

Year 2 Review  
Paris, November 8th and 9th, 2006

## *Objectives, General Structure*

# Scientific Management

Joseph Sifakis, Bruno Bouyssounouse

Verimag

# Agenda

- 9:00 **Project Officer's Announcements**  
*Javid Khan (European Commission)*
- ▶ New Projects
  - ▶ FP7
  - ▶ IST Event

## Management Overview

- 9:15 **Objectives, General Structure, and Scientific Management**  
*Scientific Coordinator: Joseph Sifakis (UJF/VERIMAG)*

- 10:15 **Financial & Contractual Management**  
*Jean-Noel Forget (CDC)*

10:30 *break*

## Real-Time Components Cluster

- 10:45 **Achievements and Perspectives**  
*Cluster leader: Albert Benveniste (INRIA)*  
*represented by Bengt Jonsson (Uppsala)*
- ▶ Overall Aims and Achievements
  - ▶ Future Evolution: 18-month Workprogramme

11:05 **General Discussion on the Deliverables**

- 11:20 **Scientific Highlights from the Cluster**
- ▶ Industrial Forums - *Werner Damm (OFFIS)*
  - ▶ EMSOFT workshop - *Joseph Sifakis (Verimag)*
  - ▶ UML for RTES - *François Terrier (CEA)*
  - ▶ Platform - *Susanne Graf (Verimag)*

12:00 *lunch*

## Adaptive Real Time

- 13:30 **Achievements and Perspectives**  
Cluster leader: *Giorgio Buttazzo (Sant'Anna - Pisa)*
- ▶ Overall Aims and Achievements
  - ▶ Future Evolution: 18-month Workprogramme

13:50 **General Discussion on the Deliverables**

- 14:05 **Scientific Highlights from the Cluster**
- ▶ Flexible Scheduling Framework - *Michael Gonzalez Harbour (Cantabria)*
  - ▶ Network support for adaptive distributed systems - *Eduardo Tovar (Porto)*

## Compilers and Timing Analysis

- 14:45 **Achievements and Perspectives**  
Cluster leader: *Reinhard Wilhelm (Saarland)*  
Rainer Leupers (Aachen)
- ▶ Overall Aims and Achievements
  - ▶ Future Evolution: 18-month Workprogramme

15:05 **General Discussion on the Deliverables**

- 15:20 **Scientific Highlights from the Cluster**
- ▶ The WCET Tool Challenge and Predictability of Cache Replacement Strategies

16:00 *break*

## Execution Platforms

- 16:15 **Achievements and Perspectives**  
Cluster leader: *Lothar Thiele (ETHZ)*
- ▶ Overall Aims and Achievements
  - ▶ Future Evolution: 18-month Workprogramme

16:35 **General Discussion on the Deliverables**

16:50 **Scientific Highlights from the Cluster**

17:30 *end of day 1*

19:30 *Gala Dinner*

## Control for Embedded Systems

### 9:00 Achievements and Perspectives

Cluster leader: *Karl-Erik Arzen (Lund)*

- ▶ Overall Aims and Achievements
- ▶ Future Evolution: 18-month Workprogramme

### 9:20 General Discussion on the Deliverables

### 9:35 Scientific Highlights from the Cluster

- ▶ Highlights related to CoDesign Tools – *Martin Törngren (KTH)*
- ▶ Embedded Control Design – *Alfons Crespo (UPVLC)*
- ▶ Conclusions from the "Workshop on Interaction Between Control and Embedded Electronics in Automotive Industry" – *Karl-Erik Arzen (Lund)*
- ▶ New European Projects
- ▶ Technical Highlights:
  - ▶ Recent advances in event-based control – *Karl-Erik Arzen (Lund)*
  - ▶ 6 Project Examples

10:15 *break*

## Testing and Verification

### 10:30 Achievements and Perspectives

Cluster leader: *Kim Larsen (Aalborg)*

- ▶ Overall Aims and Achievements
- ▶ Future Evolution: 18-month Workprogramme

### 10:50 General Discussion on the Deliverables

### 11:05 Scientific Highlights from the Cluster

- ▶ Coverage Metrics for Testing - *Ed Brinksmas (Twente/ESI)*
- ▶ Controllers: Robustness and Synthesis - *Jean-Francois Raskin (CFV/ULB)*
- ▶ Real-Time Validation Tools - *Kim G. Larsen (Aalborg)*
- ▶ Specification and Verification of Cryptographic Protocols - *Sandro Etalle (Twente)*

## Global NoE Aspects

### 11:45 Joint Programme of Activities for Spreading Excellence (JPASE)

- ▶ Vision
- ▶ Implementation: Year 2 JPASE Activities and Events
- ▶ Year 3 Perspectives
- ▶ Discussion

Technical Coordinator: *Bruno Bouyssounouse (UJF/Verimag)*

### 12:10 Perspectives for Future Evolution

Scientific Coordinator: *Joseph Sifakis (UJF/Verimag)*

- ▶ Discussion

12:30 *lunch*

## Artist2 General Assembly

### 13:45 Plenary meeting

*all participants are welcome to attend*

## Reviewer's Meeting

### 13:45 Reviewer's Meeting

*in parallel with the General Assembly*

### 15:00 Conclusions and Feedback

*Project Officer and Reviewers*

15:30 *closing*

# History

ARTIST - FP5 Accompanying Measure (2002-2005):

- Coordinate the R&D effort in the area of Advanced Real-time Systems
- Improve awareness of academics and industry in the area
- Define innovative and relevant work directions

Achieved through activities along 3 axes:

- Roadmaps for selected actions:  
(Hard Real Time, Component-based Design,  
Adaptive Real Time, Execution Platforms)
- International Collaboration
- Education

Information about these results is publicly available:  
<http://www.artist-embedded.org/Roadmaps/>

# Embedded Systems Design

Building embedded systems of guaranteed functionality and quality, at an acceptable cost, is a major technological and scientific challenge.

The challenge is to produce theoretical and practical tools, which allow system-centric design approaches, with high:

- *Optimality of the overall product for its intended market segment*  
cost and time to market, quality/safety/security//reliability/dependability, use of resources (energy, bandwidth, processor, memory, etc)
- *Interactability in the embedded system environment*  
access to all available resources via seamless interaction, cooperating and concurrent devices/applications

