Final Review
Brussels, December 12th, 2008

NoE Scientific Management

Joseph Sifakis, Bruno Bouyssounouse

UJF / Verimag Laboratory

AGENDA

9:30 **Project Officer's Introduction**
Berta Ferrer Llosa (European Commission)

ARTIST2 Final Review

9:35 **Scientific Management**

Long-term Objectives and Status
Scientific Coordinator: *Joseph Sifakis (UJF/VERIMAG)*
- Integration of the area (core, affiliated teams)
- Building Excellence

9:45 **Real-Time Components Cluster**

Achievements and Perspectives
Cluster leader: *Bengt Jonsson (Uppsala)*
- Overall Aims and Achievements
- Overview of Scientific Highlights in ARTIST2
- Lasting integration achieved

10:15 *discussion*

10:20 **Adaptive Real Time Cluster**

Achievements and Perspectives
Cluster leader: *Giorgio Buttazzo (Sant'Anna - Pisa)*
- Overall Aims and Achievements
- Overview of Scientific Highlights in ARTIST2
- Lasting integration achieved

10:50 *discussion*

10:55 *break*

11:10 **Compilers and Timing Analysis Cluster**

Achievements and Perspectives - Compilers
Cluster leader: *Peter Marwedel (Dortmund)*
- Overall Aims and Achievements
- Overview of Scientific Highlights in ARTIST2
- Lasting integration achieved

Achievements and Perspectives - Timing Analysis
Cluster leader: *Björn Lisper (Malardalen)*

11:40 *discussion*

11:45 **Execution Platforms Cluster**

Achievements and Perspectives
Cluster leader: *Jan Madsen (DTU)*
- Overall Aims and Achievements
- Overview of Scientific Highlights in ARTIST2
- Lasting integration achieved

12:15 *discussion*

12:20 *lunch*

13:45 **Control for Embedded Systems Cluster**

Achievements and Perspectives
Cluster leader: *Karl-Erik Årzen (Lund)*
- Overall Aims and Achievements
- Overview of Scientific Highlights in ARTIST2
- Lasting integration achieved

14:15 *discussion*

14:20 **Testing and Verification Cluster**

Achievements and Perspectives
Cluster leader: *Kim Larsen (Aalborg)*
- Overall Aims and Achievements
- Overview of Scientific Highlights in ARTIST2
- Lasting integration achieved

14:50 *discussion*

14:55 **Spreading Excellence**

Achievements and Perspectives
Technical Coordinator: *Bruno Bouyssounouse (UJF/Verimag)*
- Vision: Long-term impact
- Implementation:

Year 4 Events
Events over the duration of the NoE
- Transition to ArtistDesign

15:15 *discussion*

Reviewer's Meeting

15:30 **Reviewer's Meeting**

16:30 **Conclusions and Feedback**
Project Officer and Reviewers

17:00 closing

Reviewer's Recommendations: 1 /8

8.1 Recommendation 1: Policy for Year 4 Deliverables (similar to Year 3)

- All technical deliverables should be available on the ARTIST2 web site by 30 October 2008.
- All technical deliverables available on the ARTIST2 web site by 30 October 2008 will be pre-assessed by the reviewers by 15 November 2008.
- All technical deliverables MUST be available on the ARTIST2 web site by 15 November 2008 {This is a contractual requirement}.
- All technical deliverables NOT available on the ARTIST2 web site by 15 November 2008 are REJECTED.
- All management deliverables MUST be available on the ARTIST2 web site by 15 November 2008.
- If any management deliverables are NOT available on the ARTIST2 web site by 15 November 2008, the review meeting is CANCELLED.

All the deliverables were made available on time, except:

- Project Management Report (CDC)
  This is understandable, because it relies on financial reporting from the partners
- Final management report covering the full duration of the project (CDC)
- Artist2 Final Plan for Use and Dissemination of Knowledge (UJF/Verimag)
- Publishable Final Activity Report (UJF/Verimag)
  Special end-of-project deliverables.
  These were not planned in the DoW (contractual requirement, but not planned).
  Responsible persons assigned by default.

