transferred. P. Marwedel, head of the group at Dortmund, is also chair of the steering committee of the SCOPES workshop. SCOPES focuses on compilers for embedded systems. In 2005, the SCOPES workshop is being held in Dallas. In addition, an ARTIST workshop was held during DATE (Design, Automation and Test in Europe) 2005 in Munich. Furthermore, dissemination also includes the publication of the text book "embedded system design" by P. Marwedel. This book is being adopted by a growing number of Universities around the world and a cheaper paperback version will be published in 2005. The group at Dortmund is also transferring research results via the local technology transfer centre ICD. ICD works on a contract basis for industrial customers. IMEC is organizing courses that train the participants in the most mature aspects of the Data Transfer and Storage Exploration techniques that are developed in research projects like ARTIST2. These courses are open to both industry and academia.

4.14 Cluster Integration – Communication-centric Systems

The results have been extensively published at leading international conferences, such as DATE, DAC, Codes-ISSS, RTAS, RTSS, ICCAD or ECRTS. The tools, e.g. SymTA/S, were installed in several universities inside and outside Europe, such as the University of Singapore, the University of Montreal, or the University of Notre Dame, IN. Several companies have evaluated or used some of the tools, such as Netmodule, ST, Bosch, Volkswagen, or Samsung. As a consequence of the positive feedback from industry, a spin-off, SymTAVision, has been launched at the TU Braunschweig that will help to spread the results in industry.

4.15 Cluster Integration - Communication-centric Systems

The partners are very active on dissemination of their results to other research teams as well as to the industry at conferences and industrial seminars. They also organized a very successful international workshop entitled Workshop on the link between formal and computational models (http://www.loria.fr/~cortier/workshop.html) with 70 participants and very prominent speakers around the world. This workshop should in the future take place regularly.

4.16 JPIA-Platform : Component Modelling and Verification

The members of the Artist team are involved in the organisation and in the programme committees of the leading workshops and conferences in the domain, and publish their work in the relevant conferences and journals.

Cluster members organize with other external partners the MARTES workshop held within the Models'2005 conference. This workshop concerns modelling and standardisation issues pursued in Artist as well as corresponding tool support; several presentations of will be given on both subjects.

ARTIST2 teams of this cluster are involved in other national and international projects, where the standardization issues are a key point. These projects include in general also industrial users, applying the developed technology on case studies. In the past this turned out to be an excellent vector for the transition of academic technology into industrial practise.

4.17 Development of UML for Real-time Embedded Systems

ARTIST2 teams of this cluster are involved in other national and international projects, where the standardization issue addressed in this activity is a key point.

Cluster members organize with other external partners the MARTES workshop held within the Models'2005 conference. The ongoing standardisation activities which are the concern of the cluster will be in the centre of this workshop with several presentations given on this subject.

CEA is chairing the OMG submitters team called ProMARTE (www.promarte.org) consisting of main industrials (Thales, Alcatel…), tool vendors (IBM, Artisan, I-Logix…) and academics to provide a common answer to the OMG new standard RFP for RT/E.

4.18 JPIA-Compilers Platform

As the cooperation within the compiler cluster, based on common platforms, gives a lot of opportunities for exploring new avenues in compilers for embedded processors, it is expected that a number of joint publications will soon result, some of which are already in progress. Furthermore, there are common teaching activities. Members of the University of Dortmund and RWTH Aachen taught at ALARI in Lugano, Switzerland. Special arrangements were made with CoWare and ACE to provide group licenses for design software used during hands-on sessions. Students at ALARI are going for a Master's degree in embedded system design. The program is organized in cooperation with industrial sponsors. The members also taught at EPFL, Lausanne. EPFL runs a continuing education program aiming at advanced PhD students and industrial participants. In both cases, research knowledge was transferred. P. Marwedel, head of the group at Dortmund, is also chair of the steering committee of the SCOPES workshop. SCOPES focuses on compilers for embedded systems. In 2005, the SCOPES workshop is being held in Dallas. In addition, an ARTIST workshop was held during DATE (Design, Automation and Test in Europe) 2005 in Munich. Furthermore, dissemination also includes the publication of the text book "embedded system design" by P. Marwedel. This book is being adopted by a growing number of Universities around the world and a cheaper paperback version will be published in 2005. The group at Dortmund is also transferring research results via the local technology transfer centre ICD. ICD works on a contract basis for industrial customers.

4.19 Adaptive Real-time, HRT and Control

The clusters have also contributed together to different Artist2 summer schools in different ways. The control cluster participated in the development of the material for the ARTIST seminar on adaptive real-time systems, with emphasis on real-time control systems organized by the Adaptive Real-time cluster and held at UPC, Barcelona, June 20-23. Juan Antonio de la Puente from UPM (Adaptive RT) was one of the lecturer at the Artist2 graduate course on embedded control systems organized by the control cluster and held in Valencia, April 5-8. Luis Almeida from Aveiro (Adaptive RT) was one of the lecturers at the IFAC summer school on control, computing and communication co-organized by the Artist2 control cluster and held in Prague, June 27 - July 1. In addition to these activities a planned joint graduate course between the adaptive rt cluster and the control cluster on real-time and control in Aveiro had to be postponed due to lack of funding.

4.20 JPRA-Cluster Integration –Diagnosis in Distributed Hard Real-Time Systems

Preliminary results on methods and architectural considerations for diagnosis have been presented to representatives of the European automotive industry and gained substantial interest.

Furthermore, numerous papers focussing on diagnosis have been published on renowned international conferences

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4.21 JPRA-NoE Integration: QoS Aware Components

One aim of this activity is to spread its results outside this project. The following main actions are being done and will be continued along this activity:

- **Participation in standards**: The participation of the partners of this activity in standard bodies is important. As mentioned above, some of the partners are involved in the OMG standardization efforts. There is also a participation in the MPEG working group of the ISO/IEC. In particular, there is participation on QoS-aware infrastructures in the standardization of an API for Multimedia Middleware (M3W).
- **Participation in research projects**: partners participate in a large number of research projects. The results of this integration activity are and will be further developed and will be disseminated to industrial partners, as part of national and European research projects.
- **Technical papers**: a traditional way of disseminating work will be the presentation of research results in technical meetings.

4.22 NoE Integration-- Resource-aware Design

The design techniques and methods that are currently investigated in this activity have a very high potential impact on numerous industrial and research areas.

Examples of impact of resource aware design can be drawn from many application domains:

In safety-critical embedded systems (e.g. Medical Instrumentation, Avionics), system cost can be greatly decreased without compromising safety. For instance, if a predictable hierarchical memory system is used (e.g. with software-controlled caches), it will be possible to efficiently analyze at design time the cost of memory access in a program. Tight bounds on worst-case execution time can therefore be derived, and over design caused by loose bounds can be avoided.

In cost-critical embedded systems (e.g. consumer electronics), resource awareness can be used to finely tune architecture to the application needs, removing extra hardware, which is not necessary to support execution. For instance, accurate design-time estimation of memory footprint can greatly reduce system cost because it allows deploying a memory system that tightly fits the application.

In power-critical embedded systems (e.g. mobile communication), complex tradeoffs between performance metrics (e.g. Quality of service in video and audio streaming) and power consumption must be carefully explored. Resource management can enable much more effective design time, configuration time and run time power management under performance constraint.

4.23 TV_PlatformForEmbedded

In the area of parallel and distributed model checking of embedded systems we are in close collaboration with other research teams in Europe (INRIA Rhone-Alpes, CWI, Technical University Munich and Aachen Technical University) attempting to gather the European research communities working in the area on cluster and/or grids.

The partners are all part of additional research networks outside Artist2, where the platform results are discussed and evaluated. Especially, there is a large world-wide research community working on (purely functional) model checking and run-time verification, which can benefit from the results on tool support for quantitative testing and verification. Clearly, this also holds for tool developing companies.

4.24 JPIA-Platform: A Common Infrastructure for Adaptive Real-time

The expertise built in the ART cluster using the common infrastructure for adaptive real-time systems will be used to spared excellence towards

Industry: contacts with industries will be established to show the results of the activity and illustrate the benefits of the novel kernel technologies. Industries more interested in these results are those involved in automotive, consumer electronics, telecommunications, and robot control.

Education: the real-time kernel infrastructure set up for this activity will be used to organize courses, workshops and summer schools, for teaching how to apply theory into practice and to concretely illustrate the effects of kernel policies on the behaviour of time sensitive applications.

4.25 Cluster Integration: Component Modelling and Composition

ARTIST2 teams of this cluster are involved in other national and international projects, where the issues addressed in this activity are central.

The modelling and components cluster is, together with two other clusters, organizing the ARTIST2 Summer school in 2005.

ARTIST2 members have organized several tutorials and workshops at conferences, including

- Tutorial “component-based approach embedded systems” presented at Automated Software Engineering (ASE) conference, Linz, Sept. 2007,
- Organisation of a panel “component-based development for embedded systems, held at Intl. conference for commercial components (ICCBSS, Bilbao, February 2005)

5. Contributions to Standards

The basic idea for standardisation is to enable open, interoperable systems and to provide means for assessing their quality. Clearly, standards are essential for the design, deployment, and integration of embedded systems. It is widely accepted that existing standards are insufficient to coherently cover the entire system lifecycle. Furthermore, current standards are insufficiently precise, or do not adequately take into account the state of the art;

The JPRA (Joint Programme of Research Activities) defined for ARTIST2 addresses issues that are essential for the definition and further development of standards, such as: “Modelling and Components”, “Verification and Testing”, “Quality of Service Management”, “Semantic Platforms for Design Flow”, “Real-Time Programming Languages”.

ARTIST2 will take the appropriate measures and incentives, to promote and extend industrial standards in the area of embedded systems design, in tight collaboration with core or affiliated industrial partners. Of course, the emergence of standards is a complex process involving many types of players, and is beyond the scope of an NoE. Nonetheless, we have been very active in carrying out the technical work in preparation of advances on standards, in tight collaboration with industry.

The measures and incentives used by the NoE are the following:

- We provide funding to the partners, for activities related to standards, as listed below.
- In the components cluster, we have an activity called “Development of UML for Real-time Embedded Systems”, which specifically addresses this point.
- In June 2005, we have organised a high level event, on “Component-based Systems”, in collaboration with the NSF and selected industrialists from Europe and the USA (see sections 2.2 and 2.3 of this deliverable).

Our activities cover a large number of standards as described below. Many of these activities were already started in a dispersed manner, before the start of the NoE. Through our actions, the NoE has federated the efforts per topic – by identifying key players and setting up meetings and events in which they can interact.

One top new priority for Year2 are the actions around the Autosar standard for automotive applications. We have already planned a workshop on the standard that will take place in Innsbruck, March 23rd - 25th.

This section contains the relevant standards, on which it is anticipated that ARTIST2’s activities will help to shape.

5.1 Ada Programming Language

ARTIST2 participant Alan Burns, from the University of York, is member of the “ISO Ada Standardisation body WG9”, and is chair of one of its subgroups (HRG - concerned with the use of Ada in high integrity applications). He is also a member of the Ada Rapporteur Group, which is responsible for maintaining and developing the Ada standard.

ARTIST2 participant Andy Wellings, from the University of York is a member of the Ada Technical Interpretation Committee, which is responsible for maintaining and developing the RTSJ.

Expected next major release date

Jan 2006

Technical area(s) which it addresses

Many, but includes flexible scheduling

Short description of the standard

An ISO standard for the Ada language

Technical gains

A number of new features have been added to the language to make it more expressive in terms of its real-time features.

Control of resource usage and dispatching has been enhanced.

The type model has been extended to increase support for software engineering in general.

Previous revisions/versions on which it is based

Ada 95

Name of the relevant standardisation body

ISO

Industrial domains impacted

High integrity domain

Industrial gains

Including into the standard of the Ravenscr profile for deterministic concurrency with a safety critical language

Name of the your team

WG9

Responsibilities in the standard definition

One of the 12 or so active members of ARG (a subcommittee of WG9 - which is itself an ISO committee).

Main other non-ARTIST participants in the standardisation process

Sorry too many to list, but IBM and AdaCore

5.2 POSIX, IEEE 1003, ISO/IEC 9945-1 - Portable Operating Systems Interface

http://standards.ieee.org/regauth/posix/

Michael Gonzalez Harbour is an Associate Professor in the Department of Electronics and Computers at the University of Cantabria. He works in software engineering for real- time systems. He is a co-author of "A Practitioner's Handbook on Real-Time Analysis". He has been involved in several projects using Ada to build real-time controllers for robots. Michael is an active member of the POSIX real-time working group. He is the Technical Editor of the IEEE POSIX.1d and IEEE POSIX.1j standards. He teaches a graduate-level course on Real-Time Posix at his University and at the Polytechnical University of Madrid, and has given talks and tutorials on this subject at different conferences and workshops.

POSIX is the international standardization of a Unix-like operating system application program interface, with the objective of portability of applications at the source code level. Although initially POSIX was developed for general-purpose computing systems, real-time extensions have been added that make it possible to implement operating systems that can support portability of applications with real-time requirements. Today, most commercial real-time operating systems provide support for the POSIX interfaces.

POSIX is currently developed by two organizations in cooperation: IEEE, a well-known professional association, and X/Open, an industrial consortium. ARTIST2 core partner University of Cantabria has been actively participating in the POSIX real-time Working Group of IEEE for the past 12 years, and is deeply involved in the maintenance of the approved standards, and the development of new extensions, in particular those that will make it possible to have more flexible scheduling policies available to applications.

The ARTIST2 NoE, and particularly the cluster “Adaptive Real-Time”, is a privileged forum for elaborating new extensions for flexible scheduling, adapting them to the needs of embedded real-time applications, and influencing operating system vendors to implement the new services.

An example of this, already organized by ARTIST2 partners, is the Advanced Real-Time Operating System Services workshop (ARTOSS), held in July 2003. ARTIST2 will organize similar events, and the conclusions from the discussions will be submitted by University of Cantabria to the POSIX Working Group.

We have been working on two parts of the standard:

IEEE Std 1003.13-2003. IEEE Standard for Information Technology—Standardized Application Environment Profile—POSIX Realtime and Embedded Application Support (AEP)

IEEE Std 1003.26-2003. IEEE Stf for Information Technology - Portable Operating System Interface (POSIX). Part 26: Device Control Application Program Interface (API) [C Language]

Expected next major release date (approx)

2008

Technical area(s) which it addresses

Real-time and embedded operating systems

Very succinct description of the standard itself

POSIX is the standardization of the UNIX operating system at the international level. It describes application program interfaces for the operating system services, with the aim of portability at the source code level. In addition to general-purpose services, it contains optional real-time services.

IEEE Std 1003.13-2003. Defines four profiles (subsets) of the base standard that are appropriate to specific real-time and embedded application environments. The profiles are for small embedded systems, industrial controllers, large embedded systems, and general-purpose computers with real-time requirements.

IEEE Std 1003.26 is an extension to the base standard defining an API for managing and controlling device drivers from the application.

Technical gains

Portability of applications at the source code level
Programming model shared across platforms of different sizes
Portability of programmers because of using the same programming model.

Previous revisions/versions on which it is based

IEEE Std 1003.1-2001
IEEE Std 1003.13-1998

Name of the relevant standardisation body

IEEE, ISO/IEC

Main leader or contact person within this standardisation body, and his/her role

Joseph Gwinn (Raytheon), Chair of the POSIX System Services working Group.

Industrial domains impacted

Real-time and embedded operating systems vendors and users.

Industrial gains

Portability of applications gives technological advantages of being able to support the same product for multiple platforms, and evolve to new software and hardware platforms very easily.