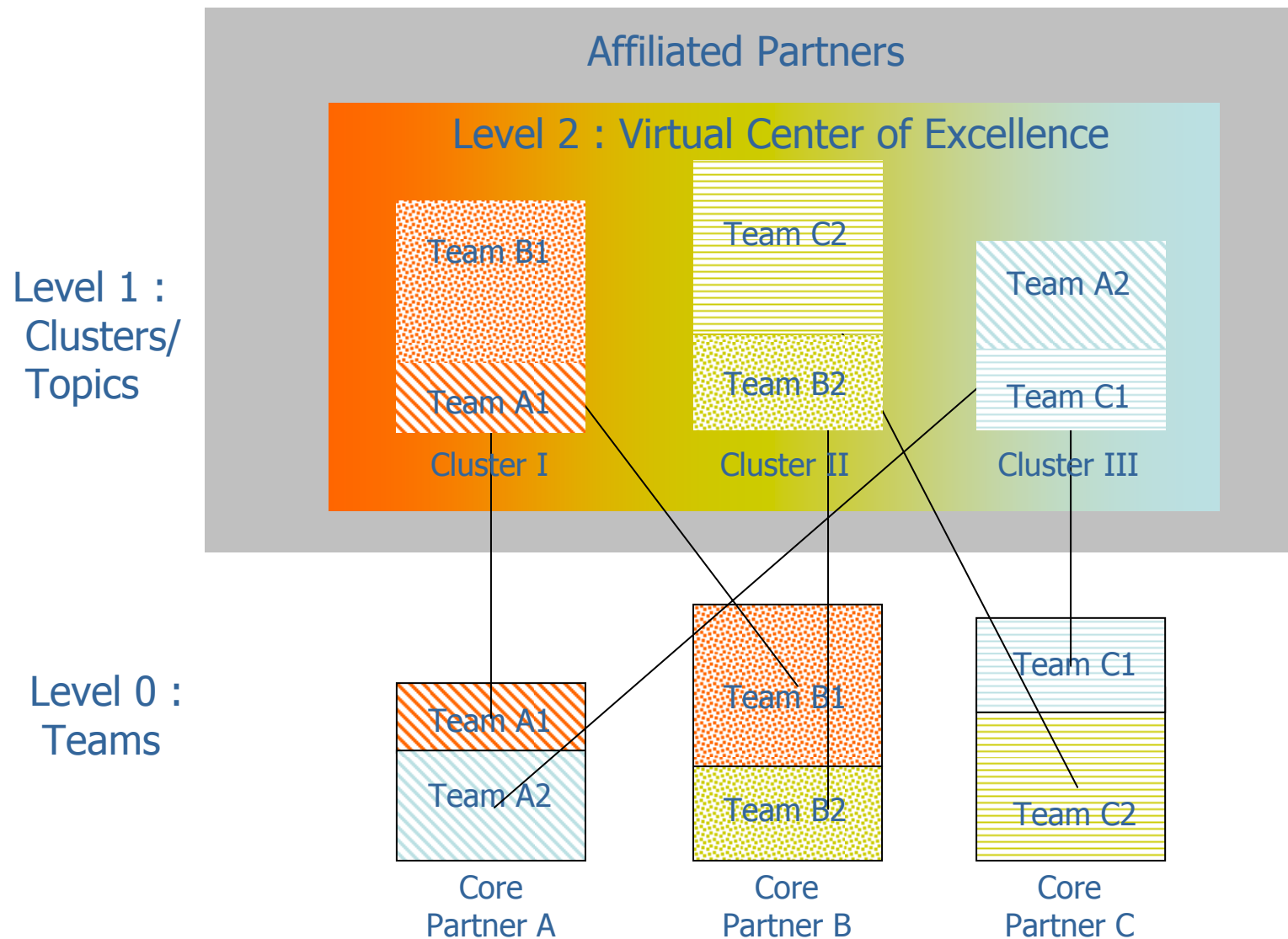
This requires a multi-disciplinary approach, integrating competencies covering the whole spectrum of activities in system development

# Objectives

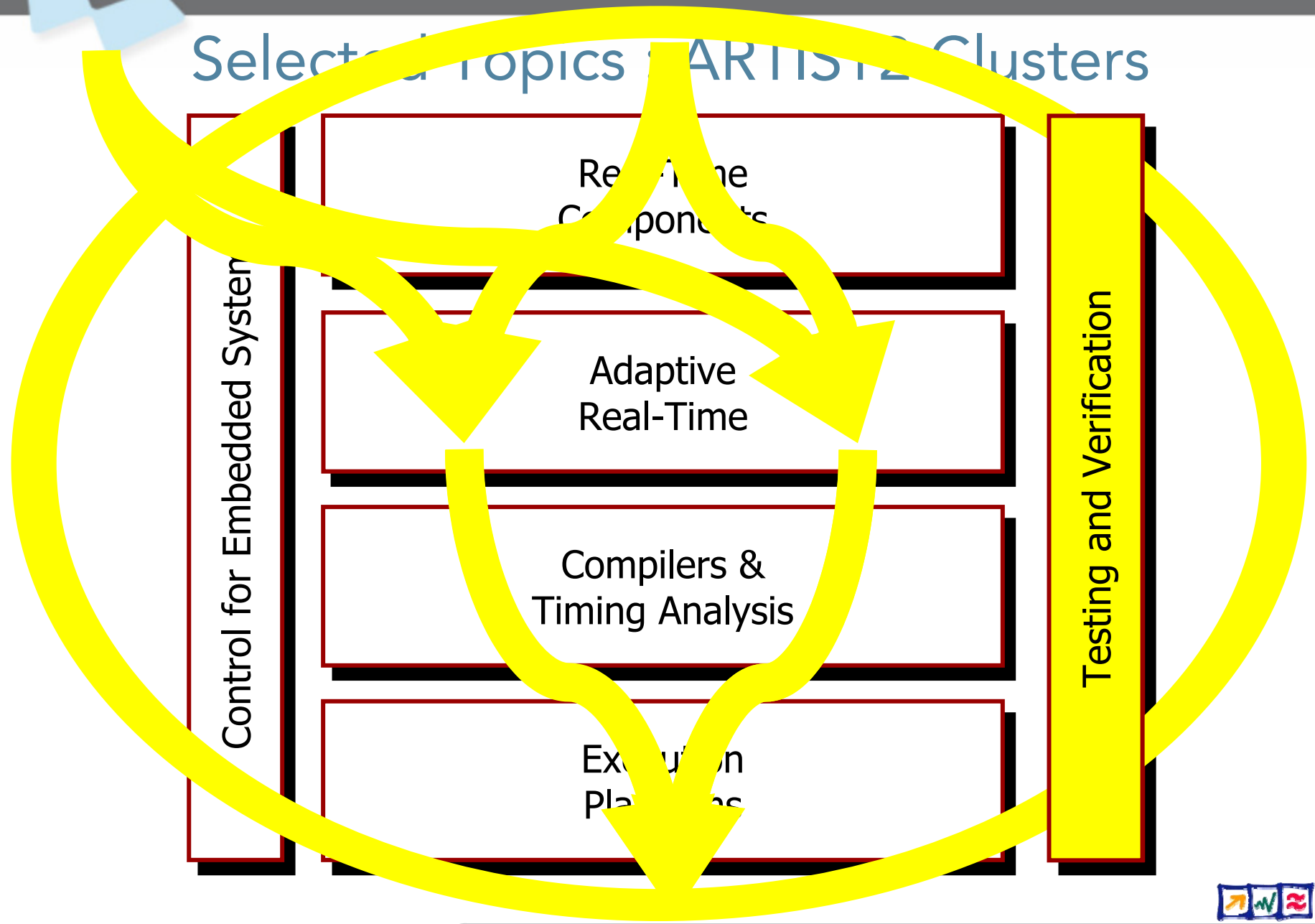
Reinforce and strengthen scientific and technological excellence in Embedded Systems Design:

- The NoE will act as a Virtual Center of Excellence
- **Two levels** of integration to create critical mass from selected European teams
  - **Strong integration** within selected topics by assembling the best European teams, to advance the state of the art in the topic.
  - **Integration between topics** to achieve the multi-disciplinary excellence and skills required for the development of future embedded technologies.
- Integration will be around a Joint Programme of Activities

# Principle of Construction



# Select Topics & ARTIS 12 Clusters



	Short Name	Full Name and Country	Key researchers
1	CDC	Caisse des Dépôts et Consignations (France)	<b>None</b>
2	UJF/ Verimag	University Joseph Fourier / Verimag (France)	Paul Caspi, Susanne Graf, Nicolas Halbwachs, Yassine Lakhnech, Oded Maler, Joseph Sifakis
3	Aachen	RWTH Aachen (Germany)	Rainer Leupers
4	Aalborg	BRICS – Aalborg University (Denmark)	Kim Larsen, Anders Ravn
5	AbsInt	AbsInt Angewandte Informatik GmbH (Germany)	Christian Ferdinand
6	Aveiro	University of Aveiro (Portugal)	Luis Almeida
7	Cantabria	Universidad de Cantabria (Spain)	Michael Gonzalez Harbour
8	CEA	Commissariat à l'Énergie Atomique – Laboratoire LIST (France)	François Terrier
9	CFV	Centre Fédéré en Vérification, Université de Liège (Belgium)	Pierre Wolper
10	Czech TU	Czech Technical University (Czech Republic)	Vladimir Kucera
11	Dortmund	Dortmund University (Germany)	Peter Marwedel
12	DTU	Technical University of Denmark (Denmark)	Jan Madsen
13	ETHZ	Swiss Federal Institute of Technology – Zurich (Switzerland)	Lothar Thiele, Manfred Morari
14	FTR&D	France Telecom R&D	Pierre Combes, Kathleen Milsted
15	INRIA	Institut National de Recherche en Informatique et Automatique (France)	Albert Benveniste, Benoit Caillaud, Alain Girault, Thierry Jéron, Jean-Marc Jézéquel, Paul Le Guernic, Eric Rutten, Yves Sorel, Robert de Simone
16	KTH	Royal Institute of Technology (Sweden)	Martin Törngren
17	Linköping	Linköping University (Sweden)	Petru Eles
18	LSV / CNRS	Centre National de la Recherche Scientifique / Laboratoire LSV (France)	Michel Bidoit, Hubert Comon, Philippe Schnoebelen