Reviewer's Recommendations: 2-5 /8

8.2 Recommendation 2: Deliverables

The 1ast year work plan document must be modified and resubmitted as soon as possible, no later than 28th February 2008. It should take into account the granted one month extension of the project.

8.3 Recommendation 3: Activity leader change

Reviewers understand that there are circumstances pushing to replace an activity leader. The management should continue to take care to ensure continuity.

8.4 Recommendation 4: Demos and demonstrators

The use of demos and demonstrator continues to be encouraged.

8.5 Recommendation 5: Peer review of deliverables

Continue to put a deliverables quality assurance process in place.

Recommendation 2:

This was done on time.

Recommendation 3:

The decision was made to halt the "Verification of Security Properties" activity.

Recommendation 4:

This has been encouraged.

Recommendation 5:

Each deliverable specifically addresses the reviewers' comments from last year.

As was the case last year, we have 2 internal reviewers for each deliverable.

Reviewer's Recommendations: 6 /8

8.6 Recommendation 7: Metrics on impact

In order to assess the impact of ARTIST2, a number of metrics have been defined in the DoW. The project managers need to take a careful look at these and other relevant metrics and start to quantify them. This topic was neglected in the previous period and should absolutely be present during the end of the project review. The reviewers continue to recommend that a calculation of the budgets (EC – national etc.) of projects "around" ARTIST2 should be done.

The metrics which are not confidential should appear on the web site of the project to better demonstrate the project impact.

The updated metrics were again included in the Project Activity Report.

Those metrics that can be quantified have been.

Calculating the budgets of projects "around" Artist2 poses several types of problems:

- In many cases, this information is confidential. While Artist2 has seen the real emergence of a scientific community, it has not created a unified legal entity comprised of all the partners (nor was this an objective).
- Defining the perimeter of such projects is arbitrary, on a case-by-case basis. The data collected would be difficult to use in any type of meaningful analysis.
- Even within a project, it is difficult to meaningfully (and consistently) determine the perimeter of what is "near" Artist2.

Reviewer's Recommendations: 7-8 /8

8.7 Recommendation 8: Final review & deliverables

The final review and deliverables of year 4 should stress the future of the network of excellence and the different component which have been developed, enhanced or integrated during the project (e.g. Shark operating system, tools, ...)

This has been done in both the deliverables and the review presentations.

8.8 Recommendation 9: Virtualization

The consortium should position itself toward an important technology such as virtualization which can solve some problems such as transparent support of multicore, isolation/reservation of resources, reducing power consumption. In the industry, processor vendors (Intel, AMD), RT operating system vendors (Windriver (VxWorks, RTLinux), ENEA (OSE), Green Hills (Integrity), Mentor graphic (Nucleus)), general purpose operating systems vendors (Redhat, Novel/SuSE, Microsoft, Sun) are all putting a lot of efforts to introduce this technology everywhere.

We are addressing the issue of virtualization for single core systems (ART cluster).

We have just started investigating the problem for multi-core systems.

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

Core Participants (1/2)

	Short Name	Full Name and Country	Key researchers
1	CDC	Caisse des Dépots et Consignations (France)	**None**
2	UJF/ Verimag	University Joseph Fourrier / 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 Participants (2/2)

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
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 Polytecnica 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
41	TU Berlin	Technische Universität Berlin	Sabine Glesner

ARTIST2 NoE : Team Leaders

Real Time Components
Bengt Jonsson – Uppsala
Albert Benveniste – INRIA
Alberto Sangiovanni – PARADES
Paul Caspi – Verimag
Hermann Kopetz – TU Vienna
Werner Damm – OFFIS
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