Name of the your team

Universidad de Cantabria

Your and/or your team's roles and responsibilities in the standard definition

Member of the POSIX Real-Time System Services Working Group
Technical editor of the IEEE 1003.13 Std
Technical editor of the IEEE 1003.26 Std
Technical editor of the IEEE 1003.1j Std
Technical editor of the IEEE 1003.1d Std

Main other ARTIST participants in the standardisation process

Indirect contributions of the partners of the Adaptive Real-Time Action through the group of the University of Cantabria

Main other ARTIST participants in the standardisation process

Very large number of participants (see the list in the actual standards)

5.3 Standards of the Object Management Group (OMG)

The OMG (Object Management Group - http://www.omg.org/) is an international consortium, which drives the development of several standards, such as: MDA (Model Driven Architectures), UML (Unified Modelling Language), CORBA (Common Object Request Broker Architecture), and middleware infrastructures.

It is well recognized that all these standards, despite their popularity and the existence of supporting tools and technology, suffer from a lack of precision, and are used in a fragmented manner, with weak coverage of the lifecycle.

ARTIST2 core and affiliated partners from the "Modelling and Components" cluster (CEA, INRIA, Thales, ABB, ARTiSAN, DaimlerChrysler, KU Leuven) but also from other clusters (OFFIS, UPM, Aachen Univ., Bologna Univ., York Univ., Ericsson, Nokia...) are active members of the OMG. Moreover, CEA, INRIA and Thalès already carry out related work with standardisation objectives in the CARROLL common research program.

In this context, the ARTIST activity on "Development of UML for Real-time Embedded Systems" (JPRA-Cluster Integration) provide very sound inputs for the definition of this UML standard for DRES (Distributed Realtime Embedded Systems). This job is expected to be one of the most active topics in the RTESS PTF for the 4 - 5 coming years. The existing UML profiles, such as SPT and QoS, are only the first steps towards a larger profile that will completely encompass embedded systems development.

We believe that an important priority for ARTIST2 should be supporting the development of these standards, to match equivalent efforts for this in the USA. Recently, DARPA and MITRE in the USA have launched special OMG groups such as a group on Model Integrated Computing. They have also taken measures for the adoption of new standards and the adaptation of existing standards to fit the requirements of US industry.

5.3.1 MOF 2.0 QVT (Query / Views / Transformations)(OMG standard)

Didier Vojtisek is research engineer at Inria. He is mainly involved in the development of the compiler and samples of transformations.

Expected next major release date (approx)

A release is expected for mid - September

Technical area(s) which it addresses

Modelling and Components

Short description of the standard

This standard addresses a technology neutral part of MOF and pertains to: Queries on models, Views on metamodels and Transformations of models.
It aims to define a language with an unambiguous semantic to express those queries, views and transformations on models.

Technical gains

This standard will ease writing of the transformations that are needed in order to implement MDD (Model Driven Development), MDE (Model Driven Engineering) or MDA (Model Driven Architecture) approaches.

Previous revisions/versions on which it is based
n/a

Name of the relevant standardisation body
OMG (Object Management Group)

Main leader or contact person within this standardisation body, and his/her role

Mariano Belaunde (France Telecom): chairman for the QVT workgroup.

Industrial domains impacted
All the domains that use a MDD, MDE, MDA approaches should benefit from using a standard language to express their transformations.

Industrial gains

It brings interoperability between the various implementation of transformations and Tool-independence. Thus, the industry will be able to capitalize on reusable transformations.

Name of the contact in your team

Didier Vojtisek

Responsibilities in the standard definition

Our team was involved from the beginning of the process and we were coauthor of one the first submission. Since then, we actively follow this standard in order to produce the final submission.

We also provided various collaboration tools in order to help the standardisation process.

Main other ARTIST participants in the standardisation process

THALES: writer of some part of the initial submission

TNI-Valiosys: writer of some part of the initial submission

Main other non-ARTIST participants in the standardisation process

France Telecom, writer of some part of the initial submission and currently leader for the final revised submission

Many other participants in this submission that are still more or less active in the process now. DSTC, International Business Machines, Compuware Corporation, Sun Microsystems, Codagen Technologies Corporation, Softeam, TCS, Kennedy Carter, Interactive Objects Software, Alcatel

5.3.2 UML Profile for Schedulability, Performance, and Time Specification V1.0

http://www.omg.org/docs/ptc/02-03-02.pdf

Juan Antonio de la Puente is a full professor at the Technical University of Madrid (UPM). He has been teaching Ada and Real-Time systems for more than 15 years.

Expected next major release date (approx)

This standard is finished

Technical area(s) which it addresses

Adaptive Real-Time

Modelling and Components

Hard Real-Time

Short description of the standard

UML extensions for the description of real-time properties in UML architectures and application of real-time analysis approaches

Technical gains

This standard includes notations for the temporal characterization of UML models. These extension are integrated with real-time analysis solutions such as Rate Monotonic Analysis.

Previous revisions/versions on which it is based

OMG Standard March 2005 (standard ended), Final adopted submission October 2003.

Name of the relevant standardization body

OMG (Object Management Group)

Main leader or contact person within this standardisation body, and his/her role

Alan Moore

Industrial domains impacted

UML Modelling tools vendors, and specially the real-time oriented modelling tools

Model-based real-time software development in general.

Industrial gains

This standard provides solutions to integrate real-time concepts in UML models. It includes notations to standardize the application of real-time technologies in UML. Several tool vendors provide support of this UML profile.

standard 3 looks for solutions to allows the interchange of model-driven based assets in different modelling tools, and make interoperable different modelling tools in the development of model-driven applications.

Name of the your team

Technical University of Madrid

Responsibilities in the standard definition

Review

Main other ARTIST participants in the standardisation process

CEA

Main other non-ARTIST participants in the standardisation process

Submitters: ARTiSAN Software, I-Logix, Ind., Rational Software Corp., Telelogic AB, TimeSys Corporation, Tri-Pacific Software

5.3.3 MDA component: Packaging the MDA artefacts.

Juan Antonio de la Puente is a full professor at the Technical University of Madrid (UPM). He has been teaching Ada and Real-Time systems for more than 15 years.

There is not version available yet.

Expected next major release date (approx)

Not yet set.

Technical area(s) which it addresses

Modelling and Components

Short description of the standard

Solutions for the deployment of assets that support the model driven development of software applications.

Technical gains

This is a draft of standard proposal that look for solutions to define a deployment facilities, which integrates artefacts that support general solutions of a model driven development problem, in a single asset.

Name of the relevant standardisation body

OMG (Object Management Group)

Main leader or contact person within this standardisation body, and his/her role

Philippe Desfray

Industrial domains impacted

Model-driven development tool vendors and software developers that apply model-driven technologies

Industrial gains

This standard looks for solutions to allows the interchange of model-driven based assets in different modelling tools, and make interoperable

different modelling tools in the development of model-driven applications.

Name of the your team

Technical University of Madrid

Responsibilities in the standard definition

Submitters

Main other ARTIST participants in the standardisation process

Thales submitters

5.3.4 UML Profile for Modelling Quality of Service and Fault Tolerance Characteristics and Mechanisms V1.0

Juan Antonio de la Puente is a full professor at the Technical University of Madrid (UPM). He has been teaching Ada and Real-Time systems for more than 15 years.

Expected next major release date (approx)

1 July 2005

Technical area(s) which it addresses

Adaptive Real-Time

Modelling and Components

Short description of the standard

UML extensions for the description and analysis of Quality of Service properties in software architectures and specially the safety analysis and the application of fault tolerance solutions.

Technical gains

This standard proposes UML extensions for the description of extra-functional properties associates to services in general. UML do no includes notations for the description of quality properties of software in general, these properties have been included traditionally as informal description. These extensions propose solutions for the description of these concepts and integrates the notation with the general description of UML. It includes some solutions for the description of Risk assessment analysis and for the description of fault tolerant based software solutions.

Previous revisions/versions on which it is based

Draft of Adopted submission: June 2004, Final adopted submission September 2004.

Name of the relevant standardisation body

OMG (Object Management Group)

Main leader or contact person within this standardisation body, and his/her role

Miguel A. de Miguel

Industrial domains impacted

UML Modelling tools vendors, and specially the real-time oriented modelling tools

Model-based real-time software development in general.

Industrial gains

This standard provides solutions to integrate QoS and fault-tolerance concepts in UML models. They are notations to standardize the application of these technologies in UML. Tool vendors provide support of this UML profile.

Name of the your team

Technical University of Madrid

Responsibilities in the standard definition

Chairs of this standard. Definition of QoS extensions. Redaction of standard proposal.

Main other ARTIST participants in the standardisation process

CEA, Thales: Submitters

Main other non-ARTIST participants in the standardisation process

Submitters: IBM, Ilogix-Inc., Open-IT, ARTISAN, Lockheed Martin, SINTEF, Softeam

5.4 ISO/IEC TR 18037 - Programming Languages - C - Extensions to support embedded processors

Rainer Leupers (Aachen)

Expected next major release date

2005-12

Short description of the standard (max 5 lines)

Extensions to the programming language C to offer support for the performance improving features of embedded processors, such as fixed point arithmetic, memory spaces and low-level I/O.

Technical gains

The specifications are a 'natural' extension of the C language to support features that used to be available only by assembly programming. The specification is precise enough to be used as a blueprint for future development of embedded hardware and software systems.

Previous revisions/versions on which it is based

None.

Name of the relevant standardisation body

ISO/IEC JTC1 SC22 WG14.

Main leader or contact person within this standardisation body, and his/her role

Willem Wakker, ACE, project editor.

Industrial domains impacted

Embedded software systems

Industrial gains

The use of the specification allows the development and implementation of complex embedded software systems and algorithms in a portable, processor independent fashion.

Name of the your team

As per 7.

Responsibilities in the standard definition

Preparation of (a large part of) the specification, reaching consensus amongst the international C working group, editing of the specification.

Cite the main other ARTIST participants in the standardisation process, and their roles, responsibilities

None.

Main other non-ARTIST participants in the standardisation process

Cooperation within an international working group.

5.5 ETHERNET Powerlink, current version - 2 (EPL v2)

University of Aveiro

Expected next major release date (approx)

Unknown

Technical area(s) which it addresses

Both adaptive and hard real-time systems

Short description of the standard

Provision of real-time communication services on top of Ethernet COTS with low latency and jitter.

Technical gains

Increased throughput exploring parallel switching paths while maintaining low latency and jitter.

Increased integrity by improved detection and isolation of timing faults.

Handling of dynamic communication requirements.

Seamless integration of EPL and non-EPL nodes in the same segment.

Previous revisions/versions on which it is based

Based on EPL v2

Name of the relevant standardisation body

EPSG - ETHERNET Powerlink Standardization Group

Main leader or contact person within this standardisation body, and his/her role

Andreas Pfeiffer (B&R Industrie-Elektronik GmbH), member of the EPSG board of directors

Industrial domains impacted

Industrial automation, large distributed embedded systems

Industrial gains

Higher capacity of the network

Higher integrity of the system

Lower device count

Name of the your team

Univ. Aveiro

Responsibilities in the standard definition

We are ordinary members of EPSG since mid 2004 and have had a rather passive participation until now. At this point we are starting to participate actively towards a new EPL version.

Main other non-ARTIST participants in the standardisation process

These are the members of the Board of Directors and also represent the institutions/companies that are more active in the standard.

Dr. Edwin Kiel (Lenze Drive Systems GmbH), chairman

Prof. Thomas Müller (Zürcher Hochschule Winterthur)

Andreas Dreher (Hirschmann Automation and Control GmbH)

Prof. Dr. Konrad Etschberger (FH Ravensburg-Weingarten)

Andreas Pfeiffer (B&R Industrie-Elektronik GmbH)

However, the EPSG has now 72 members and users.

5.6 Executable UML Foundation

Didier Vojtisek

Expected next major release date (approx)

The standard should be available for late 2006

Technical area(s) which it addresses
I mainly addresses the "Modelling and Components" cluster and probably will also be useful in "Testing and Verification" and "Execution Platforms" clusters.

Short description of the standard

The objective of this standard is to enable a chain of tools that support the construction, verification, translation, and execution of computationally complete executable models. For the tool chain to link together, the interchanged models must conform to the same meta-model and semantics.

This standard will define a computationally complete and compact subset of UML 2.0 to be known as "Executable UML Foundation"

Technical gains

By pointing out all the variation points that are in UML2.0, this standard will help specifying and testing models at the various phases of a development process

Previous revisions/versions on which it is based

N/A

Name of the relevant standardisation body

OMG (Object Management Group)

Main leader or contact person within this standardisation body, and his/her role

no main leader defined yet for this workgroup

Industrial domains impacted

Industrial domains that use executable models that are expressed or that can be translated into this new Executable UML standard will benefit from it.

In particular the domains that already use UML2.0 to specify their models.

Industrial gains

This standard will enable the collaboration between tools that usually cannot communicate with each other. The end user will be able to build a complete model driven engineering process.

Name of the your team

Didier Vojtisek

Responsibilities in the standard definition

Our team will collaborate to define the standard and implement a prototype.

Main other ARTIST participants in the standardisation process

CEA is one of the main participant who have insisted to define this standard

Thales

Main other non-ARTIST participants in the standardisation process

As this is the very early phases of the standard (no submission yet) we can only cite the participants we are aware of:

Alcatel, CARE Technologies S.A./SOSY Inc., Data Access, France Telecom, I-Logix, Kennedy Carter, Lockheed Martin, Mentor Graphics Corporation, Pathfinder Solutions, Softeam, Telelogic AB

5.7 AUTOSAR Timing Model

Technical Areas

Formal performance verification of complex heterogeneous embedded systems in the automotive domain

Description

Creation of a unified global timing model for the open standard for automotive E/E architectures.

Technical Gains

- Easy and reliable integration of functional components from multiple suppliers
- Fast verification of timing requirements of the overall heterogeneous system
- Early architecture exploration

Previous Revisions / Versions

N.A.

standardisation body

N.A.

Artist Teams

Prof. Ernst (IDA, University Braunschweig)
Role: SymTAVision, an associate partner of IDA, participated in behalf of Ford in the development of the AUTOSAR Timing model. Main contribution was the application of the expertise in system-level timing analysis of Prof. Ernst's working group for the systematic integration of highly specialized requirements to the timing model on different levels of abstraction into the resulting global timing model.

Non-Artist Teams

N.A.

5.8 Embedded-C

ARTIST2 affiliated partner ACE, represented by Willem Wakker on the ISO C standardisation committee WG14, has been a contributor to the new Embedded-C standard. In providing the opportunity for significant performance improvements for embedded/DSP applications and architectures, European initiated innovation is gaining industry-wide acceptance. A predecessor, DSP-C, is currently used by numerous teams including those at ST and Aachen.

5.9 Matlab-Simulink and Synchronous Languages

Matlab-Simulink has established itself as the de-facto standard for highly engineering-oriented embedded systems industries, such as automobile and aeronautics. Matlab provides high quality support for domain specific and control engineering as well as scientific engineering in general and visualization. Simulink itself, with its add-on Stateflow, provides an integrated description and simulation environment for hybrid systems, both dataflow and state based.

ARTIST2 partners are the founders of synchronous languages, such as Esterel, Lustre, and Signal, which are widely used in the aeronautics/avionics industries. These languages are semantically close to Matlab/Simulink. ARTIST2 partners have developed a semantic framework for graphical notations such as those found in Simulink/Stateflow, and have improved on code generation, formal validation, and architecture generation for Matlab/Simulink.