Core Partner	Short Name	Full Name and Country	Key scientists
19	Lund	Lund University (Sweden)	Karl-Erik Årzén
20	Mälardalen	University of Mälardalen (Sweden)	Björn Lisper
21	OFFIS	Kuratorium OFFIS e. V. (Germany)	Werner Damm, Bernhard Josko
22	PARADES	PARADES EEIG (Italy)	Alberto Sangiovanni Vincentelli
24	UP Madrid	Universidad Politecnica de Madrid (Spain)	Juan de la Puente
25	Saarland	Saarland University	Reinhard Wilhelm
26	STM	ST Microelectronics – Central R&D (France)	Christian Bertin
27	Eindhoven	Technical University of Eindhoven (Netherlands)	Martin Rem
28	TU Vienna	Technical University of Vienna (Austria)	Hermann Kopetz, Peter Puschner, Philipp Petti
29	TUBS	Technical University Braunschweig (Germany)	Rolf Ernst
30	Twente	University of Twente (Netherlands)	Ed Brinksma
31	UoB	University of Bologna (Italy)	Luca Benini
32	Uppsala	Uppsala University (Sweden)	Bengt Jonsson
33	UPVLC	Universidad Polytechnica de Valencia (Spain)	Alfons Crespi
34	York	University of York (UK)	Guillem Bernat, Alan Burns, Iain Bate, Andy Wellings
35	Porto	Polytechnic of Porto	Eduardo Tovar
36	EPFL	Ecole Polytechnique Fédérale de Lausanne	Tom Henzinger
37	Pisa	Scuola Superiore Sant'Anna (Pisa)	Giorgio Buttazzo
38	Ace	Ace	Joseph Van Vlijmen
39	Tidorum	Tidorum	Niklas Holsti
40	Kaiserslautern	University of Kaiserslautern	Gerhard Fohler

## Real Time Components

### Hard Real Time

Albert Benveniste – INRIA  
 Alberto Sangiovanni – PARADES  
 Paul Caspi – Verimag  
 Hermann Kopetz – TU Vienna  
 Werner Damm – OFFIS

### Modeling and Components

Bengt Jonsson – Uppsala  
 François Terrier – CEA/LIST  
 Jean-Marc Jezequel – INRIA  
 Susanne Graf – Verimag  
 Tom Henzinger - EPFL

### Adaptive Real-time

Giorgio Buttazzo – Pisa  
 Alan Burns – University of York  
 Michael Gonzalez - Cantabria  
 Luis Almeida – Aveiro  
 Gerhard Fohler – Kaiserslautern  
 Juan de la Puente – Polytechnic de Madrid

### Testing & Verification

Kim Larsen - Aalborg/ CISS  
 Ed Brinksma – Twente/Eindhoven  
 Pierre Wolper – Centre Fédéré de Verification  
 Michel Bidoit - LSV  
 Thierry Jeron - INRIA

## Control for Embedded

Karl-Erik Arzen – Lund  
 Martin Torngren – KTH  
 Alfons Crespo – UP Valencia  
 Vladimir Kucera - Czech TU

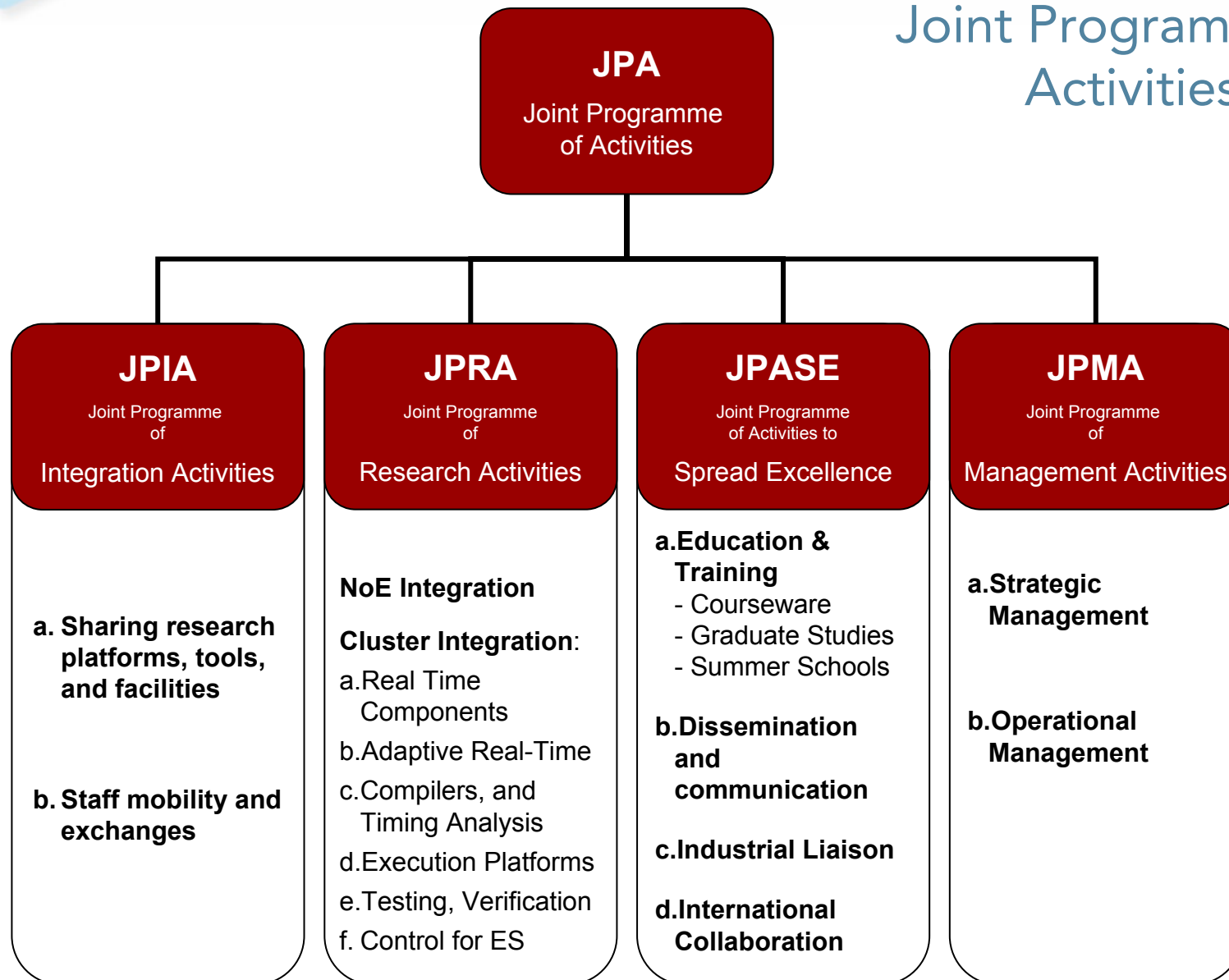
## Compilers and Timing Analysis

Reinhard Wilhelm - Saarland  
 Rainer Leupers - Aachen  
 Christian Bertin – ST Microelectronics  
 Christian Ferdinand – AbsInt  
 Peter Marwedel - Dortmund  
 Puschner, Krall – TU Vienna  
 Bjorn Lisper –Maalardalen  
 Guillem Bernat – University of York  
 Joseph van Vlijmen – Ace  
 Niklas Holsti - Tidorum

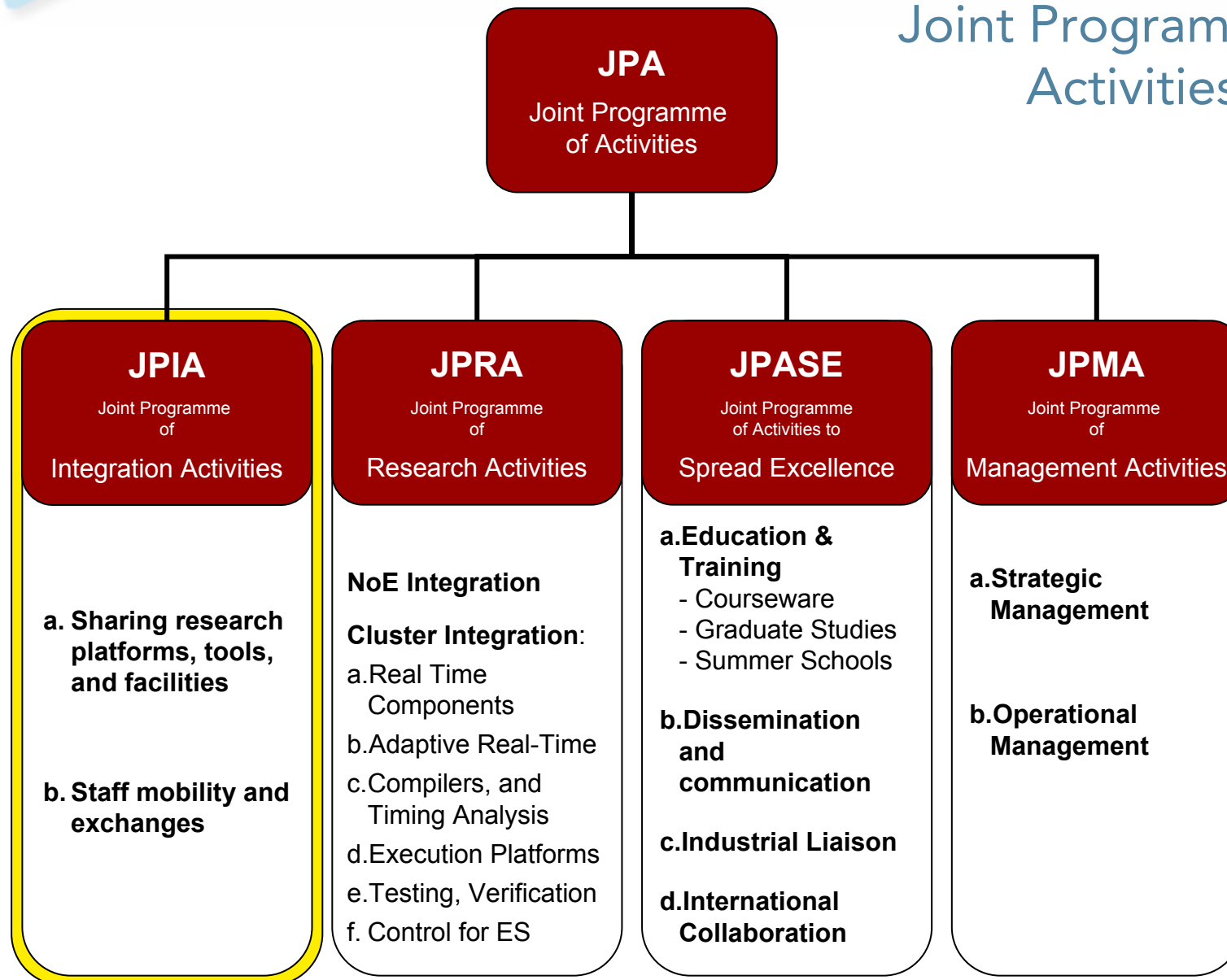
## Execution Platforms

Lothar Thiele – ETH Zurich  
 Jan Madsen –DTU (TU Denmark)  
 Luca Benini – UoB  
 Petru Eles – ESLAB/Liu  
 Rolf Ernst – UBR  
 Josef Hooman - Eindhoven