ARTIST2 research activities – and specifically through the "Hard Real-Time" cluster - will aim to develop results for distributed architecture generation, from Matlab/Simulink specifications. While not contributing directly to a "standard" in the usual sense, this work could provide the basis for improving the existing technology, or even for developing an independent European technology to replace Matlab/Simulink.

6. Staff Mobility

The strongest form of direct collaboration is through visits between core and affiliated participants.

6.1 Mobility Involving Affiliated Participants

This is perhaps the most significant type of mobility for Artist2, since it clearly shows deep involvement in the NoE's technical activities by the affiliated partners. The impact in terms of Spreading Excellence via these affiliated partners is huge.

Please note that this list is not necessarily complete, nor are they necessarily financed directly by Artist2 (especially those serving to set up new project proposals).

Who:	Pau Marti, University of Catalonia (Aff. Malardalen)
Role in the meeting:	Contribution on control methods for real-time systems
Cluster & Activity:	ART – JPIA Platforms: A common infrastructure for adaptive real-time systems
Meeting title:	A common infrastructure for adaptive real-time systems
Location:	SANA Lisboa Park Hotel, Lisbon, Portugal
Date:	December 7, 2004

Who:	Giuseppe Lipari, Scuola Superiore S. Anna (Aff. Pavia)
Role in the meeting:	Contribution on kernel maintenance and tools
Cluster & Activity:	ART – JPIA Platforms: A common infrastructure for adaptive real-time systems
Meeting title:	A common infrastructure for adaptive real-time systems
Location:	SANA Lisboa Park Hotel, Lisbon, Portugal
Date:	December 7, 2004

Who:	Lucia Lo Bello, Univeristy of Catania (Aff. Pavia)
Role in the meeting:	Contribution on networks and distributed real-time systems
Cluster & Activity:	ART – JPIA Platforms: A common infrastructure for adaptive real-time systems
Meeting title:	A common infrastructure for adaptive real-time systems
Location:	SANA Lisboa Park Hotel, Lisbon, Portugal
Date:	December 7, 2004

Who:	All ART affiliates
Role in the meeting:	Learning about the Shark kernel
Cluster & Activity:	ART – JPIA Platforms: A common infrastructure for adaptive real-time systems
Meeting title:	First Shark Workshop
Location:	Scuola Superiore S. Anna, Pontedera, Pisa, Italy

Date:	Feb. 28, 2005 - March 4, 2005

Who:	Guillem Bernat, Rapita
Role in the meeting:	Contribution on execution time analysis tools
Cluster & Activity:	ART – JPRA Cluster: Flexible Scheduling Technologies
Meeting title:	Preparation for the FRESCOR Proposal
Location:	Palma de Mallorca, Spain
Date:	July 5, 2005

Who:	Thorbjorn Jemander (ENEA Epact)
Role in the meeting:	Contribution on operating systems
Cluster & Activity:	ART – JPRA Cluster: Flexible Scheduling Technologies
Meeting title:	Preparation for the FRESCOR Proposal
Location:	Palma de Mallorca, Spain
Date:	July 5, 2005

Who:	Johan Eker (Ericsson)
Role in the meeting:	Contribution on Consumer Electronics applications
Cluster & Activity:	ART – JPRA Cluster: Flexible Scheduling Technologies
Meeting title:	Preparation for the FRESCOR Proposal
Location:	Palma de Mallorca, Spain
Date:	July 5, 2005

Who:	Liesbeth Steffens (Philips Research)
Role in the meeting:	Contribution on Consumer Electronics applications
Cluster & Activity:	ART – JPRA Cluster: Adaptive Resource Management for Consumer Electronics
Meeting title:	Adaptive resource management for consumer electronics
Location:	Palma de Mallorca, Spain
Date:	July 8, 2005

Who:	Johan Eker (Ericsson)
Role in the meeting:	Contribution on Consumer Electronics applications
Cluster & Activity:	ART – JPRA Cluster: Adaptive Resource Management for Consumer Electronics
Meeting title:	Adaptive resource management for consumer electronics
Location:	Palma de Mallorca, Spain
Date:	July 8, 2005

Who:	Peter van der Stok (Philips Research)

Role in the meeting:	Contribution on Consumer Electronics applications
Cluster & Activity:	ART – JPRA Cluster: Adaptive Resource Management for Consumer Electronics
Meeting title:	Research issues in adaptive resource management for consumer electronics
Location:	Philips Research Eindhoven
Date:	August 17, 2005

Who:	Jose Luis Lorente
Who was visited:	Giuseppe Lipari, PISA
Date, duration:	1-jun-2005 to 31-12-2005
Purpose:	Work in flexible scheduling techniques for real-time systems. Develop real-time schedulability analysis methods based on response time analysis

Who traveled:	Jose Luis Lorente
Who was visited:	Giuseppe Lipari, PISA
Date, duration:	one week
Purpose:	Seminar on the use of the Shark operating system

Who:	Prof Lui Sha, University of Illinois
Role in the meeting:	Researcher
Cluster & Activity:	Cluster: Control for Embedded Systems, Activities: Control in real-time computing and Real-time techniques in control system implementation
Meeting title:	International Meeting on Control for Embedded System
Where, when:	Lund, 13-16 June 2005

Who:	Prof Tarek Abdelzaher, University of Virginia
Role in the meeting:	Researcher
Cluster:	Control for Embedded Systems,
Activities:	Control in real-time computing and Real-time techniques in control system implementation
Meeting title:	International Meeting on Control for Embedded System
Where, when:	Lund, 13-16 June 2005

Who:	Prof Bo Bernhardsson, Expert, Ericsson Mobile Platforms
Role in the meeting:	Industrial and academic participant
Cluster & Activity:	Cluster: Control for Embedded Systems, Activities: Control in real-time computing and Real-time techniques in control system implementation
Meeting title:	International Meeting on Control for Embedded System
Where, when:	Lund, 13-16 June 2005

Who:	Dr Johan Eker, Expert, Ericsson Mobile Platforms
Role in the meeting:	Industrial researcher

Cluster & Activity:	Cluster: Control for Embedded Systems, Activities: Control in real-time computing and Real-time techniques in control system implementation
Meeting title:	International Meeting on Control for Embedded System
Where, when:	Lund, 13-16 June 2005
Who:	Mikael Petersson, Developer, ABB Automation Systems
Role in the meeting:	Industrial developer
Cluster:	Control for Embedded Systems
Activities:	Control in real-time computing and Real-time techniques in control system implementation
Meeting title:	International Meeting on Control for Embedded System
Where, when:	Lund, 13-16 June 2005
Who:	López Tarazón; Rafael; Robotnik; Valencia (Spain) Alonso de Dompablo;Pablo; REDHADA SL; Valladolid; SPAIN; Sabalza; Xabier; IDEKO S.Coop.; Elgoibar; Spain; Gonzalvo; Noemi; Sony; Barcelona; SPAIN; Lopes; Daniel; Esterel technologies; Villeneuve Loubet; France; Zamorano, Bruno; INASMET (TECNALIA); San Sebastián; SPAIN Arjonilla Garrote, Agustin; TCP Sistemas e Ingenieria, S.L.; Madrid; Spain Garcia Martin, Manuel; TCP Sistemas e Ingenierias.L.; Madrid; Spain Morera, David; European Software Institute;Zamudio;Spain Ruiz de Olano, Alberto; Ikerlan; Arrasate-Mondragon; Spain Quesada Morales, Mariano;AIDO (Instituto Tecnológico); Valencia; España
Role in the meeting:	Industrial course participant – not affiliated to Artist2
Cluster:	Control for Embedded Systems
Activities:	Real-time techniques in control system implementation
Meeting title:	Graduate week in Valencia
Where, when:	Valencia, 4-8 April 2005

Who traveled:	F. Maraninchi (Professor), P.Caspi (Researcher) Verimag
Who was visited:	J. Romberg (Assistant) Technical University München
Date, duration:	January 2005, one day
Purpose:	Give seminars, investigate the possibility of joint European Strep proposal on merging ET and TT.
Who traveled:	L. Almeida (Professor) U. of Aveiro
Who was visited:	P. Caspi (Researcher) Verimag
Date, duration:	October 2005, one day
Purpose:	Thesis committee, discussions on the joint Strep proposal Democrites on merging ET and TT.
Who traveled:	R. Wilhelm, Prof. Dr.
Who was visited:	Verimag, Grenoble
Date, duration:	July 2005

Purpose:	Verimag Review
Who traveled:	R. Wilhelm
Who was visited:	Lothar Thiele, ETH Zürich
Date, duration:	several times
Purpose:	work on Design for Predictability
Who traveled:	R. Wilhelm
Who was visited:	Kim Larsen, Aalborg
Date, duration:	2004
Purpose:	Tutorial
Who traveled:	R. Wilhelm
Who was visited:	Bengt Jonsson, Uppsaala
Date, duration:	2004
Who traveled:	Oleg Parshin
Who was visited:	Luca Benini, Bologna
Date, duration:	2005
Purpose:	cooperation on Predictability
Who traveled:	Andreas Ermedahl, Dr., Ola Eriksson, Mr. (M.Sc. student), Yina Zhang, Ms. (M.Sc. student)
Who was visited:	R. Wilhelm (Univ. Saarbrücken), C. Ferdinand (AbsInt – affiliated)
Date, duration:	February 2005, duration two days Purpose: course to learn the aiT tool
Who travelled:	Marwedel, Prof. Dr; Pyka, PhD student; Verma, PhD student; Wagner, PhD student
Who was visited:	Leupers, Prof. Dr.
Date, duration:	Sept. 20th, 2005; 1 day
Purpose:	Setting up the cluster
Who travelled:	Marwedel, Prof. Dr.
Who was visited:	Meeting at DATE 05
Date, duration:	March 9th, 2005, 1 day
Purpose:	Synchronization
Who travelled:	Falk, Dr.; Lokuciejewski, master student
Who was visited:	AbsInt, Saarbrücken
Date, duration:	March 18th, 2005; 1 day
Purpose:	Interfacing tools from Saarbrücken and Dortmund
Who travelled:	Name, titles: Pyka, PhD student; Verma, PhD student
Who was visited:	Name, titles: Benini, Prof., PhD

Date, duration:	July 27th-29th, 2005
Purpose:	Interfacing tools from Bologna and Dortmund
Who travelled:	Marwedel, Prof. Dr.
Who was visited:	SCOPES workshop
Date, duration:	Sept 29th-Oct 1st, 2005; 3 days
Purpose:	representation at sponsored workshop
Who travelled:	Name, titles: Schwenk, PhD student
Who was visited:	Name, titles: Catthoor (IMEC), Prof. Dr.
Date, duration:	Aug. 30th-Sept. 17th, 2004; April 11th-15th, 2005
Purpose:	exchange of ideas and tools
Who traveled:	Paul Pop,Dr. Linkoping; Traian Pop, PhD student Linkoping
Who was visited:	Rolf Ernst, Prof.
Date, duration:	2004, October, one month
Purpose:	project work
Who traveled:	Alexandru Andrei, PhD student Linkoping
Who was visited:	Luca Benini, Prof.
Date, duration:	2005, April, one month
Purpose:	project work
Who traveled:	Paulo Pedreiras, Prof; Ricardo Marau, PhD student
Who was visited:	SSSUP, Giuseppe Lipari, Prof
Date, duration:	March 2005, 6 days
Purpose:	participation in the SHaRK workshop.
Who traveled:	Luis Almeida, Prof
Who was visited:	Univ Pavia, Giorgio Buttazzo, Prof
Date, duration:	May 2005, 4 days
Purpose:	preparation of a project on a real-time mobile infrastructure for multiple robotic units, lecture of a course on real-time networks.
Who traveled:	Ana Antunes, PhD student
Who was visited:	Pau Marti, Prof
Date, duration:	June 2005, 6 days
Purpose:	Participation in the school on embedded control in Barcelona.
Who traveled:	Luis Almeida, Prof
Who was visited:	Zdenek Hanzalek, Prof

Date, duration:	June 2005, 3 days
Purpose:	preparation of a project on improved Ethernet switch technology for hard real-time communication in demanding embedded systems, lecture of a course on real-time networks within the IFAC Summer School.

Who traveled:	Luis Almeida, Prof; Frederico Santos, PhD student
Who was visited:	U Illes Baleares, Julian Proenza, Prof.
Date, duration:	July 2005, 5 days
Purpose:	participation in several meetings during ECRTS 2005, for the organization of the STREPs that were submitted in the following September.

Numerous visits between Oldenburg and Saarbruecken
Purpose: cooperation on Verification and Optimization of Embedded Systems.

Meeting with University of Cantabria at CEA-List/Saclay to organise collaboration on UML profile development for RTE. Beginning of 2005.

Several meeting for defining a proposal of UML standard for real time embedded systems. They involved mainly CEA, INRIA and Thales (all involved in ARTIST2). They have been organised at several places in France and also in conjunction with the OMG meetings where the standard is defended.

Presentation of ARTIST 2 results on component based modelling with UML of real time embedded systems to various industrials. In particular, they have lead to setting up project proposals together with Siemens VDO, Volvo Technology, Daimlerchrysler, Thales, Schneider Electric, EADS ST, Dassault Aviation, Axalto

- Industrial participants at the **IFAC Summer School on Control, Computing and Communication, Prague, June 27 – July 1**

Organized by CTU (Zdenek Hanzalek)

Adamcík, Rostislav	SIEMENS a.s.	Prague	Czech Rep.
Cermak, Jiri	ANF DATA	Prague	Czech Rep.
Cihák, Jirí	SIEMENS a.s.	Prague	Czech Rep.
Dolejs,Ondrej	WAGO	Prague	Czech Rep.
Harel,Dan	Aerodan Systems LTD	Tel Aviv	Israel
Horka,Peter	PPA ENERGO s.r.o.	Pieštany	Slovakia
Hubácek,Stepán	SIEMENS a.s.	Prague	Czech Rep.
Krivsky,Radek	ANF DATA spol. s r.o.	Prague	Czech Rep.

Malek, Ladislav	DEL a.s.	Zdar n. Sazavou	Czech Rep.
Mezera,Pavel	SIEMENS a.s.	Prague	Czech Rep.

At the same meeting also academic affiliate Tarek Abdelzaher, Univ of Virginia and Artist2 partner Luis Almeida (Aveiro) participated as lecturers.

- Industrial participation at the Colloquium on Embedded systems organized by CTU (Zdenek Hanzalek) in Prague, April 2005

Struzka, Petr	UNIS a.s.	Brno	Czech Rep.
Cerny, Stanislav	UNIS a.s.	Brno	Czech Rep.
Kolar, Dusan	UNIS a.s.	Brno	Czech Rep.
Hajny, Ales	Unicontrols	Prague	Czech Rep.
Nenutil, Dobromil	Unicontrols	Prague	Czech Rep.
Kolísek, Zdenek	Unicontrols	Prague	Czech Rep.
Kerlin, Tomas	Siemens VDO	Frenstat	Czech Rep.
Kovár, Antonín	Siemens VDO	Frenstat	Czech Rep.
Šotkovský, Radim	Siemens VDO	Frenstat	Czech Rep.

6.2 Modelling and Components

6.2.1 Mobility: with Monash University>

Sending Institution	Monash University, Centre for Distributed Systems and Software Engineering, Melbourne, Australia, http://www.dsse.monash.edu.au/ Contact: Prof. Heinz Schmidt
Receiving Institution	**ARTIST2 Affiliated Partner** Mälardalen University, Department of Computer Science and Electronics, Mälardalen Real-time Research Centre, http://www.mrtc.mdh.se/ Prof. Ivica Crnkovic
Persons	PhD student, Anders Möller, 6 months visit to Monash University: Research topics: Predictable assembly of components Prof. Heinz Schmidt, several short visits (1 week) to MdH. : Research topics: Predictable assembly of components, composition of real-time properties
Area of Collaboration	Composition models of reliability, and real-time (execution time) properties for component models used in embedded systems. Optimisation of the component composition with regards to different resource usage when relating component models to execution models.

Technical Work	PhD student, Anders Möller, - work on the PhD thesis Prof. Heinz Schmidt - work on collaboration and directions in combination with industrial partners
Dates	PhD student, Anders Möller 2005-02-15 - 2005-07-31 Prof. Heinz Schmidt, 2004-11-20 – 2005-11-25, 2005-07-27 – 2005-07-30,
Approximate Costs	Nb people : 2 Travel : 4000€ Stay: 7000€
Long Range Impact on Integration	Impact on implementation of component models for embedded systems, in particular in automotive industry. Saving development costs and increasing software quality by prediction of quality attributes of component-based real-time systems. Implementation and deployment of the models in the automotive industry.
Published Work	*Monitoring and Stochastic Analysis of Component-Based Control-Systems*, Anders Möller, Mikael Nolin, Ian Peake*)*, Heinz Schmidt*)*, Real-Time in Sweden - the 8th biennial SNART conference on real-time systems, Skövde, Sweden, August, 2005 *Component-Based Context-Dependent Hybrid Property Prediction*, Anders Möller, Ian Peake*)*, Mikael Nolin, Heinz Schmidt *(external)*, ERCIM Workshop on Dependable Software Intensive Embedded systems, Porto, Portugal, August, 2005 *Probabilistic Analysis and Predictions of Component-Based Real-Time Systems*, Anders Möller, Mikael Nolin, Ian Peake, Heinz Schmidt *(external)*, WiP Session of the 17th Euromicro Conference on Real-Time Systems, IEEE, Palma de Mallorca, Balearic Islands, Spain, July, 2005 *Component-Based Software Engineering, 8th International Symposium, CBSE 2005*, George Heineman, Ivica Crnkovic, Heinz Schmidt, Judith Stafford, Kurt Wallnau, Springer, Lecture Notes in Computer Science,, ISBN: 3-540-25877-9, 2005
Further Collaboration Planned	A six months stay of PhD student Johan Fredriksson from MdH at Monash University. Collaboration in transformation of component-based design to execution model by optimising usage of different resources (CPU, memory). A two months visiof of Prof. Hainz Schmidt to MdH and work on predictable assembly of components and quality attributes. Continous work on component-based models for embedded systems.

6.2.2 Mobility: PACC – predictable assembly from cerificated components

Sending Institution	Software Engineering Institute, Carnegie Mellon University, Pittsbourgh, US Contact: Kurt Wallnau
Receiving Institution	**ARTIST2 Affiliated Partner** Mälardalen University, Department of Computer Science and Electronics,

	Mälardalen Real-time Reseach Centre, http://www.mrtc.mdh.se/ Prof. Ivica Crnkovic
Persons	Reseacher Kurt Wallnau, predictable assembly
Area of Collaboration	Building prediction-enabled technologies (PECT) for component-based systems. Applying composition theories on component models and build restrictions/ extensions on them to achieve the predictability of the system's properties.
Technical Work	Wriiting a PhD thesis. Evaluate the concept at industrial cases.
Dates	Kurt Wallnau 2004-10-18 – 2004 -10-24
Approximate Costs	Nb people : 1 Travel : 1000€ Stay: 1000€
Long Range Impact on Integration	The aim of the prediction-enabled technology is to take advantages of component-based approach and at the same time ensure particular system properties – which is essential for embedded and real-time systems.
Published Work	*Component-Based Software Engineering, 8th International Symposium, CBSE 2005*, George Heineman, Ivica Crnkovic, Heinz Schmidt, Judith Stafford, Kurt Wallnau, Springer, Lecture Notes in Computer Science,, ISBN: 3-540-25877-9, August, 2005
Further Collaboration Planned	Further collaboration is planned – a complete description of PECT, and its validation in industrla systems. A longer visit (4-6 weeks) is planned for Q4 2005.

6.2.3 Mobility: Deadlock freedom by construction

Sending Institution	University of Mannheim Contact: Mila Majster-Cederbaum
Receiving Institution	**ARTIST2 Partner** Verimag Susanne Graf
Persons	Prof. Mila Majster-Cederbaum
Area of Collaboration	Working on result for deadlock freedom by construction in the context of component systems defined in [GS05]
Technical Work	Writing a paper
Dates	2005-04-01 – 2005 -06-01
Approximate Costs	Nb people : 1
Long Range Impact on	Integrating non-functional properties and probabilities in the existing framework. Starting new collaborations

Integration	
Published Work	Article in the submission process
Further Collaboration Planned	Further collaboration is foreseen, possibly in the form of student exchanges.

6.2.4 Mobility: Assume-Guarantee Specifications and Games in component specifications

Sending Institution	National Taiwan University, prof. Yih-Kuen Tsay
Receiving Institution	Uppsala University, Prof. Bengt Jonsson
Persons	Prof. Yih-Kuen Tsay
Area of Collaboration	Investigating the use and relationships between assume-guarantee specifications, game models, for the specification and reasoning about components in reactive systems.
Technical Work	Initiation of research collaboration.
Dates	2005-06-15 – 2005-09-15
Approximate Costs	Nb people : 1 Travel : 2000€ Stay: 2000€
Long Range Impact on Integration	Several approaches exist to model dependencies between functional specifications of components, e.g., using assume-guarantee specification, games, and other formalisms. For research integration, it is important to understand the exact relationships between approaches.
Published Work	
Further Collaboration Planned	Further collaboration is planned

6.2.5 Mobility: Generation of functional and timing models of components

Sending Institution	Uppsala University, Prof. Bengt Jonsson
Receiving Institution	**ARTIST2 Affiliated Partner** Univ. of Dortmund, Prof. Bernhard Steffen

Persons	Ph.D. Student Therese Berg
Area of Collaboration	Generation of component models
Technical Work	Building tool for generation of functional models of components from observations of system behavior
Dates	2005-02-15 – 2005-08-31
Approximate Costs	Nb people : 1 Travel : 2000€ Stay: 2000€
Long Range Impact on Integration	The developed tool will be a vehicle for collaboration between the involved partner, and for subsequent dissemination of the technology.
Published Work	
Further Collaboration Planned	Further collaboration is planned during 2006, including longer stays in the other direction.

6.2.6 Mobility: CBSE textbook

Sending Institution	Technical University, Eindhoven Contact: Michel Chaudron
Receiving Institution	**ARTIST2 Affiliated Partner** Mälardalen University, Department of Computer Science and Electronics, Mälardalen Real-time Reseach Centre, http://www.mrtc.mdh.se/ Prof. Ivica Crnkovic
Persons	Ass. Prof. Michel Chaudron, work on a textbook Component-based software engineering
Area of Collaboration	Component Based Software Engineering - education
Technical Work	Work on a book: Component Based Software Engineering, Fundamental Concepts and Engineering Practices - The book provides a comprehensive overview of the effects of the software-component paradigm on modern software development. It does this by considering all phases of the software engineering lifecycle –from requirements, through architecture and design to maintenance. Real-time and embedded systems are taken as an example of a domain in which it CBSE is applied on.
Dates	Michel Chaudron: 2005-02-14 – 2004 -02-19, 2005-08-15 – 2005-08-20 Ivica Crnkovic: 2004-12-06 – 2004-12-09, 2005-06-11 -2005-07-21
Approximate Costs	Nb people : 2 Travel : 2000€ Stay: 3000€

Long Range Impact on Integration	The dissemination of CBSE in the area of embedded and real-time system is very important as this approach is still not widely accuquired. Educaion and traning is an essential part of the dissemination.
Published Work	*Component-based Development Process and Component Lifecycle*, Ivica Crnkovic, Stig Larsson, Michel Chaudron *(Technical University Eindhoven)*, 27th International Conference Information Technology Interfaces (ITI), IEEE, Cavtat, Croatia, June, 2005
Further Collaboration Planned	In addition to the textbook, the partners are negoitiating with a publishe for another book: CBSE for embedded systems that probably will be written in collaboration with several exeprets in the domain of embedded systems and experts in CBSE.

6.3 Hard Real Time

6.3.1 Mobility: affiliate partners attending meetings

The following affiliate partners attended HRT meetings:

- TTTech Computertechnik AG: James Sippl (control eng., architectures & TT)
- University of Firenze: Andrea Bondavalli (fault tolerance, modeling & evaluation)
- Humboldt-University Berlin: Miroslaw Malek (dependable distributed/embedded systems)
- TU Darmstadt: Neeraj Suri (distributed systems & protocols, fault tolerance)
- GM: Tom Forest, Arnold Millsap
- BMW: Josef Berwanger, Tillmann Schumm
- Uppsala: Pavel Krcal
- TU Munich: Jan Romberg
- Politecnico di Torino: Luciano Lavagno
- University of Udine: Tiziano Villa Villa@uniud.it
- University of California at Berkeley: A. Pinto (PhD Student)
- University of L'Aquila: S. Di Gennaro, (include dibenede@parades.rm.cnr.it)
- UNU-IIST Macao, Zhiming Liu, Jifeng He
- FTR&D Pierre Combes, Fabien Baligand
- Monash University Heinz Schmidt
- DaimlerChrysler Ines Fey

6.4 Adaptive Real Time

6.4.1 Mobility: Real-time communication in SHARK

Sending Institution	University of Aveiro www.ua.pt Luis Almeida, team leader
Receiving Institution	Scuola Sup Sant'Anna, Pisa Giuseppe Lipari, group leader
Persons	Paulo Pedreiras, Prof. Ricardo Marau, PhD student
Area of Collaboration	Utilization of the SHARK operating system
Technical Work	Participation in the SHARK workshop Port the FTT-Ethernet protocol onto the version 1.5 of SHARK
Dates	March 5-12, 2005
Approximate Costs	Nb people : 2 Travel : 700 Stay: 700
Long Range Impact on Integration	Deployment of the FTT-Ethernet protocol onto the SHARK OS to deliver flexible real-time communication services. Work on real-time communication support for SHARK, at the network driver level.
Published Work	Preparation of a submission to DATE 2006
Further Collaboration Planned	Further enhancements to real-time communication support for SHARK.

6.4.2 Mobility: real-time wireless communication for mobile robots

Sending Institution	University of Aveiro www.ua.pt Luis Almeida, team leader
Receiving Institution	University of Pavia Giorgio Buttazzo, cluster leader
Persons	Luis Almeida, Prof.
Area of Collaboration	Real-time wireless communication for mobile robots

Technical Work	Teaching of a short course on real-time networks Discussion of appropriate protocols, particularly for topology tracking.
Dates	2-5/May/2005
Approximate Costs	Nb people : 1 Travel : 330 Stay: 140
Long Range Impact on Integration	Strengthening of the cooperation between both groups in the referred topic.
Published Work	Submission to RTSS 2005, finalization of a paper accepted for publication in the EURASIP Journal of Wireless Networks
Further Collaboration Planned	Preparation of a STREP proposal in the area.

6.4.3 Mobility: Flexible scheduling for adaptive distributed control

Sending Institution	University of Aveiro www.ua.pt Luis Almeida, team leader
Receiving Institution	Politechnic Univ of Catalonia Pau Marti, group leader
Persons	Ana Antunes, PhD student
Area of Collaboration	Flexible scheduling of communications in adaptive distributed control systems.
Technical Work	Participation in a scheduling and control workshop Discussion of the interference of the communicationin the control and the modelling of such impact
Dates	19-25/Jun/2005
Approximate Costs	Nb people : 1 Travel : 390 Stay: 315
Long Range Impact on Integration	Assimilation of knowledge on implementation and tuning issues of adaptive distributed control systems
Published Work	A. Antunes, P. Pedreiras, A. Mota. Adapting the sampling period of a real-time adaptive distributed controller to the bus load. ETFA 2005, Work-in-progress session, Catania, September 2005.
Further Collaboration Planned	Collaboration on the scope of CAN-based distritbuted control systems implementation. Joint submission to journal is planned before end of 2005.

6.4.4 Mobility: IFAC Summer School

Sending Institution	University of Aveiro www.ua.pt Luis Almeida, team leader
Receiving Institution	TechnicalUniversity of Prague Zdanek Hanzalek, team leader
Persons	Luis Almeida, Prof.
Area of Collaboration	Real-time communication
Technical Work	Teaching of a short course on real-time networks in the scope of an IFAC Summer School. Discussion of various common research interests, particularly real-time communication and scheduling issues.
Dates	26-29/Jun/2005
Approximate Costs	Nb people : 1 Travel : 450 Stay: 550
Long Range Impact on Integration	Strengthening of the cooperation between both groups in the referred topics.
Published Work	None
Further Collaboration Planned	Preparation of a STREP proposal in the area.

6.4.5 Other Visits

Who traveled:	Paulo Pedreiras, Prof., University of Aveiro
Who was visited:	Giuseppe Lipari, Scuola Sup. Sant'Anna, Pisa (Affiliate Pavia)
Dates:	March 5-12, 2005
Purpose:	Participation in the SHARK workshop and porting the FTT-Ethernet protocol onto the version 1.5 of SHARK.

Who traveled:	Ricardo Marau, PhD student, University of Aveiro
Who was visited:	Giuseppe Lipari, Scuola Sup. Sant'Anna, Pisa (Affiliate Pavia)
Dates:	March 5-12, 2005
Purpose:	Participation in the SHARK workshop and porting the FTT-Ethernet protocol onto the version 1.5 of SHARK.

Who traveled:	Rosa Castañé Selga, PhD student, Univesidad de Barcelona
Who was visited:	Giuseppe Lipari, Scuola Sup. Sant'Anna, Pisa (Affiliate Pavia)
Dates:	March 5-12, 2005
Purpose:	Participation in the SHARK workshop.

Who traveled:	Roberta Cerami, PhD student, University of Catania
Who was visited:	Giuseppe Lipari, Scuola Sup. Sant'Anna, Pisa (Affiliate Pavia)
Dates:	March 5-12, 2005
Purpose:	Participation in the SHARK workshop.

Who traveled:	Yan-Ching Chu, PhD student, University of York (UK)
Who was visited:	Giuseppe Lipari, Scuola Sup. Sant'Anna, Pisa (Affiliate Pavia)
Dates:	March 5-12, 2005
Purpose:	Participation in the SHARK workshop.

Who traveled:	Jose Luis Lorente Aragon, PhD student, Universidad de Cantabria (ES)
Who was visited:	Giuseppe Lipari, Scuola Sup. Sant'Anna, Pisa (Affiliate Pavia)
Dates:	March 5-12, 2005
Purpose:	Participation in the SHARK workshop.

Who traveled:	Nuno Pereira, PhD student, Universidad de Porto (PT)
Who was visited:	Giuseppe Lipari, Scuola Sup. Sant'Anna, Pisa (Affiliate Pavia)
Dates:	March 5-12, 2005
Purpose:	Participation in the SHARK workshop.

Who traveled:	Nicola Serreli, PhD student, Evidence S.r.l. (IT)
Who was visited:	Giuseppe Lipari, Scuola Sup. Sant'Anna, Pisa (Affiliate Pavia)
Dates:	March 5-12, 2005
Purpose:	Participation in the SHARK workshop.

Who traveled:	Santiago Uruena, PhD student, Universidad Carlos III de Madrid (ES)
Who was visited:	Giuseppe Lipari, Scuola Sup. Sant'Anna, Pisa (Affiliate Pavia)
Dates:	March 5-12, 2005
Purpose:	Participation in the SHARK workshop.