# Joint Programme of Activities

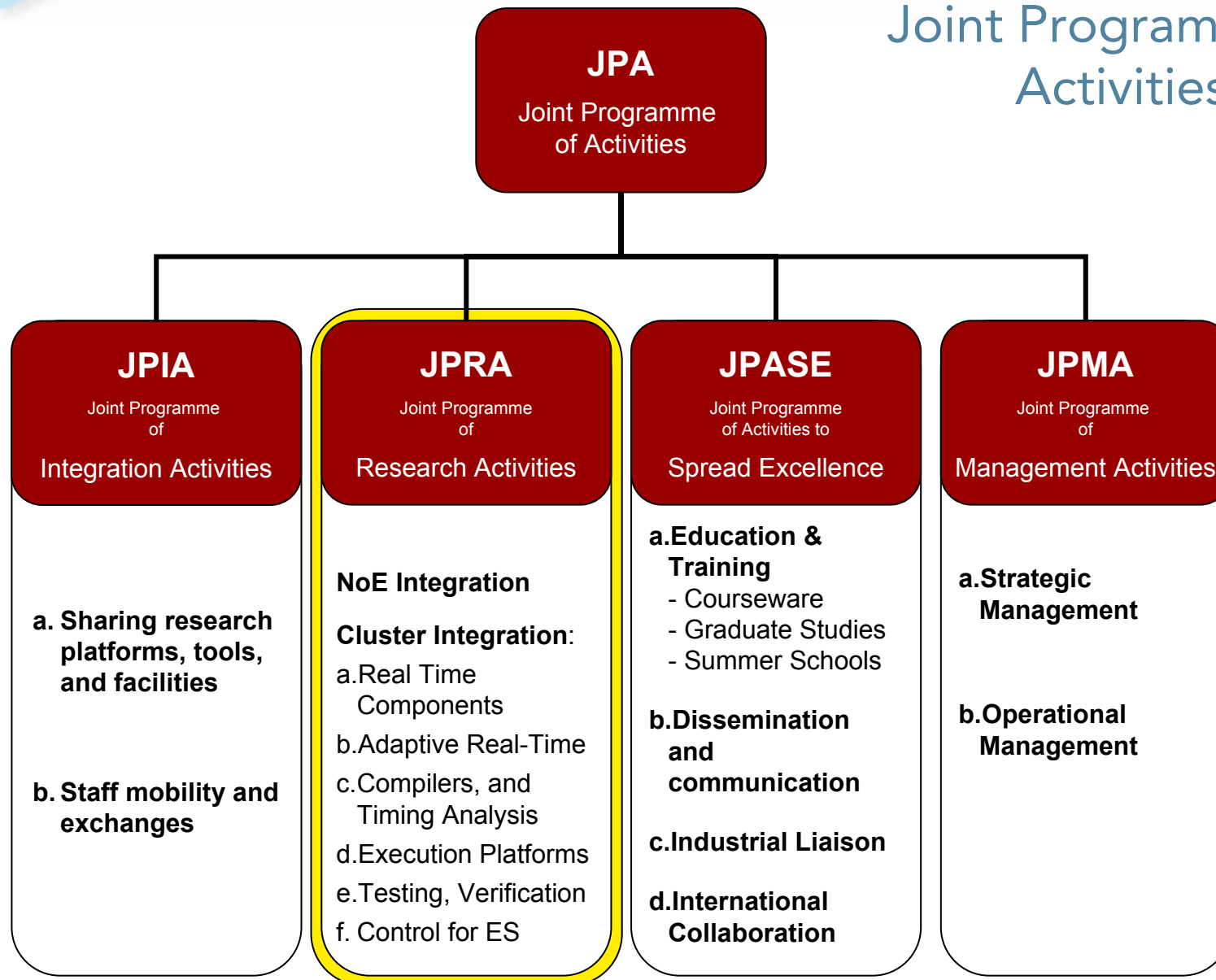


# Joint Programme of Activities



Cluster	JPIA - Platform
Modelling and Components	<p>Platform for Component Modelling and Verification</p> <p><i>This platform will support translations to semantic kernel languages to leverage associated powerful analysis tools, in particular those from the “Testing and Verification” cluster.</i></p>
Adaptive Real-Time	<p>A common infrastructure for adaptive Real-time Systems</p> <p><i>Promote extension of operating systems (eg: RT-POSIX and OSEK) and network protocols to support emerging real-time applications having a high degree of complexity and operating in dynamic environments.</i></p>
Compilers and Timing Analysis	<p>Timing - Analysis Platform</p> <p><i>Combine the best existing Timing-Analysis tools in a standard tool architecture with well-defined textual interfaces, to preserve the existing lead of European Research and Industry in this important sector.</i></p>
	<p>Compilers Platform</p> <p><i>Provide world-class code-synthesis and compiler tools for the generation of efficient machine code. Integration of existing compiler-generation approaches allowing compilers for new architectures to be built quickly, efficiently and reliably.</i></p>
Execution Platforms	<p>System Modelling Infrastructure</p> <p><i>Integrate ongoing research efforts on infrastructure modelling. This would replace prototyping hardware to reduce the cost and time required for designing embedded systems.</i></p>
Control for Embedded Systems	<p>Design Tools for Embedded Control</p> <p><i>Develop a suite of tools, for developing resource-constrained embedded control systems - taking control, computing, and communication aspects into account.</i></p>
Testing and Verification	<p>Testing and Verification Platform for Embedded Systems</p> <p><i>Will also make available new powerful analysis tools developed within the network, in particular those from the related Joint Research Activities (“Testing and Verification”, “Verification, Testing and Control” and “Verification of Security Properties”).</i></p>

# Joint Programme of Activities

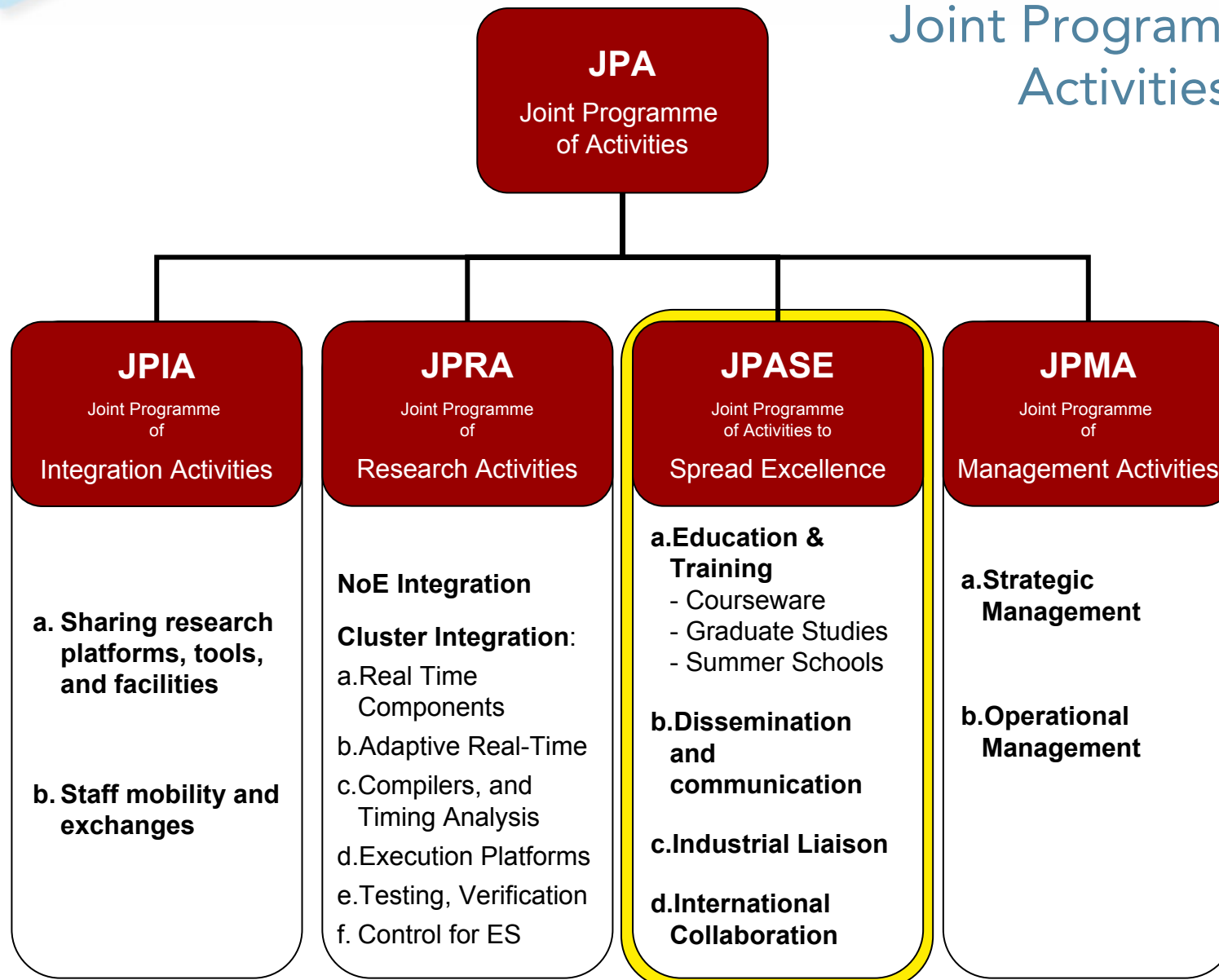


Clusters	JPRA – NoE Integration
<ul style="list-style-type: none"> <li>• <u>Real-Time Components</u></li> <li>• Control for ES</li> <li>• Execution Platforms</li> </ul>	<p><b>Forums with Specific Industrial Sectors</b>  <i>Collect issues from industry in the two key sectors of automotive and aeronautics and interacting with high-level engineers from these industrial sectors. Results will be a collection of findings and new issues and challenges.</i></p>
<ul style="list-style-type: none"> <li>• <u>Real-Time Components</u></li> <li>• Control for ES</li> <li>• Execution Platforms</li> </ul>	<p><b>Seeding New Research Directions in Real Time Components</b>  <i>This activity encompasses all research topics of the former clusters HRT and Components (diagnosis, semantic platform, heterogeneity, interfaces and composition, ET&amp;TT, and, more generally, what is relevant to the concept of Real-Time Component). It consists in in-depth meetings among researchers.</i></p>
<ul style="list-style-type: none"> <li>• <u>Adaptive Real-Time</u></li> <li>• Modelling and Components</li> </ul>	<p><b>QoS aware Components</b>  <i>Develop holistic frameworks and models for QoS management to combine features of component models, component frameworks, middleware infrastructure, OS and Kernel support, and networking.</i></p>
<ul style="list-style-type: none"> <li>• <u>Execution Platforms</u></li> <li>• Compilers and Timing Analysis</li> </ul>	<p><b>Resource-aware Design</b>  <i>Provide a viable path for resource-aware software and hardware development.</i></p>
<ul style="list-style-type: none"> <li>• <u>Control for Embedded Systems</u></li> <li>• Hard Real-Time</li> <li>• Adaptive Real-Time</li> </ul>	<p><b>Adaptive Real-time, HRT and Control</b>  <i>Integrate research among control and real-time teams on different computational models for embedded control systems and the use of control techniques to provide flexibility in embedded systems.</i></p>
<ul style="list-style-type: none"> <li>• <u>Testing and Verification</u></li> <li>• Real Time Components</li> </ul>	<p><b>Quantitative Testing and Verification</b>  <i>The objective is to combine the efforts and skills of the individual leading researchers in Europe, into a world-class virtual team, for advancing the state of the art in verification and testing methodologies.</i></p>