Who traveled:	Filipe Valpereiro, PhD student, Universidad de Porto (PT)
Who was visited:	Giuseppe Lipari, Scuola Sup. Sant'Anna, Pisa (Affiliate Pavia)
Dates:	March 5-12, 2005

Purpose:	Participation in the SHARK workshop.

Who traveled:	Alex Zerzelidis, PhD student, University of York (UK)
Who was visited:	Giuseppe Lipari, Scuola Sup. Sant'Anna, Pisa (Affiliate Pavia)
Dates:	March 5-12, 2005
Purpose:	Participation in the SHARK workshop.

Who traveled:	Luis Almeida, Prof., team leader, University of Aveiro
Who was visited:	Giorgio Buttazzo, cluster leader, University of Pavia
Dates:	May 2-5, 2005
Purpose:	Teaching of a short course on real-time networks. Discussion of appropriate protocols, particularly for topology tracking.

Who traveled:	Ana Antunes, PhD student, University of Aveiro
Who was visited:	Pau Marti, group leader, Politechnic Univ of Catalonia
Dates:	June 19-25, 2005
Purpose:	Participation in a scheduling and control workshop. Discussion of the interference of the communicationin the control and the modelling of such impact.

Who traveled:	Luis Almeida, Prof., team leader, University of Aveiro
Who was visited:	Zdanek Hanzalek, team leader, TechnicalUniversity of Prague
Dates:	June 26-29, 2005
Purpose:	Teaching of a short course on real-time networks in the scope of an IFAC Summer School. Discussion of various common research interests, particularly real-time communication and scheduling issues.

6.5 Compilers and Timing Analysis

6.5.1 Mobility: Mälardalen research visit to AbsInt and USaar

Sending Institution	Mälardalen, ARTIST2 Partner Contact: Björn Lisper, prof., core partner project leader
Receiving Institution	USaar, ARTIST2 Partner and AbsInt, ARTIST2 Partner Contact: Reinhard Wilhelm, prof., timing-analysis platform cluster director, Christian Ferdinand, core partner company leader
Persons	Dr Andreas Ermedahl, WCET analysis MSc Student Ola Eriksson, WCET analysis MSc Student Yina Zhang, WCET analysis

Area of Collaboration	Introduction to the aiT WCET analysis tool for Infineon C167 processor. Discussions on WCET analysis towards Swedish industrial company. Research discussions regarding CRL2 format
Dates	16 feb 2005 - 20 feb 2005
Approximate Costs	Nb people : 3 Travel : €650,00 Stay: €450,00
Long Range Impact on Integration	The research visit was used as a starting point for two MSc works. It resulted in two MSc reports (and potentially later some conference publication). It helped M?lardalen perform two case studies on static timing analysis towards the Swedish company CC-Systems
Published Work	• MSc Thesis, Yina Zhang, 'Evaluation of Methods for Dynamic Time Analysis for CC-Systems AB'. • MSc Thesis, Ola Ericsson, 'Evaluation of Static Time Analysis for CC-Systems AB'. • WCET2005 Workshop article, Andreas Ermedahl, Jan Gustafsson and Björn Lisper. 'Experiences from Industrial WCET Analysis Case Studies'
Further Collaboration Planned	Mälardalen is planning to continue their case-studies on static timing analysis towards Swedish industry using the aiT and Bound-T tools. More research visits to AbsInt and USaar will be performed by Mälardalen MSc students and researchers, including topics like:instruction semantics in CRL2 and interfacing of M?lardalen flow analysis to common CRL2-based format.

6.5.2 Mobility: Research visits between Mälardalen and Tidorum

Sending Institution	Tidorum, ARTIST2 affiliated Partner Contact: Niklas Holsti, affiliated partner company leader
Receiving Institution	Mälardalen, ARTIST2 Partner Contact: Björn Lisper, prof., core partner project leader
Persons	Prof. Björn Lisper, WCET analysis Dr Andreas Ermedahl, WCET analysis Dr Jan Gustafsson, WCET analysis PhD Student Christer Sandberg, WCET analysis MSc Student Samuel Petersson, WCET analysis Dr Niklas Holsti, WCET analysis
Area of Collaboration	• Research visits of Tidorum to Mälardalen University. • Collaboration for porting the Bound-T WCET analysis tool to the Renesas H8/3292 processor and Lego Mindstorms.

	• Usage of Bound-T in real-time courses given at Mälardalen University. • Research discussions regarding instruction semantics in CRL2 and interfacing of WCET analysis tools.
Dates	2004-05-25 - 2004-05-26 2004-05-04 - 2005-05-05
Approximate Costs	Nb people : <nb people> Travel : <costs for travel> Stay: <costs on-site>
Long Range Impact on Integration	The research visit was used as a starting point for one MSc works resulted in one MSc report and a workshop publication. As a result the Bound-T WCET analysis tool will be used in real-time systems education at Mälardalen.
Published Work	• 'Using a WCET Analysis Tool in Real-Time Systems Education', Proc. of the 5th International Workshop on Worst-Case Execution Time Analysis (WCET'05), Samuel Petersson, Andreas Ermedahl, Anders Pettersson, Daniel Sundmark, and Niklas Holsti. • 'Porting the Bound-T WCET tool to Lego Mindstorms and the Asterix RTOS', MSc Thesis, Samuel Petersson, Mälardalen University, 2005.
Further Collaboration Planned	Mälardalen will be using the Bound-T tool in their real-time courses. More research travels between Mälardalen and Tidorum are planned.

6.5.3 Mobility: Sensititvity Analysis

Sending Institution	Saarland University> Reinhard Wilhelm, Professor
Receiving Institution	Bologna University Luca Benini, Professor
Persons	Oleg Parshin PhD student, Oleg Parshin Architecture Simulation for Sensititivity Analysis
Area of Collaboration	Analysis of the sensititivity of performance and predictability of processor architecrtures against changes in architectural paramteters.
Technical Work	Introduction to the MPARM simulator technology.
Dates	01.06.2005 - 06.06.2005
Approximate Costs	Nb people : 1 Travel : €350 Stay: €240
Published	<References for publications produced during the stay, or as a direct

Work	consequence of the stay>
Further Collaboration Planned	<Provide a brief description of any further or ongoing collaboration or mobility that is planned between these teams>

6.5.4 Mobility: between Dortmund and IMEC

Sending Institution	**ARTIST2 Partner** Univ. Dortmund, //ls12-www.cs.uni-dortmund.de Contact: Prof. Peter Marwedel …
Receiving Institution	**ARTIST2 Affiliated Partner** IMEC, imec.be Contact: Prof. Francky Catthoor (partner coordinator) and Erik Brockmeyer (technical partner responsible)
Persons	People who have travelled for this mobility action: PhD student Sergej Schwenk: define and start to develop high-level control flow cost estimator based on C source code, to aid in steering locality-improving loop transformations Prof. Peter Marwedel: exchange of high-lvel information and discussions about the practical organisation of the co-operation
Area of Collaboration	High-level cost estimators at the C source code level to steer locality-improving loop transformations
Technical Work	Alignment of research objectives and working out basic WHAT specification
Dates	Sergej Schenk: 1/9/04 to17/9/04 (3 weeks) and 11/4/05 to 15/4/05 (1 week) Peter Marwedel: 17/9/04 (1 day)
Approximate Costs	Nb people : 1 Travel : <costs for travel> Peter/Rainer, what can we report here? Stay: <costs on-site> Peter/Rainer, what can we report here?
Long Range Impact on Integration	Will allow to better steer loop transformations, and the WHAT specification is essential to align the activities at both sides
Published Work	Too early as yet (definition phase).
Further Collaboration Planned	The cooperation is expected to continue, but might involve a new PhD student. Based on the feasibility of working with appropriate students this work will be continued to arrive at a prototype technique and tool to generate the high-level cost estimator.

6.5.5 Mobility: <find a title for the Mobility action>

Sending Institution	<if an Artist core partner, state "**ARTIST2 Partner**"> <if an Artist affiliated partner, state "**ARTIST2 Affiliated Partner**"><Full name of the institution>

	<website> Contact: <titles><firstname><lastname>: <role>
Receiving Institution	<if an Artist core partner, state "**ARTIST2 Partner**"> <if an Artist affiliated partner, state "**ARTIST2 Affiliated Partner**"><Full name of the institution> <website> Contact: <titles><firstname><lastname>: <role>
Persons	<People who have travelled for this mobility action: Title (PhD student, lecturer, professor, etc) firstname lastname : research topics Title (PhD student, lecturer, professor, etc) firstname lastname : research topics >
Area of Collaboration	<describe in one or a few lines the technical area of collaboration>
Technical Work	<what will these people be doing during their stay ?>
Dates	<arrival date> - <departure date>
Approximate Costs	Nb people : <nb people> Travel : <costs for travel> Stay: <costs on-site>
Long Range Impact on Integration	<2-10 lines>
Published Work	<References for publications produced during the stay, or as a direct consequence of the stay>
Further Collaboration Planned	<Provide a brief description of any further or ongoing collaboration or mobility that is planned between these teams>

6.6 Execution Platforms

6.6.1 Mobility: Study of fast Network-on-Chip exploration frameworks

Sending Institution	**ARTIST2 Partner** Technical University of Denmark, DTU (www.dtu.dk) Contact: Prof. Jan Madsen: ARTIST2 team leader
Receiving Institution	**ARTIST2 Partner** University of Bologna, UoB (www.unibo.it) Contact: Prof. Luca Benini: ARTIST2 team leader
Persons	PhD student Shankar Mahadevan: Research topics: Multi-processor Networked System-on-Chip
Area of	Study of Network-on-Chip exploration using simpler IP emulation devices

Collaboration	called reactive traffic generator (RTG).
Technical Work	Integrated the RTG toolset, developed at DTU, with the cycle-true multiprocessor ARM (MPARM) platform, developed at UoB.
Dates	20/10-2004 - 30/11-2004
Approximate Costs	Number of people : 1 from DTU Travel : DKK 6997 Stay: DKK 0
Long Range Impact on Integration	Though cycle-true co-exploration tools such as MPARM will continue to be useful for accurate MPSoC performance evaluation, RTG has the potential to speed up exploration and optimization of NoC in parallel development.
Published Work	Mahadevan, S., Angiolini, F., Storgaard, M., Olsen, R., Sparsø, J., Madsen, J., *A Network Traffic Generator Model for Fast Network-on-Chip Simulation*, Design, Automation and Test in Europe, pp. 780-785, 2005
Further Collaboration Planned	The RTG toolset will be extended to support interrupt-driven application flows.

6.6.2 Mobility: Realistically Rendering SoC Traffic Patterns with Interrupt Awareness

Sending Institution	**ARTIST2 Partner** Technical University of Denmark, DTU (www.dtu.dk) Contact: Prof. Jan Madsen: ARTIST2 team leader
Receiving Institution	**ARTIST2 Partner** University of Bologna, UoB (www.unibo.it) Contact: Prof. Luca Benini: ARTIST2 team leader
Persons	PhD student Shankar Mahadevan: Research topics: Multi-processor Networked System-on-Chip
Area of Collaboration	Study of fast and accurate Network-on-Chip exploration frameworks.
Technical Work	Modelled applications with interrupt and operating system interactions in both MPARM and RTG, and judged the accuracy of the approach.
Dates	2/6-2005 – 7/7-2005
Approximate Costs	Number of people : 1 from DTU Travel : DKK 2648 Stay: DKK 0
Long Range Impact on Integration	RTG has extensive features to accurately mimic ARM7 behaviour, available in MPARM. Designer can use RTG for exploration and optimization of NoC in parallel MPSoC design and development.
Published Work	Mahadevan, S., Angiolini, F., Madsen, J., Benini, L., Sparsø, J., *Realistically Rendering SoC Traffic Patterns with Interrupt Awareness*, IFIP International Conference on Very Large Scale Integration (VLSI-SoC), 2005

	A Reactive IP Emulator for Multi-Processor System-in-Chip Exploration Journal paper to be submitted in near future.
Further Collaboration Planned	Documenting the design and implementation of RTG, and its validation via the MPARM for a journal publication is an ongoing activity.

6.6.3 Mobility: Time Triggered Protocol modeling

Sending Institution	**ARTIST2 Partner** Technical University of Denmark, DTU (www.dtu.dk) Contact: Prof. Jan Madsen: ARTIST2 team leader
Receiving Institution	**ARTIST2 Partner** Linköping University, (www.liu.se) Contact: Prof. Petru Eles: ARTIST2 team leader
Persons	MSc student, Yoav Yanai: Modeling Time Triggered protocols
Area of Collaboration	Understanding the time-triggered protocol for system-level modeling of automotive systems
Technical Work	Discussion and understanding of the TTP used for automotive systems
Dates	June 9, 2005
Approximate Costs	Nb people : 1 student from DTU Travel : DKK 800 Stay: DKK 0
Long Range Impact on Integration	The aim is to extend the multiprocessor simulation framework (ARTS) developed at DTU, with capabilities of modeling Time-Triggerede and Event-Triggerede protocols used by the automotive industry.
Published Work	None
Further Collaboration Planned	Linköping University and DTU will continue their cooperation towards extending the multiprocessor simulation framework (ARTS) to support the requirements for it to be useful as an embedded simulation platform for simulating automotive applications.

6.6.4 Mobility: Power Aware Embedded Systems: Modelling and Optimization

Sending Institution	**ARTIST2 Partner** Linkoeping University, Sweden Contact: Prof. Petru Eles
Receiving Institution	**ARTIST2 Partner** University of Bologna, Italy Contact: Prof. Luca Benini
Persons	PhD Student Alexandru Andrei
Area of Collaboration	The groups at LIU and the University of Bologna are cooperating in the area of modelling and optimisation of power efficient embedded systems.

Technical Work	During the one month visit at Bologna, the following two issues will be investigated: 1. Capturing of the background communication due to cache misses in our system level models. 2. Capturing the bus load due to system-wide synchronization.
Dates	1st of April – 30th of April 2005
Approximate Costs	Nb people : 1 Travel : 250 Euro Stay: 350 Euro
Long Range Impact on Integration	Current and future work is aiming at a more accurate modelling of actual communication and memory techniques used in MP SoC. Such an accurate modelling is needed in order for a system level analysis and optimization to produce useful results.
Published Work	Work on a publication is in progress.
Further Collaboration Planned	Once these modelling issues are solved, different optimization techniques can be used for e.g. task mapping and scheduling, as well as voltage selection. Results can be validated using accurate and fast simulation in the environment developed at Bologna. Another issue which is currently addressed is that of efficient optimization techniques based on advanced constraint solving and mathematical programming techniques. A visit of a PhD student from Bologna to Linköping is planned.

6.6.5 Mobility: Network on Chip Architectures and Optimization

Sending Institution	**ARTIST2 Partner** University of Bologna, Italy Contact: Prof. Luca Benini
Receiving Institution	**ARTIST2 Partner** Linkoeping University, Sweden Contact: Prof. Petru Eles
Persons	Prof. Luca Benini
Area of Collaboration	Optimization strategies for time and energy constrained applications implemented on NoCs.
Technical Work	The main objective of this three days mobility was to discuss potential cooperation topics and to plan for future work. Professor Benini has also given a scientific talk and a lecture to graduate students.
Dates	14.12.2004 -17.12.2004
Approximate Costs	Nb people : 1 Travel : 4000 SEK Stay: 4000 SEK
Long Range Impact on Integration	This work is aimed at extending our cooperation in the area of power efficient embedded systems, with the issues that are particular to communication intensive applications implemented on NoCs.

Published Work	No publication yet.
Further Collaboration Planned	The work is continued in the particular topics of worst case execution time and buffer need estimation/optimisation for NoCs.