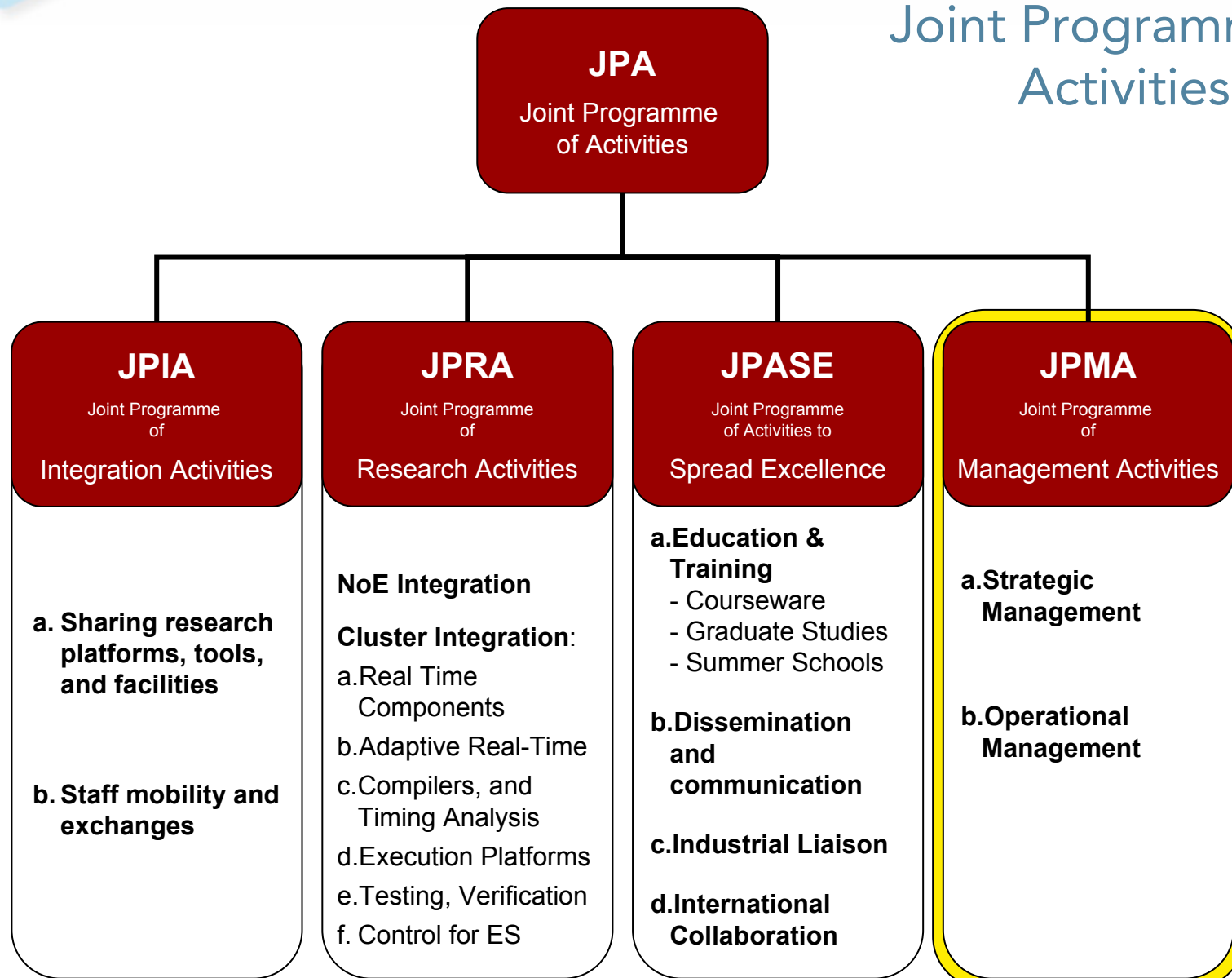
Cluster	JPRA-Cluster Integration
<ul style="list-style-type: none"> <li>Real-Time Components</li> </ul>	<p><b>Development of UML for Real-time Embedded Systems</b>  <i>Development of a general framework for component-based engineering of complex heterogeneous systems.</i></p>
<ul style="list-style-type: none"> <li>Adaptive Real-Time</li> </ul>	<p><b>Flexible Resource Management</b>  <i>(starting in Y3: fusion of “Flexible Scheduling” and “Adaptive Resource Management for Consumer Electronics”)</i>  <i>Develop a real-time scheduling framework capable of handling different real-time requirements in the same system – to be used in next-generation OS kernels for adaptive QoS control of dynamic behavior.</i></p> <hr/> <p><b>Real Time Languages</b> <i>(started mid-Y2)</i>  <i>Develop tools and techniques for flexible real-time systems – principally the programming language used to develop the application code.</i></p> <hr/> <p><b>Dynamic and Pervasive Networking</b> <i>(starting in Y3)</i>  <i>Wireless sensor networks, Mobile Ad-Hoc Networks (MANETs), elaborating on exemplificative applications; identify and characterize network protocols to support integrated and dynamic resource management in distributed environments as necessary for on-line adaptation and reconfiguration.</i></p>
<ul style="list-style-type: none"> <li>Compilers and Timing Analysis</li> </ul>	<p><b>Architecture-aware compilation</b>  <i>Provide a unified architecture-aware code-synthesis and compiler methodology.</i></p>

Cluster	JPRA-Cluster Integration
. Execution Platforms	<p><b>Communication-centric systems</b> Use formal methods to increase design productivity and quality.</p>
	<p><b>Design for low power</b> Address low-power issues across several layers of abstraction</p>
. Control for Embedded Systems	<p><b>Control in real-time computing</b> Applying control methods for handling uncertainty and to provide flexibility in real time applications.</p>
	<p><b>Real-time techniques in control system implementations</b> Advances in real-time control applications</p>
. Testing and Verification	<p><b>Verification of Security Properties</b> Develop the basic technology needed to certify security applications at levels EAL6, and EAL7, from the Common Criteria.</p>

# Joint Programme of Activities

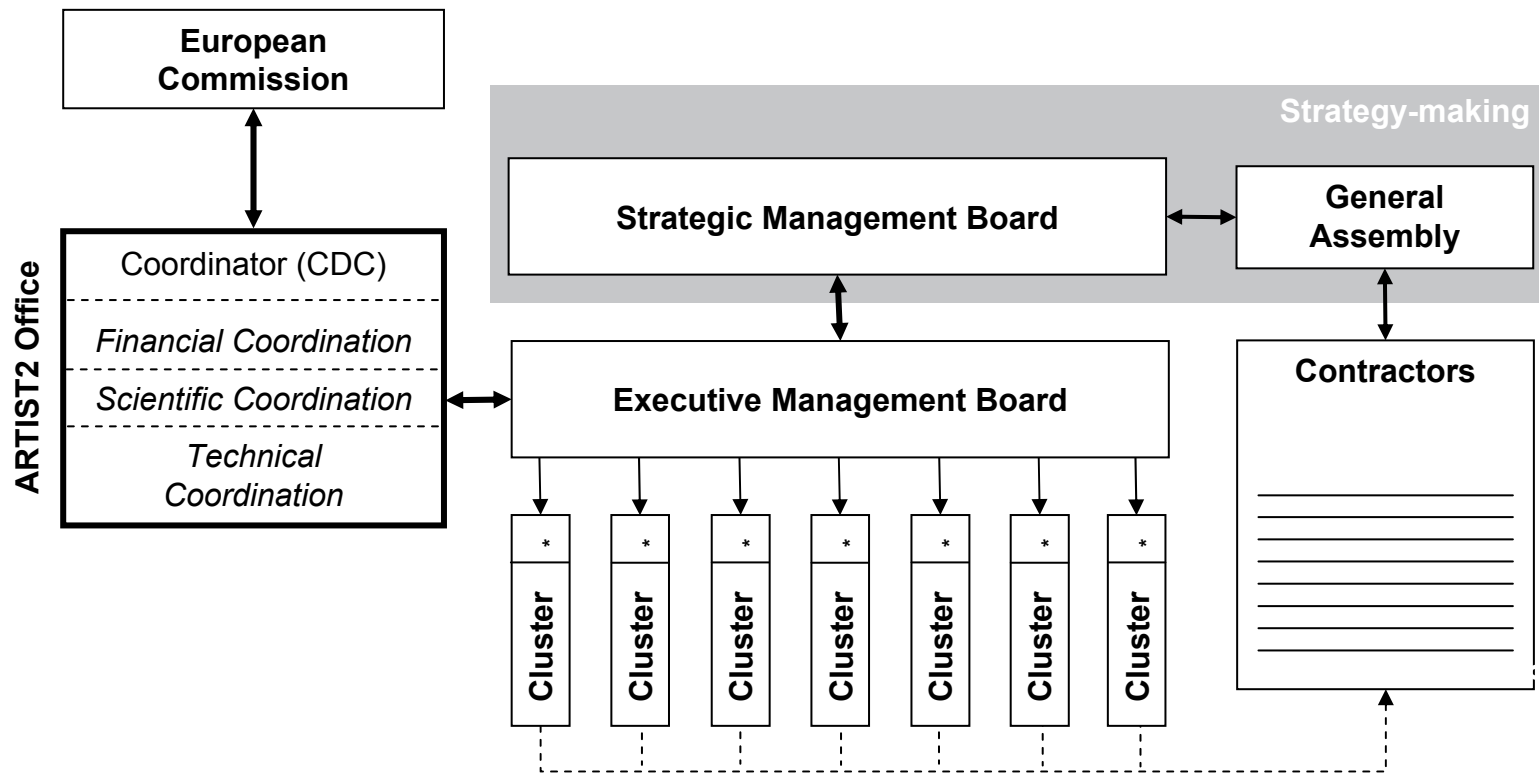


# Joint Programme of Activities



# Management Structure

Joint Programme of Management Activities (JPMA)