6.6.6 Mobility: Schedulability Analysis and Communication Synthesis for Distributed Embedded Systems.

Sending Institution	**ARTIST2 Partner** Linkoeping University, Sweden Contact: Prof. Petru Eles
Receiving Institution	**ARTIST2 Partner** University Braunschweig Contact: Prof. Rolf Ernst
Persons	Researcher Dr. Paul Pop PhD student Traian Pop
Area of Collaboration	The groups at Linköping and Braunschweig are cooperating in the area of analysis and optimisation of communication intensive distributed embedded systems.
Technical Work	The main goal of the mobility is to study the Symta and the so called holistic approaches developed at Braunschweig and Linköping, respectively. An important objective is to explore possible extensions of the systems towards new scheduling policies and communication protocols.
Dates	03.10.2004- 30.10.2004
Approximate Costs	Nb people : 2 Travel : 3000 SEK Stay: 10000 SEK
Long Range Impact on Integration	The long range objective of this work is to develop efficient and user friendly tools for the analysis and optimization of distributed embedded systems with strong time constraints. An important aspect is to capture the interactions between applications running under different scheduling policies as well as the impact of various, possibly hybrid, communication protocols.
Published Work	Work on publications is in progress.
Further Collaboration Planned	This collaboration will continue. One interesting aspect, to be considered in future, is the impact of fault tolerance requirements. A visit of a PhD student from Braunschweig to Linköping is planned.

6.6.7 Mobility: Combining Performance Analysis with Simulation

Sending Institution	**ARTIST2 Partner** ETH Zurich Contact: Prof. Lothar Thiele
Receiving Institution	**ARTIST2 Partner** University Bologna Contact: Prof. Luca Benini
Persons	PhD Student: Simon Kuenzli
Area of Collaboration	Performance Analysis and Simulation of Heterogeneous System-On-Chip Architectures
Technical Work	The existing simulation framework was extended by the interfaces needed for the proposed hybrid approach. Further, an example application was analyzed using the new approach. The hybrid analysis can be performed automated and exposes the expected speed-up for the simulation of embedded systems, with only a small deterioration of the accuracy of the results.
Dates	3 weeks in May 2005
Approximate Costs	Nb people : 1 Travel : 800 Euro Stay: 800 Euro
Long Range Impact on Integration	This activity describes a joint project with the research group of Prof. L. Benini at University of Bologna. In this activity, a hybrid approach for performance evaluation of embedded systems was developed. The method will be used to speed-up simulation times. It consists of a combination of the existing SystemC simulation framework developed at Uni Bologna with formal performance analysis method developed at ETH Zurich.
Published Work	The results achieved during the visit in Bologna in May 2005 are now collected and a paper submission is prepared for DATE 2006. The tools for the combination are operational and can be used for further experiments.
Further Collaboration Planned	In future, we would like to extend the hybrid approach to support the analysis of more general systems.

6.6.8 Mobility: Application and Comparison of Performance Analysis Methods

Sending Institution	**ARTIST2 Partner** Embedded Systems Institute Eindhoven Contact: Prof. Jozef Hooman
Receiving Institution	**ARTIST2 Partner** ETH Zurich Contact: Prof. Lothar Thiele
Persons	PhD Student: Marcel Verhoef
Area of Collaboration	Application and Comparison of Performance Analysis Methods

Technical Work	As a first case study, an existing distributed in-car radio navigation system was chosen and was specified in UML. For this case study, Real-Time Calculus was used to evaluate and compare 5 different potential system architectures. Sensitivity analysis was applied to all architectures to identify their robustness and potential bottlenecks. For the architecture that is actually used in the commercial implementation of the case-study system, the robustness and the bottlenecks could be identified correctly using formal performance analysis methods.
Dates	11-15 April 2005
Approximate Costs	Nb people : 1 Travel : 1000 Euro
Long Range Impact on Integration	In collaboration with other researchers, the initial case-study system was analyzed using other performance analysis methods. In particular, the system was analyzed using UPPAAL (Timed Automata), SymTA/S and Simulation. Further a student project is currently undertaken at ESI to implement a multi-processor test-bed to obtain performance results from measurements.
Published Work	In April 2005, Marcel Verhoef spent 5 days at ETH. During this time, a journal paper was written, based on a former conference paper. Further, new potential case-study systems, as well as plans for a performance analysis tool were discussed.
Further Collaboration Planned	In future, we would like to compare and evaluate different performance analysis methods, and we would like to identify strengths and weaknesses of the various performance analysis methods.

6.6.9 Mobility: ARTIST 2 Seminar on Adaptive Real-Time Systems with emphasis on real-time control systems

Sending Institution	**ARTIST2 Partner**: Institute of Computer and Communication Network Engineering (IDA), Technical University Braunschweig, Germany. http://www.ida.ing.tu-bs.de Contact: Prof. Rolf Ernst
Receiving Institution	**ARTIST2 Affiliated Partner**: Automatic Control Deptartment, Technical University of Catalonia (UPC), Barcelona, Spain http://dcs.upc.es/ Contact: Prof. Pau Marti Colom (Organiser), Prof. Gerhard Fohler (Organiser)
Persons	PhD student Arne Hamann: Optimization of embedded real-time systems PhD student Rafik Henia: Context sensitive formal performance analysis PhD student Matthias Ivers: Network processor architectures PhD student Razvan Racu: Sensitivity analysis PhD student Simon Schliecker: Memory access modeling and analysis
Area of	Adaptive and soft-real time systems, control systems in the context of

Collaboration	complex real-time systems.
Technical Work	N.A.
Dates	20.6.2005 – 24.6.2005
Approximate Costs	Nb people : 5 Travel : 1500 Stay: 2000
Long Range Impact on Integration	Extension of the SymTA/S approach to support the modelling and the analysis of soft- and firm-real time systems.
Published Work	N.A.
Further Collaboration Planned	N.A.

6.6.10 Mobility: Resource-Aware design

Sending Institution	Università di Bologna www.unibo.it ARTIST2 Partner Contact: Prof. Luca Benini: Coordinator
Receiving Institution	Linkoeping University www-zhv.rwth-aachen.de ARTIST2 Partner Contact: Prof. Reiner Leupers; coordinator
Persons	Phd Student Federico Angiolini: execution platforms, on-chip networks Phd Student Francesco Poletti: execution platforms, simulation of MPSoC architectures
Area of Collaboration	Resource-Aware design
Technical Work	Research seminars and tutorial on tools and simulation platforms
Dates	13/12/2004 - 16/12/2004
Approximate Costs	Nb people : 2 Travel : 1200€ Stay: 400
Long Range Impact on Integration	Developing a joint research strategy for building a virtual platform that integrates high-level (ISS-accurate) models of heterogeneous processors with different system interconnects
Published Work	

Further Collaboration Planned	Additional cooperation and mobility is planned for 2005-2006, as the two groups have started an active research cooperation on virtual platforms and communication libraries for multiprocessor platforms

6.6.11 Mobility: Low-power Engineering

Sending Institution	Università di Bologna www.unibo.it ARTIST2 Partner Contact: Prof. Luca Benini: Coordinator
Receiving Institution	Linkoeping University www.liu.se ARTIST2 Partner Contact: Prof. Petru Eles; coordinator
Persons	Professor Luca Benini: execution platforms
Area of Collaboration	Low power engineering: design of power-efficient execution platforms
Technical Work	Research seminars and planning of joint work
Dates	14/12/2004 - 17/12/2004
Approximate Costs	Nb people : 1 Travel : 800€ Stay: 0
Long Range Impact on Integration	Developing a joint research strategy to bridge the abstraction gap between formal system modelling techniques and architectural modelling and optimization, which is essentially based on simulation models
Published Work	A. Pullini, F. Angiolini, L. Benini, D. Bertozzi, “Fault Tolerange Overhead in Network-on-Chip Flow Control Schemes”, International Symposium on Integrated Circuits and Systems Design 2005.
Further Collaboration Planned	Additional cooperation and mobility is planned for 2005-2006, as the two groups have started an active research cooperation on algorithms for low-power scheduling and allocation on multiprocessor platforms

6.7 Control for Embedded Systems

6.7.1 Mobility: PhD student visit from CTU to LUND

Sending Institution	**ARTIST2 Partner** Czech Technical University Contact: Zdenek Hanzalek
Receiving Institution	**ARTIST2 Partner** Lund University Contact: Karl-Erik Årzén
Persons	PhD student Michal Kutil: embedded control systems, use of queuing models in traffic control

Area of Collaboration	Applying models developed for queue length control in server systems to traffic control problems
Technical Work	Theory development
Dates	May 9 – July 15
Approximate Costs	Nb people : 1 Travel : 300 € Stay: 2000 €
Long Range Impact on Integration	The integration allows us to evaluate the wider applicability of the model types developed for web server control.
Published Work	Joint publications are planned, but now is too early.
Further Collaboration Planned	The collaboration will be continued

6.7.2 Mobility: PhD student visit from UPVLC to LUND

Sending Institution	**ARTIST2 Partner**: Universidad Politechnica de Valencia Contact: Alfons Crespo
Receiving Institution	**ARTIST2 Partner** Lund University Contact: Karl-Erik Årzén
Persons	PhD student Manuel Lluesma Camps: statistical scheduling, temporal robustness of control loops
Area of Collaboration	Robustness of control loops to timing variations in sampling and i-o latency
Technical Work	Modeling and simulation using Jitterbug and Truetime tools
Dates	May 28 – July 3
Approximate Costs	Nb people : 1 Travel : 400 € Stay: 1500 €
Long Range Impact on Integration	Temporal robustness of control loops simplifies the design problem for embedded control systems
Published Work	n.a.
Further Collaboration	The collaboration between UPVLC and LUND will continue

Planned	

6.7.3 Mobility: PhD student visit from UPVLC to LUND

Sending Institution	**ARTIST2 Partner**: Universidad Politechnica de Valencia Contact: Pedro Albertos
Receiving Institution	**ARTIST2 Partner** Lund University Contact: Karl-Erik Årzén
Persons	PhD student/lecturer Pedro Garcia Gil : deadtime compensation
Area of Collaboration	New methods for dynamic compensation for time delays, caused, e.g., by communication networks, in control loops
Technical Work	Theory development
Dates	August 9 – September 15
Approximate Costs	Nb people : 1 Travel : 400 € Stay: 1000 €
Long Range Impact on Integration	Temporal robustness and dynamic delay compensation in control loops simplifies the design problem for embedded control systems
Published Work	Too early
Further Collaboration Planned	The collaboration between UPVLC and LUND will continue

6.7.4 Mobility: PhD student visit from UPC to LUND

Sending Institution	**ARTIST2 Affliated Partner**: Universidad Politechnica de Catalunya, UPC (affiliated to Mälardalens högskola – Gerald Fohler) Contact: Pau Marti
Receiving Institution	**ARTIST2 Partner** Lund University Contact: Karl-Erik Årzén
Persons	PhD student candidate Rosa Castane Selga: Feedback scheduling of control systems
Area of Collaboration	Feedback scheduling of control loops

Technical Work	Theory development, modelling and simulation, thesis production
Dates	August 8 – December 31
Approximate Costs	Nb people : 1 Travel : 400 € Stay: 4000 €
Long Range Impact on Integration	Important integration effort for the collaboration between LUND, Mälardalen and UPC.
Published Work	Is planned
Further Collaboration Planned	The collaboration between UPC, LUND and Mälardalen will continue

6.7.5 Mobility: PhD student visit from UPVLC to KTH

Sending Institution	**ARTIST2 Partner**: Universidad Politechnica de Valencia Contact: Pedro Albertos
Receiving Institution	**ARTIST2 Partner** Royal Institute of Technology, KTH Contact: Martin Törngren
Persons	PhD student candidate Vicente Casanova: Embedded control systems
Area of Collaboration	Embedded control systems
Technical Work	Theory development, modelling and simulation
Dates	August - September
Approximate Costs	Nb people : 1 Travel : 400 € Stay: 2000 €
Long Range Impact on Integration	Important integration effort for the collaboration between KTH and UPVLC
Published Work	Not yet decided
Further Collaboration Planned	The collaboration KTH and UPVLC will continue

6.7.6 Mobility: Graduate Week in Valencia (LUND to UPVLC)

Sending Institution	**ARTIST2 Partner** Lund University Contact: Karl-Erik Årzén
Receiving Institution	**ARTIST2 Partner**: Universidad Politechnica de Valencia Contact: Pedro Albertos
Persons	Researcher/Lecturer Karl-Erik Årzén: Control for embedded systems Researcher7Lecturer Anton Cervin: Control for embedded systems
Area of Collaboration	JPASE graduate course. Lectures
Technical Work	Course material development
Dates	April 4 – April 8
Approximate Costs	Nb people : 2 Travel : 800 € Stay: 1000 €
Long Range Impact on Integration	The course material developed will be reused at future industrial and academic workshops
Published Work	Evaluation report from the course available
Further Collaboration Planned	The next workshop is planned for CDC-ECC in Sevilla, December 2005

6.7.7 Mobility: Graduate Week in Valencia (KTH to UPVLC)

Sending Institution	**ARTIST2 Partner** Royal Institute of Technology, KTH Contact: Martin Törngren
Receiving Institution	**ARTIST2 Partner**: Universidad Politechnica de Valencia Contact: Pedro Albertos
Persons	Researcher/Lecturer Bengt Eriksson: Control for embedded systems PhD student Jianlin Shi: Control for embedded systems
Area of Collaboration	JPASE graduate course. Lectures
Technical Work	Course material development
Dates	April 4 – April 9

Approximate Costs	Nb people : 2 Travel : 800 € Stay: 1000 €
Long Range Impact on Integration	The course material developed will be reused at future industrial and academic workshops
Published Work	Evaluation report from the course available
Further Collaboration Planned	The next workshop is planned for CDC-ECC in Sevilla, December 2005

6.7.8 Mobility: Graduate Week in Valencia (CTU to UPVLC)

Sending Institution	**ARTIST2 Partner** Czech Technical University Contact: Zdenek Hanzalek
Receiving Institution	**ARTIST2 Partner**: Universidad Politechnica de Valencia Contact: Pedro Albertos
Persons	Researcher/Lecturer Zdenek Hanzalek: Control for embedded systems
Area of Collaboration	JPASE graduate course. Lectures
Technical Work	Course material development
Dates	April 7 – April 9
Approximate Costs	Nb people : 1 Travel : 400 € Stay: 300 €
Long Range Impact on Integration	The course material developed will be reused at future industrial and academic workshops
Published Work	Evaluation report from the course available
Further Collaboration Planned	The next workshop is planned for CDC-ECC in Sevilla, December 2005

6.7.9 Mobility: Graduate Week in Valencia (UPM to UPVLC)

Sending Institution	**ARTIST2 Partner** Universidad Politechnica de Madrid Contact: Juan de la Puente
Receiving Institution	**ARTIST2 Partner**: Universidad Politechnica de Valencia Contact: Pedro Albertos
Persons	Researcher/Lecturer Juan de la Puente: Control for embedded systems
Area of Collaboration	JPASE graduate course. Lectures
Technical Work	Course material development
Dates	April 5 – April 7
Approximate Costs	Nb people : 1 Travel : 200 € Stay: 200 €
Long Range Impact on Integration	The course material developed will be reused at future industrial and academic workshops
Published Work	Evaluation report from the course available
Further Collaboration Planned	The next workshop is planned for CDC-ECC in Sevilla, December 2005

6.7.10 Mobility: Lund Workshop (UPVLC to Lund)

Sending Institution	**ARTIST2 Partner**: Universidad Politechnica de Valencia Contact: Alfons Crespo
Receiving Institution	**ARTIST2 Partner** Lund University Contact: Karl-Erik Årzén
Persons	Researcher Pedro Albertos: Control for embedded systems Researcher Alfons Crespo: Control for embedded systems

Area of Collaboration	Control for computing systems, Real-Time implementation of control systems
Technical Work	Participation in the International Artist2 Workshop/Thinktank on Control for Embedded Systems
Dates	June 12 – June 15
Approximate Costs	Nb people : 2 Travel : 800 € Stay: 600 €
Long Range Impact on Integration	A workshop of crucial importance to this cluster
Published Work	Scientific research agenda available on http://www.control.lth.se/~karlerik/LundWorkshop.html
Further Collaboration Planned	No new workshop of this type is currently planned.