# Strategy Making Bodies

*Joint Programme of Management Activities (JPMA)*

## *General Assembly*

*The General Assembly is composed of one institutional representative (or its substitute) per Contractor and duly authorised for this purpose. It is chaired by the Scientific Manager.*

*The General Assembly is convened at the beginning of the Network of Excellence and meets physically at least once a year.*

*It discusses and ratifies proposals from the Strategic Management Board for modifying the Consortium, the Consortium Agreement, or any other decision requiring approval and signature by all the core partners.*

## *Strategic Management Board*

*The Strategic Management Board leads the scientific policy of the NoE.*

*The Strategic Management Board is chaired by the Scientific Manager, assisted by the Technical Manager. Initially, it has 14 members, but the Scientific Manager can propose additional members as required.*

*The Coordinator is member “ex officio” of the Strategic Management Board with voice but no vote.*

*Its members are elected between all Contractors by the General Assembly every two years. The renewal does not include the Scientific and Technical Managers and the Coordinator.*

*Decisions such as bringing in new partners, or ending membership for one or more existing core partners, must be ratified by the General Assembly.*



# Strategic Management Board

*Joint Programme of Management Activities (JPMA)*

<i>JPMA – Strategic Management</i>	
Policy Objective	<i>ARTIST2 Strategic and Scientific Management</i>
Members	Albert Benveniste (INRIA, France) Giorgio Buttazzo (University of Pavia, Italy) Alberto Sangiovanni (PARADES, Italy) Alan Burns (University of York, UK) Bengt Jonsson (Uppsala University, Sweden) Kim Larsen (Aalborg, Denmark) Ed Brinksma (Twente, Netherlands) Karl-Erik Årzén (Lund University, Sweden) Reinhard Wilhelm (Saarland University, Germany) Rainer Leupers (Aachen, Germany) Lothar Thiele (ETHZ, Switzerland) Luca Benini (Bologna, Italy) Jean-Noel Forget (CDC, France)
Chairman	Joseph Sifakis (VERIMAG, ARTIST2 Scientific Coordinator), Bruno Bouyssounouse (VERIMAG, ARTIST2 Technical Coord)
Scope of the activity	The activity is piloted by the Strategic Management Board, in close interaction with the General Assembly.

## *Executive Management Board*

*It implements the decisions of the Strategic Management Board, and supervises the day-to-day management for implementing the JPA.*

*Composed of one representative from each cluster, amongst the Cluster Leaders, and a representative of the Coordinator – who attends, with no voting rights.*

*Chaired by the Scientific Manager, assisted by the Technical Manager.*

## *Cluster Leaders*

*Responsible for the overall coordination of the activities led by their cluster. A cluster functions as a virtual team, with a degree of autonomy for defining its internal meetings and day to day management.*

*Monitor the day-to-day JPRA activities driven by the cluster, and report to the ARTIST2 Executive Management Board as a whole.*

## ARTIST2 Office

### Financial Management (Caisse des Dépôts et Consignations)

- ❖ *Receives EC payments, dispatches funds.*
- ❖ *Negotiates contracts, agreement, and annual amendments. Ensures signatures.*

### Technical Management (UJF/Verimag)

- ❖ *Checks the milestones, work progress, deliverables, consumption against the planned schedule*
- ❖ *Organises meetings to prepare and finalize reports, internal audits and submits deliverables and schedules to the European Commission.*
- ❖ *Organizes the information flow throughout the consortium*

### Scientific Management (UJF/Verimag)

- ❖ *Responsible for implementing the scientific policy*
- ❖ *Reports to the Executive Management Board, and is especially in charge of informing this body of any eventual modifications in manpower, or resource consumption and planning compared to the original contract, so that the Executive Management Board may take corrective actions in a timely fashion.*

## Assessment of the Management

We believe that the current two-tiered Management structure - dividing the management amongst cluster leaders and the Strategic Management Board composed of both cluster leaders and a limited number of other selected prominent core partners – is the right one for managing such a large research entity. It provides the right combination of flexibility and accountability, while leaving room for innovation and evolution.

Within the consortium, we have refined the reporting procedures, and strengthened the monitoring.

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Prof. [Shankar Sastry](#)

[Prof. Kang Shin](#)  
University of Michigan

[Chinese Academy of Sciences \(CAS\)](#)  
[Prof. Zhou Chaochen](#)

[Monash University](#)  
[Prof. Heinz Schmidt](#)

University of Notre Dame  
Prof. Sharon Hu

University of Illinois at Urbana-Champaign  
Prof. Lui Sha

Stanford University  
Prof. Giovanni De Micheli

Tata Research Development & Design  
Centre (TRDDC)  
Mathai Joseph

National University of Singapore  
Prof. P.S. Thiagarajan

UNU-IIST (United Nations University -  
Institute for Software Technology)  
Zhiming Liu

Vanderbilt University  
Prof. Janos Sztipanovits

University of Virginia  
Prof. John Stankovic  
Prof. Tarek Abdelzaher

[Columbia University at New York City](#)  
[Dept. of Computer Science](#)  
[Stephen Edwards](#)

# Affiliated Industrial Partners

Christer  
Norström  
Göran  
Arinder



Sven  
Holme  
Sørensen

SIEMENS

Dr. Michael  
Winokur



Magnus  
Helling

VOLVO

Thomas  
Thurner  
Matthias  
Grochtmann



Roberto  
Zafalon



Peter  
Mårtensson

MAQUET

Jakob  
Axelsson

VOLVO  
for life

Alain  
Ourghanlian



Dr. Kai  
Richter



Peter  
Mårtensson

NOKIA  
CONNECTING PEOPLE

Johan Eker



Dominique  
Potier

THALES

Philippe  
Baufreton



Fabian  
Wolf



Vladimir  
Havlina



Magnus  
Helling

VOLVO

# Affiliated SME Partners

Alan Moore



Paolo Gai



Dr. Monica Donno



Carl von Platen



Joachim Stroop



António Garrido



Jan Lindblad



Bernard Dion



## Budget Distribution – Year 2

CDC	56 875,00 €	INRIA	55 497,00 €	TUBS	34 528,00 €
UJF/Verimag	183 637,00 €	KTH	49 904,00 €	Twente	26 303,00 €
Aachen	44 881,00 €	Linkoping	36 184,00 €	Bologna	41 123,00 €
Aalborg	46 490,00 €	CNRS	20 986,00 €	Uppsala	76 945,00 €
Absint	24 386,00 €	Lund	65 005,00 €	UPVLC	50 007,00 €
Aveiro	18 169,00 €	Malardalen	13 926,00 €	York	29 660,00 €
Cantabria	21 199,00 €	OFFIS	17 226,00 €	Porto	18 170,00 €
CEA	33 800,00 €	PARADES	26 162,00 €	EPFL	39 329,00 €
CFV	19 686,00 €	Pavia	3 028,00 €	Pisa	76 584,00 €
Czech	41 834,00 €	Madrid	39 366,00 €	ACE	18 211,00 €
Dortmund	28 918,00 €	Saarland	36 346,00 €	Tidorum	8 461,00 €
DTU	41 124,00 €	ST	15 925,00 €	KaiserSlautern	21 988,00 €
ETHZ	52 565,00 €	Eindhoven	18 493,00 €		
FTRD	13 752,00 €	Vienna	45 836,00 €		

## Budget Distribution by Cluster

RTC	ART	Compilers TA	Exec Platforms	Control	T&V	Non- Cluster
21%	13,9%	14,5%	13,7%	11,8%	11,7%	13,0%

Non-Cluster : 7% Management + 6% Spreading Excellence

An additional 6% Spreading Excellence is controlled by the clusters

## Key Points : Artist2 « Brand Recognition »

Artist2 has strong 'brand recognition' within the European and international community. This is visible through:

- Our leading role in WG for the ARTEMIS Strategic Research Agenda (European Centers of Excellence, ARTEMISIA bylaws, reference architecture WG)
- Organization of major conferences (Embedded Systems Week, Date, RTSS) as well as in IEEE and the ACM.
- International Collaboration activities (high-level meetings and schools)
- Triggering important R&D projects (national and European)
- Many teams play a leading role in their own countries, by participating in setting up and leading national centers of excellence and major projects.
- The European embedded systems community is now a reality, through a structured constituency, as attested by strong presence in conferences, and significant interaction at all levels.

## Key Points : The NoE works!

We are on the right track :

- Financial and Technical reporting has been streamlined
- We believe that the consortium and affiliates now understand and adhere to the principle: Artist2 provides support for integration, structured by a JPA mainly funded by external resources. Nevertheless, our excellence is evaluated on the basis of this JPA.

# Artist2 Integration

## ***Real Time Components***

- Merger between HRT and Modelling and Components (was a good move)
- This area is a focal point for the NoE:
  - Collaboration on Real-Time Components has surpassed that which was initially planned. Beyond the current set of NoE Integration activities, there exists spontaneous interaction and collaboration between teams in the RTC cluster the other clusters, as documented in the RTC Cluster report (chapter II of this deliverable).
  - all teams work on Components one way or another, as attested by workshops and technical meetings involved many Artist2 clusters (eg: Beyond Autosar, WS jointly organized with Execution Platforms cluster)
- Large size makes it difficult to manage as a monolithic cluster – needs a federated structure

## ***Adaptive Real Time***

- Joint research involving the Adaptive Real Time cluster and the Control for Embedded Systems cluster - around the common platform on “A Common Infrastructure for Adaptive Real-time Systems” - to integrate feedback control schemes into the Shark operating system (used as a shared platform) and to investigate the effects of different scheduling policies on delays and jitter in control loops.
- The new activity on Real-Time Languages was started and a series of workshops and meetings were successfully organized.
- A new activity on Real-Time Networks will address numerous research challenges in Embedded Networked Systems.
- Recommendation: take into account emerging areas to restructure this cluster

# Artist2 Integration

## ***Compilers and Timing Analysis***

- Brings together the two complementary areas Compilation and Timing Analysis.
- In Year2, we see that this complementarity leads to useful synergies between the teams. Scientific discussion within the cluster is lively.
- There is a healthy competitive spirit, as witnessed by the WCET Competition being organized.
- The integration of two new partners (Ace and Tidorum) at the start of Year 2 has been quite successful.
- We propose that a new Partner is added – TU Berlin (Sabine Glesner) – to coordinate the Compilers Platform activity.
- The strong involvement of affiliated partners shows the interest and relevance of this clusters' research and integration activities.

## ***Execution Platforms***

- Substantial progress in integrating different research directions and view points, shown by the number and quality of joint publications, as well as the integration of tools.
- This cluster is particularly well managed, and benefits from the strong leadership of its members, and its world-wide influence is considerable.
- Strong interaction with the Real Time Components cluster, through 3 joint workshops organized in the space of one year.
- U. Bologna and teams outside Artist2 such as TU Karlsruhe, U.Edinburgh, and TU Dresden have adopted the proposed compiler platform.

# Artist2 Integration

## ***Control for Embedded Systems***

- Good progress on integration within the cluster.
- Strong collaboration with the Adaptive Real Time cluster.
- Collaboration is increasing and there is a much higher number of joint publications in Year 2.
- This cluster is a bridge between the control community (eg: HyCon) and the embedded systems community.

## ***Testing and Verification***

- Brings together the two complementary areas “Quantitative Testing and Verification”, and “Verification of Security Properties”.
- Integration on each of these topics is progressing well.
- The activities on Quantitative Testing and Verification of Security Properties share a common core technology. However, they specialize towards different application areas.
- Given the importance of security aspects for current and future embedded systems, it seems essential to maintain and reinforce this topic within Artist2.

# Artist2 Integration - Platforms

## ***Real Time Components***

- Good progress has been made on the “Component Modelling and Verification” platform, which capitalizes on the Integrated Project SPEEDS and French project OpenEmbeDD, by integrating tools and contributions from CEA, France Telecom, INRIA, Thales, and VERIMAG, EPFL and, Uppsala.

## ***Adaptive Real Time***

- Significant progress has been made on the ART platform “Common Infrastructure for Adaptive Real-time Systems”.
- Shark is now used for research at a number of sites, including the University of York, TU Kaiserslautern, Logobject AG – Switzerland, University of Illinois – Urbana Champaign.

## ***Compilers and Timing Analysis***

- *Timing Analysis platform*  
The definition of a common intermediate program representation (AIR) will allow for an easier exchange of tool components and results.
- *Compilers platform*  
Considerable work has gone into improving the new functionalities and features, including WCET-aware compilation and optimization, optimisation and conditional execution in CoSy.

# Artist2 Integration - Platforms

## ***Execution Platforms***

- Work on the System Modelling Infrastructure Platform (Execution Platforms) has progressed significantly.
- Early integration of the simulation-based models, ARTS and MPARM, and of the formal-based models SymTA/S and Real-Time Calculus has been achieved. Initial linking between simulation- and formal-based models, MPARM and Real-Time Calculus has been investigated.

## ***Control for Embedded Systems***

- Work on the Design Tools for Embedded Control platform involved tool integration, has focused on further development of the individual tools by the cluster partners.
- Integration work has only just begun, and will cover continue over the course of Year3.

## ***Testing and Verification***

- Work on the Testing and Verification Platform focused on implementing, improving and disseminating a large number of testing and verification tools allowing for the analysis of quantitative models including real-time aspects, resource models, hybrid and stochastic models.
- These will be improved and evaluated more carefully through case studies. Work on distributed analysis tools will be strengthened.
- In particular, a common coordination layer integrating individual PC-clusters will be implemented in a European verification Grid.

## Spreading Excellence

Overall objective is the emergence of Embedded Systems Design as a scientific discipline. This objective is pursued within the international scientific and industrial community.

*This is implemented in 3 levels:*

- **International Collaboration**
  - High-level meetings (NSF/IST),
  - International Schools (eg: China school, SouthAmerican school)),
  - support for selected conferences (eg: Embedded Systems Week)
- **European level**
  - Direct organisation of top workshops and schools
  - Support for existing workshops, schools (eg: FOSAD) and conferences (eg: DATE)
  - Industrial Liaison (ARTEMIS, triggering projects and promoting standards)
- **Affiliated Partners**
  - Direct involvement in the workprogramme (technical meetings).

## End Results – Integration within the NoE

At the end of the NoE, we expect to achieve a strongly integrated community.

We see progressive changes to the consortium, through convergence of interests:

- Real Time Components and the Execution Platforms clusters
- Adaptive Real Time and Control for Embedded Systems
- Execution Platforms and Compilers and Timing Analysis
- Testing and Verification with Real Time Components
- Testing and Verification with Execution Platforms
- We would like to see emergence of a cluster on Security

## End Results - Wider Role

We are currently promoting the emergence of Centres of Excellence in the area. For this, we are actively monitoring the evolution at national and European level, and positioning the NoE so as to be in line with this evolution.

Define the role of Artist2 for integrating the wider European embedded systems area, eg: through ARTEMIS/ARTEMISIA

Define a vision for what happens beyond the end of the of the initial funding period (Sept 2008), given the current level of success of the NoE.