6.7.11 Mobility: Lund Workshop (KTH to Lund)

Sending Institution	**ARTIST2 Partner**: Royal Institute of Technology, KTH Contact: Karl-Henrik Johansson
Receiving Institution	**ARTIST2 Partner** Lund University Contact: Karl-Erik Årzén
Persons	Researcher Karl-Henrik Johansson: Control for embedded systems Researcher Mikael Johansson: Control for embedded systems Researcher Martin Törngren: Control for embedded systems
Area of Collaboration	Control for computing systems, Real-Time implementation of control systems
Technical Work	Participation in the International Artist2 Workshop/Thinktank on Control for Embedded Systems
Dates	June 12 – June 15
Approximate Costs	Nb people : 3 Travel : 750 € Stay: 800 €
Long Range Impact on Integration	A workshop of crucial importance to this cluster
Published Work	Scientific research agenda available on http://www.control.lth.se/~karlerik/LundWorkshop.html

Further Collaboration Planned	No new workshop of this type is currently planned.

6.7.12 Mobility: Lund Workshop (UIUC to Lund)

Sending Institution	**ARTIST2 Affiliated Partner**: University of Illinois, Urbana-Chanpagne Contact: Lui Sha
Receiving Institution	**ARTIST2 Partner** Lund University Contact: Karl-Erik Årzén
Persons	Researcher Lui Sha: Control for embedded systems
Area of Collaboration	Control for computing systems, Real-Time implementation of control systems
Technical Work	Participation in the International Artist2 Workshop/Thinktank on Control for Embedded Systems
Dates	June 11 – June 17
Approximate Costs	Nb people : 1 Travel : 1.000 € Stay: 700 €
Long Range Impact on Integration	A workshop of crucial importance to this cluster
Published Work	Scientific research agenda available on http://www.control.lth.se/~karlerik/LundWorkshop.html
Further Collaboration Planned	No new workshop of this type is currently planned.

6.7.13 Mobility: Lund Workshop (UVirginia to Lund)

Sending Institution	**ARTIST2 Affiliated Partner**: University of Virginia Contact: Tarek Abdelzaher
Receiving Institution	**ARTIST2 Partner** Lund University Contact: Karl-Erik Årzén
Persons	Researcher Tarek Abdelzaher: Control for embedded systems
Area of Collaboration	Control for computing systems, Real-Time implementation of control systems

Technical Work	Participation in the International Artist2 Workshop/Thinktank on Control for Embedded Systems
Dates	June 11 – June 17
Approximate Costs	Nb people : 1 Travel : 1.000 € Stay: 700 €
Long Range Impact on Integration	A workshop of crucial importance to this cluster
Published Work	Scientific research agenda available on http://www.control.lth.se/~karlerik/LundWorkshop.html
Further Collaboration Planned	No new workshop of this type is currently planned.

6.7.14 Mobility: Artist2 activities at IFAC World Congress (LUND to CTU)

Sending Institution	**ARTIST2 Partner** Lund University Contact: Karl-Erik Årzén
Receiving Institution	**ARTIST2 Partner** Czech Technical University Contact: Zdenek Hanzalek
Persons	Researcher Karl-Erik Årzén: Control for embedded systems Researcher Anton Cervin: Control for embedded systems PhD Student Dan Henriksson: Control for embedded systems
Area of Collaboration	Control for computing systems, Real-Time implementation of control systems
Technical Work	Participation in the Artist2 tutorial and invited session at the IFAC World Congress, Prague
Dates	July 2 – July 9
Approximate Costs	Nb people : 3 Travel : 700 € Stay: 2400 €
Long Range Impact on Integration	Imporant for the dissemination of the cluster activities and for the cluster integration
Published Work	Invited session papers available in the Proceedings of the IFAC World Congress. The survey presentation by Årzén and Cervin is included in "Selected Plenaries, Milestones and Survey," 16th IFAC World Congress, Prague, Czech Republic, 2005
Further	A workshop will be held at CDC-ECC'05 December 2005

Collaboration Planned	

6.7.15 Mobility: Artist2 activities at IFAC World Congress (UPVLC to CTU)

Sending Institution	**ARTIST2 Partner**: Universidad Politechnica de Valencia Contact: Alfons Crespo
Receiving Institution	**ARTIST2 Partner** Czech Technical University Contact: Zdenek Hanzalek
Persons	Researcher Pedro Albertos: Control for embedded systems
Area of Collaboration	Control for computing systems, Real-Time implementation of control systems
Technical Work	Participation in the Artist2 invited session at the IFAC World Congress, Prague
Dates	July 4 – July 9
Approximate Costs	Nb people : 1 Travel : 400 € Stay: 800 €
Long Range Impact on Integration	Imporant for the dissemination of the cluster activities and for the cluster integration
Published Work	Invited session papers available in the Proceedings of the IFAC World Congress. The survey presentation by Årzén and Cervin is included in "Selected Plenaries, Milestones and Survey," 16th IFAC World Congress, Prague, Czech Republic, 2005
Further Collaboration Planned	A workshop will be held at CDC-ECC'05 December 2005

6.7.16 Mobility: Artist2 activities at IFAC World Congress (KTH to CTU)

Sending Institution	**ARTIST2 Partner**: Royal Institute of Technology Contact: Martin Törngren
Receiving Institution	**ARTIST2 Partner** Czech Technical University Contact: Zdenek Hanzalek
Persons	Researcher Martin Sanfridson: Control for embedded systems Researcher Karl Henrik Johansson: Control for embedded systems Researcher Xiaoming Hu: Control for embedded systems

Area of Collaboration	Control for computing systems, Real-Time implementation of control systems
Technical Work	Participation in the Artist2 invited session at the IFAC World Congress, Prague
Dates	July 4 – July 9
Approximate Costs	Nb people : 3 Travel : 700 € Stay: 2400 €
Long Range Impact on Integration	Imporant for the dissemination of the cluster activities and for the cluster integration
Published Work	Invited session papers available in the Proceedings of the IFAC World Congress. The survey presentation by Årzén and Cervin is included in "Selected Plenaries, Milestones and Survey," 16th IFAC World Congress, Prague, Czech Republic, 2005
Further Collaboration Planned	A workshop will be held at CDC-ECC'05 December 2005

6.8 Testing and Verification

6.8.1 Mobility: Partner collaboration

Sending Institution	Brno (affiliated partner)
Receiving Institution	Aalborg (partner)
Persons	Jiri Barnat, researcher
Area of Collaboration	Distributed model checking
Dates	March 2005, 3 months

6.8.2 Mobility: Partner collaboration

Sending Institution	Aalborg (partner)

Receiving Institution	Twente (partner)
Persons	Gerd Behrmann, associate professor
Area of Collaboration	Verification of cost automata
Dates	May 2005, 3 days

6.8.3 Mobility: Partner collaboration

Sending Institution	LSV/CNRS (partner)
Receiving Institution	Aalborg (partner)
Persons	Patricia Bouyer, researcher
Area of Collaboration	Timed games
Dates	February 2005, 1 week

6.8.4 Mobility: Partner visit

Sending Institution	Aalborg (partner)
Receiving Institution	Offis (partner)
Persons	Gerd Behrmann, associate professor
Technical Work	Investigation of possible collaboration on tools for verification of real-time systems
Dates	November 2004, 2 days

6.8.5 Mobility: Partner collaboration

Sending Institution	Twente (partner)
Receiving Institution	Aalborg (partner)
Persons	Ed Brinksma, professor
Area of Collaboration	Cost automata
Dates	November 2004, 3 days

6.8.6 Mobility: Partner collaboration

Sending Institution	Aalborg (partner)
Receiving Institution	LSV/CNRS (partner)
Persons	Kim G Larsen, professor
Area of Collaboration	Quantitative verification of timed models
Dates	March 2005, 10 days

6.8.7 Mobility: Partner collaboration

Sending Institution	CFV (Partner)
Receiving Institution	INRIA, Rennes (Partner)
Persons	Axel LEGAY, researcher
Area of Collaboration	Verification of infinite and timed systems
Dates	2*5 days (two visits)

6.8.8 Mobility: Partner collaboration

Sending Institution	Uppsala (Partner)
Receiving Institution	CFV (Partner)

Persons	Johan Deneux, researcher
Area of Collaboration	Timed systems
Dates	6 days

6.8.9 Mobility: Partner collaboration

Sending Institution	CFV (Partner)
Receiving Institution	EPFL (Affiliated partner)
Persons	Laurent Doyen, researche
Area of Collaboration	Hybrid systems
Dates	3 months

6.8.10 Mobility: Partner collaboration

Sending Institution	CFV (Partner)
Receiving Institution	Uppsala (Partner)
Persons	Gilles Geeraerts, researcher
Area of Collaboration	Timed systems
Dates	8 days

6.8.11 Mobility: Partner collaboration

Sending Institution	France Telecom (Affiliated partner)
Receiving Institution	Verimag (Partner)
Persons	Francis Klay, researcher
Area of Collaboration	Verification of security properties
Dates	1 month

6.8.12 Mobility: Partner collaboration

Sending Institution	University of Newcastle upon Tyne
Receiving Institution	Verimag (Partner)
Persons	Peter Ryan, professor
Area of Collaboration	Verification of security properties
Dates	3 days

6.8.13 Mobility: Partner collaboration

Sending Institution	Indian Institute of Science, Bangalore
Receiving Institution	Verimag (Partner)
Persons	Kanchi Gopinath, Associate Professor
Area of Collaboration	Verification of security properties
Dates	3 months

6.8.14 Mobility: Partner collaboration

Sending Institution	University A.I. Cuza, Iassy
Receiving Institution	Verimag (Partner)
Persons	Ferucio Laurentiu Tiplea, Professor
Area of Collaboration	Verification of security properties
Dates	2 days

6.8.15 Mobility: Partner collaboration

Sending Institution	LSV Cachan (Partner)
Receiving Institution	Inria Rennes (Partner)
Persons	Jerome Leroux, Post-doc

Area of Collaboration	Verification of infinite state systems and conformance testing of programs with floating point numbers
Dates	1 year

6.8.16 Mobility: Partner collaboration

Sending Institution	Uppsala (Partner)
Receiving Institution	NUS, Singapore
Persons	Pavel Krcal, researcher
Area of Collaboration	Semantics of timed systems
Dates	30 days

6.8.17 Mobility: Partner collaboration

Sending Institution	Brno (Affiliated partner)
Receiving Institution	Uppsala (Partner)
Persons	Radek Pelanek, researcher
Area of Collaboration	Verification of timed systems
Dates	3 weeks

6.8.18 Mobility: Partner collaboration

Sending Institution	LSV/CNRS (Partner)
Receiving Institution	University of Bonn
Persons	Nathalie Bertrand, researcher
Area of Collaboration	Verification of probabilistic channel systems
Dates	August 2005, 6 weeks

6.8.19 Mobility: Partner collaboration

Sending Institution	University of Torino
Receiving Institution	LSV/CNRS (partner)
Persons	Jeremy Sproston, researcher
Area of Collaboration	Verification of probabilistic timed systems
Dates	July 2005, 2 weeks

6.8.20 Mobility: Partner collaboration

Sending Institution	University of Bonn
Receiving Institution	LSV/CNRS (partner)
Persons	Christel Baier, professor
Area of Collaboration	Verification of probabilistic channel systems
Dates	February 2005, 4 weeks

7. Joint projects and joint proposals

Project/proposal name:	PREDATOR: Design for Predictability and Efficiency
Date:	September 2005
Artist2 partners:	Universität des Saarlandes (Reinhard Wilhelm), University of Bologna (Luca Benini), University of Pavia (Giorgio Buttazzo), Swiss Federal Institute of Technology (Lothar Thiele), Absint (Christian Ferdinand).

Project/proposal name:	CREW: Cooperative Real-time Environment based on Wireless mobile networks
Date:	September 2005
Artist2 partners:	University of Pavia (Giorgio Buttazzo), Technische Universität Kaiserslautern (Gerhard Fohler), Univeristy of Aveiro (Luis Almeida), Scuola Superiore S. Anna (Giuseppe Lipari), Evidence s.r.l. (Paolo Gai).
Other Partners:	(CSEM) Jean-Dominique Decotignie

Project/proposal name:	FRESCOR: Cooperative Real-time Environment based on Wireless mobile networks
Date:	September 2005
Artist2 partners:	University of Cantabria (Michael Gonzalez Harbor), University of York (Alan Burns), Technische Universität Kaiserslautern (Gerhard Fohler), Scuola Superiore S. Anna (Giuseppe Lipari), Univeristy of Valentia (Alfons Crespo), Evidence s.r.l. (Paolo Gai).
Other Partners:	Rapita (Guillem Bernat), ENEA Epact (Thorbjorn Jemander).

Project/proposal name:	SIMD code optimization Date: 2006 Artist2 partners: Aachen, ACE, (+ potentially STM)
Project name: Date: 2003-2006	FLEXCON (Swedish National project) Artist2 partners: Lund University (Karl-Erik Årzén), Martin Törngren (KTH), Mälardalens Högskola (Ivica Crnkovic, Gerhard Fohler)
Project name: Date: 2004-2007	RUNES (EU/IST FP6 IP) Artist2 partners: Lund University (Karl-Erik Årzén), Karl-Henrik Johansson (KTH)
Significant other Partners:	Ericsson (Andras Toth)
Project name:	OCERA (EU FP5)

Date:	2004
Artist2 partners:	CTU (Zdenek Hanzalek), UPVLC (Alfons Crespo), SSSA (Giuseppe Lipari)
Project name:	SMERobot (EU FP6 IP)
Date:	2005-2008
Artist2 partners:	Lund University (Rolf Johansson), ABB (Torgny Brogårdh)
Project/proposal name:	QeS (Quantitative Methods for Medel Driven Design of Embedded Systems), STREP proposal
Date: September, 2005	Artist2 partners: Aalborg (Larsen), Uppsala(Yi), Twente(Langemak), INRIA(Tripakis), CNRS(Laroussinie), Brno (Brim) (Affiliated in Artist2), Saarland (Hermans), CFV(Raskin), Significant other Partners: Nijmegen University (Netherlands), Aachen University (Germany), FOSS A/S (Denmark), Bosch GmbH (Germany), CRIL Technology (France), Embedded Systems Institute (Netherlands),
Project:	ATESST – IST/FP6-4 eSafety
Date:	02/01/2006
Artist2 partners:	CEA-List (S. Gérard & D. Servat); KTH
Significant other Partners:	Daimlerchrysler, Volvo Technology, Siemens VDO, ETAS, Mentor Graphics
Project:	Usine Logicielle (Software Factory) – French national project of the System@tic competitivity pole
Date:	01/12/2005
Artist2 partners:	CEA-List (F. Terrier & S. Gérard & H. Dubois); INRIA
Significant other Partners:	Thales R&T, EADS ST, Dassault Aviation, Hispano Suiza, Esterel Technologies
Proposal:	SPICES – ITEA
Date of acceptance:	Nov. 2005
Artist2 partners:	CEA-List, Verimag, U. Cantabria
Significant other Partners:	Thales Communications, Airbus, Thales Avionics, Barco
Proposal:	OpenEmbDD – French national project
Date of acceptance:	Nov. 2005
Artist2 partners:	CEA-List, Verimag, INRIA, FT R&D
Significant other Partners:	Thales R&T, Airbus, Thales Avionics
Project/proposal name:	Democrites
Date:	October 2005
Artist2 partners:	P. Caspi Verimag, L. Almeida U of Aveiro
Significant other Partners:	Esterel technologies (T. LeSergent) Prover technology (N. Breton) Audi (D. Kant)
Project/proposal name:	WCET (project within the ASTEC competence centre)
Date:	2004 – 2005
Artist2 partners:	Mälardalen University (B. Lisper), AbsInt (C. Ferdinand), Tidorum (N. Holsti), Uppsala University (J. Engblom)

Significant other Partners:	Volcano Communication Technologies AB, Enea Embedded Technologies AB, Arcticus Systems AB, CC-Systems AB, IAR Systems AB
Project/proposal name:	Execution Time Analysis of Time-Critical Embedded Software
Date: 2006 – 2008,	
Artist2 partners:	Mälardalen University (B. Lisper), AbsInt (C. Ferdinand), Tidorum (N. Holsti)
Significant other Partners:	Arcticus Systems AB, CC-Systems AB, IAR Systems AB, Volvo Construction Equipment AB
Project/proposal name:	SYSMODEL
Date:	Submitted April 2005 as FP6 Collective Research Project. Was prequalified and a full proposal has been submitted November 2005.
Artist2 partners:	DTU, Jan Madsen KTH, Axel Jantsch (affiliated partner)
Significant other Partners:	IO Technology (DK), Rune Domsten, Free2Move (SE), Avantel (SE), Maria Mansson, Artec (EE), Juri Poldre, VLSI (FI), Tapani Ritoniemi, DELTA (DK), Gunnar B. Andersen, TTÜ (EE), Peeter Ellervee, TUT (FI), Jari, Nurmi, Acreo (SE), Stella Granstrom
Project/proposal name:	HEART (STREP proposal)
Date:	Sept 2005 (submitted)
Artist2 partners:	U Aveiro, Luis Almeida; CTU Prague, Zdenek Hanzalek; U Catania, Lucia Lo Bello (affiliate); U Illes Baleares, Julian Proenza (affiliate).
Significant other Partners:	Austrian Academy of Sciencies, Thilo Sauter; ZH Winterthur, Thomas Muller.
Project/proposal name:	QeS (Quantitative Methods for Medel Driven Design of Embedded Systems), STREP proposal
Date:	September, 2005
Artist2 partners:	Aalborg (Larsen), Uppsala(Yi), Twente(Langemak), INRIA(Tripakis), CNRS(Laroussinie), Brno (Brim) (Affiliated in Artist2), Saarland (Hermans), CFV(Raskin),
Significant other Partners:	Nijmegen University (Netherlands), Aachen University (Germany), FOSS A/S (Denmark), Bosch GmbH (Germany), CRIL Technology (France), Embedded Systems Institute (Netherlands),

8. Durable Structures for Spreading Excellence

One of the main objectives for the consortium is to successfully implement lasting integration in the area. This can be achieved by setting up the appropriate instruments and structure, with a vision for financial autonomy.

ARTIST2 will establish lasting structures to enhance interaction and collaboration between partners, and also with the industrial and research communities at large. ARTIST2 will capitalize on knowledge through a set of instruments, to build a common reference point for the development of research and training of new researchers.

We have begun setting up such a structure, based around a Distringuished Lecturer Programme, described here. This is only the first of what we hope will be a large set of self-sustaining structures for interfacing between public research and industry.

8.1 ARTIST2 Distinguished Lecturer Programme

The Distinguished Lecturer Program is a well-tested concept introduced by the IEEE Professional Societies who have used it to favour spreading of knowledge in the IEEE community. The lecturers are nominated by the executive committees of the Professional Societies and are chosen on the basis of their prominence in the field. They are available to local IEEE sections who wish to organize seminars and conferences for their constituencies. The cost of travel and a fee for the seminars are paid with the IEEE budget set aside for this purpose. We propose to follow this model whereby some of the pre-eminent European researchers in the ARTIST NoE will be selected by the International Scientific Council to represent the research community on embedded software and systems. These lecturers will be rotated every two years to offer a continuous refresh of ideas and approaches. The ARTIST2 NoE will take care of the expenses incurred by the lecturer and will pay a fee for the seminars. Core teams will have the priority in asking for a seminar from the Distinguished Lecturers.

9. Affiliated Partners in the ARTIST2 Research Activities

ARTIST2 has a very extended family, through its affiliated industrial, SME, academic, and international collaboration partners. These are one of our main operational links for concretely spreading excellence outside the Network of Excellence.

ARTIST2 is proactive in identifying and integrating new affiliated partners into our research activities.

The affiliated partners have strong relations with the consortium, and they contribute actively to and fully benefit from the NoEs results.

9.1 Affiliated Industrial Partners

Company	Areas of expertise	ARTIST2 Activities	Company Contacts
ABB Automation	Modelling and validation of industrial robotics non-functional properties in industrial control systems	Quantitative Testing and Verification Component Modelling and Composition	Christer Norström,
ABB Automation	real-time control and automation, cases	Real-time techniques in control system implementations Adaptive Real-time, HRT and Control	Göran Arinder
Airbus France	avionics industrial case study	Merging the Event-triggered and Time-triggered Paradigms	Francois Pilarski
Bosch	automotive industrial case study	Merging the Event-triggered and Time-triggered Paradigms	Stephan Kowalewski
DaimlerChrysler	Specification, Design and Implementation of automotive systems	Component Modelling and Composition	Matthias Grochtmann
DaimlerChrysler	automotive industrial case study	Merging the Event-triggered and Time-triggered Paradigms	Thomas Thurner / Hermann von Hasseln
Daimler-Chrysler	automotive systems design	Semantic Framework for Hard Real-Time Design Flow	Heiko Dörr
EADS	Case study on architecture	Platform for	David Lesens

	modelling and schedulability analysis	Component Modelling and Verification	
EDF Recherche et Développement	static analysis and model checking	Quantitative Testing and Verification	Alain Ourghanlian
Ericsson Mobile Platforms	Telecommunication, resource management, multimedia content , case studies	Control in Real-time Computing Adaptive Resource Management for Consumer Electronics Adaptive Real-time, HRT and Control	Johan Eker
Hispano-Suiza (previously: Snecma)	avionics systems design	Semantic Framework for Hard Real-Time Design Flow	Philippe Baufreton
Honeywell Prague Labs	case studies	Design Tools for Embedded Control Real-time techniques in control system implementations	Vladimir Havlena
Infineon	failure rates for hardware components	Diagnosis in Distributed Hard Real-Time Systems	Knut Hufeld
Israeli Aircraft Industries	avionics systems design	Semantic Framework for Hard Real-Time Design Flow	Michael Winokur
Nokia Mobile Phones Denmark A/S	providing requirements and applications	EP: System Modeling Infrastructure	Peter Mårtensson
Philips Research	Consumer electronics, video streaming	Adaptive Resource Management for Consumer Electronics	Withheld for reasons of confidentiality
Siemens Mobile Phones A/S	development of embedded systems using model-driven methodology	Quantitative Testing and Verification	Sven H. Sørensen
STMicroelectronics	low power single-chip	Design for Low	Roberto Zafalon

	multiprocessors providing requirements and applications dynamically controlling power consumption in PMSoC platforms	Power EP: System Modeling Infrastructure Resource-aware Design	
SymTAVision GmbH		Communication-centric Systems	Kai Richter
Telelogic	Testing tool provider	Quantitative Testing and Verification	Tommy Ericsson
Thales	component-based middleware, Co-Chair of MARS group at OMG on CORBA, RTE	QoS aware Components	Virginie Watine
Thalès Research and Technology	standardization and case study from the aerospace or telecommunication domain	Development of UML for Real-time Embedded Systems	Dominique Potier
Volkswagen AG	software integration under real-time constraints	Communication-centric Systems	Fabian Wolf
Volvo	requirements analysis	EP: System Modeling Infrastructure Design Tools for Embedded Control Communication-centric Systems	Magnus Hellring
Volvo Car Corporation	real-time control, networked control, case studies	Design Tools for Embedded Control Real-time techniques in control system implementations Merging the Event-triggered and Time-triggered Paradigms	Jakob Axelsson
Volvo Technical Development	real-time control, networked control, cases	Real-time techniques in control system implementations	Henrik Lonn

9.2 Affiliated SME Partners

Company	Areas of expertise	ARTIST2 Activities	Company Contacts
ACE:	compiler development platform compilation techniques	Architecture-aware compilation Compilers Platform	Hans van Someren
ARTiSAN Software	UML standard evolutions	Component Modelling and Composition Development of UML for Real-time Embedded Systems	Alan Moore
dSPACE	case studies and development tools real-time control	Design Tools for Embedded Control Real-time techniques in control system implementations Semantic Framework for Hard Real-Time Design Flow	Joachim Stroop
Enea Embedded Technology	Real Time Operating Systems and Testing	Quantitative Testing and Verification	Jan Lindblad
Esterel Technologies	tool provider	Semantic Framework for Hard Real-Time Design Flow	Bernard Dion
Evidence s.r.l.	real-time kernels and OSEK standard	A Common Infrastructure for Adaptive Real-time Systems Flexible Scheduling Technologies Adaptive Resource Management for Consumer Electronics	Paolo Gai
IAR Systems A/S	verification and code generation tool provide	Quantitative Testing and Verification	Henrik Leerberg
Tidorum	Timing-Analysis Tools	Timing Analysis Platform	Niklas Holsti
TNI-ValioSys	tool provider	Semantic Framework for Hard Real-Time	Jean-Luc Lambert

		Design Flow	
TTTech	diagnostic tools	Diagnosis in Distributed Hard Real-Time Systems	Judith Sattlberger

9.3 Affiliated Academic Partners

Contacts	Institution	Areas of expertise	ARTIST2 Activities
Miroslaw Malek	Humboldt-University of Berlin	diagnostic algorithms	Diagnosis in Distributed Hard Real-Time Systems
Francky Catthoor	IMEC	high-level code optimization	Architecture-aware compilation
Isabelle Puaut	IRISA	Timing-Analysis Tools	Timing Analysis Platform
Geert Deconinck	K.U. Leuven	low power architectures	Design for Low Power
Stefan van Baelen	K.U. Leuven	QoS specifications and negotiation mechanisms	Development of UML for Real-time Embedded Systems QoS aware Components
Ahmed Bouajjani	LIAFA (Paris)	Real-time and hybrid model checking	Quantitative Testing and Verification
Ivica Crnkovic	Mälardalen **	Component models for embedded systems Platform for Component Modelling and Verification	Component Modelling and Composition
Tretmans	Nijmegen	Testing	Quantitative Testing and Verification
Laurent Pautet	Paris Telecom	distributed systems real-time middleware, timed contract based behavioural typing, component-based adaptive services in mobile networks	Flexible Scheduling Technologies QoS aware Components
Luciano Lavagno	Politecnico di Torino	low power circuits system-level design and hardware platforms	Design for Low Power Semantic Framework for Hard Real-Time Design Flow
Giuseppe Lipari	Scuola Superiore S. Anna	dynamic priority schemes	A Common

		kernel maintenance	Infrastructure for Adaptive Real-time Systems Flexible Scheduling Technologies
Marius Minea	Timisoara	extraction and abstraction of interfaces	Component Modelling and Composition
Andreas Krall	TU Vienna **	code optimization Program-Analysis Tool	Architecture-aware compilation Compilers Platform
Carlos Delgado Kloos	U. Carlos III of Madrid	QoS Management QoS component infrastructures	A Common Infrastructure for Adaptive Real-time Systems QoS aware Components
Marisol García-Valls	U. Carlos III of Madrid	QoS management	Adaptive Resource Management for Consumer Electronics
Willem-Paul de Roever	U. Kiel	formal methods, stepwise refinement	Semantic Framework for Hard Real-Time Design Flow
Julio Medina	Univ. of Cantabria **	notations and tools for scheduling analysis	Component Modelling and Composition Platform for Component Modelling and Verification
Lucia Lo Bello	Univ. of Catania	communication protocol and stochastic scheduling	Flexible Scheduling Technologies
Pau Marti	Universitat Politècnica de Catalunya	control methodologies	A Common Infrastructure for Adaptive Real-time Systems
Lubos Brim	University Brno	distributed model checking	Quantitative Testing and Verification
Bernhard Steffen	University Dortmund **	tool integration platform	Platform for Component Modelling and Verification
Andrea Bondavalli	University of Florence	statistical methods for diagnosis	Diagnosis in Distributed Hard Real-Time Systems

** different team from the Artist2 partner

9.4 Affiliated International Partners

Contacts	Institution	Areas of expertise	ARTIST2 Activities
Stephen Edwards	Columbia University	software engineering, formal methods in programming languages, automated testing, component-based approaches	
Mathai Joseph	Tata Research Development & Design Centre (TRDDC), a division of Tata Consultancy Services, Ltd	Formal methods	
Ed Lee	UC Berkeley	systems theory, concurrent models of computation	
Shankar Sastry	UC Berkeley	hybrid Systems, computation and control	
Lui Sha	Univ of Illinois	control of server systems control in embedded computing	Control in Real-time Computing Adaptive Real-time, HRT and Control
P.S. Thiagarajan	Univ of Singapore	models and logics for distributed systems	Semantic Framework for Hard Real-Time Design Flow
Kang Shin	University of Michigan	mobile and wireless networks, security, sensor networks	
Sharon Hu	University of Notre Dame, USA	Power analysis and optimization	Communication-centric Systems
Tarek Abdelzaher	University of Virginia	control of server systems control in embedded computing	Control in Real-time Computing Adaptive Real-time, HRT and Control
John Stankovic	University of Virginia	Real-time computing, embedded computing, operating systems, wireless sensor networks, and large	

		scale distributed computing.	

10. Publications

10.1 Joint Publications

Joint publications reflect deep and lasting integration between participants, while at the same time spreading the results the the wider research community.

10.1.1 Papers

The list is unsorted.

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S.Mahadevan, F. Angiolini, M. Storgaard, R. G. Olsen, J. Sparsø, and J. Madsen. A network traffic generator model for fast networkon-chip simulation. In Proceedings of Design, Automation and Testing in Europe Conference 2005 (DATE05)

F. Angiolini, S. Mahadevan, J. Madsen, L. Benini, and J. Sparsø. Realistically rendering soc traffic patterns with interrupt awareness. In IFIP International Conference on Very Large Scale Integration (VLSI-SoC), September 2005.

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Paul Pop, Petru Eles, Zebo Peng, Viacheslav Izosimov, Magnus Hellring, Olof Bridal: Design Optimization of Multi-Cluster Embedded Systems for Real-Time Applications. l Design, Automation and Test in Europe (DATE 2004). **Publication with Volvo**

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A. Benveniste, B. Caillaud, L. Carloni, P. Caspi, A. Sangiovanni-Vincentelli. ``Heterogeneous Reactive Systems Modeling: Capturing Causality and the Correctness of Loosely Time-Triggered Architectures (LTTA)". *Proc. of EMSOFT'2004,* G. Buttazzo and S. Edwards, Eds., Sept. 27-29, 2004.

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10.2 Modelling and Components

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M. Åkerholm: A Software Component Technology for Vehicle Control Systems, Licentiate Thesis, Mälardalen University Press, February, 2005

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