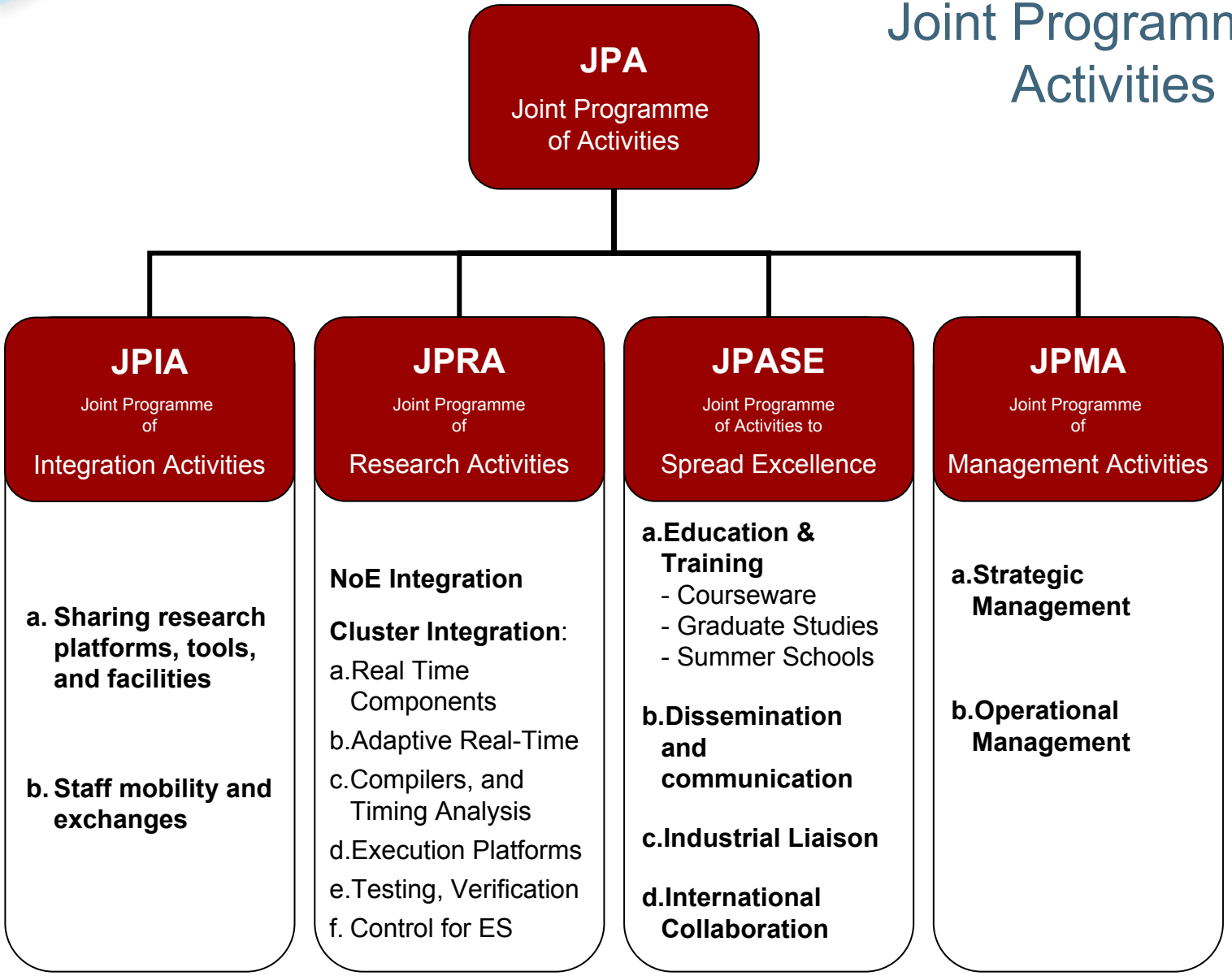
Testing & Verification
Kim Larsen - Aalborg/ CISS
Ed Brinksma – Twente/Eindhoven
Pierre Wolper – Centre Fédéré de Verification
Michel Bidoit - LSV
Thierry Jeron - INRIA

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 Ferdinand – AbsInt
Peter Marwedel - Dortmund
Puschner, Krall – TU Vienna
Bjorn Lisper –Maalardalen
Guillem Bernat – University of York
Joseph van Vlijmen – Ace
Niklas Holsti – Tidorum
Sabine Glesner – TU Berlin

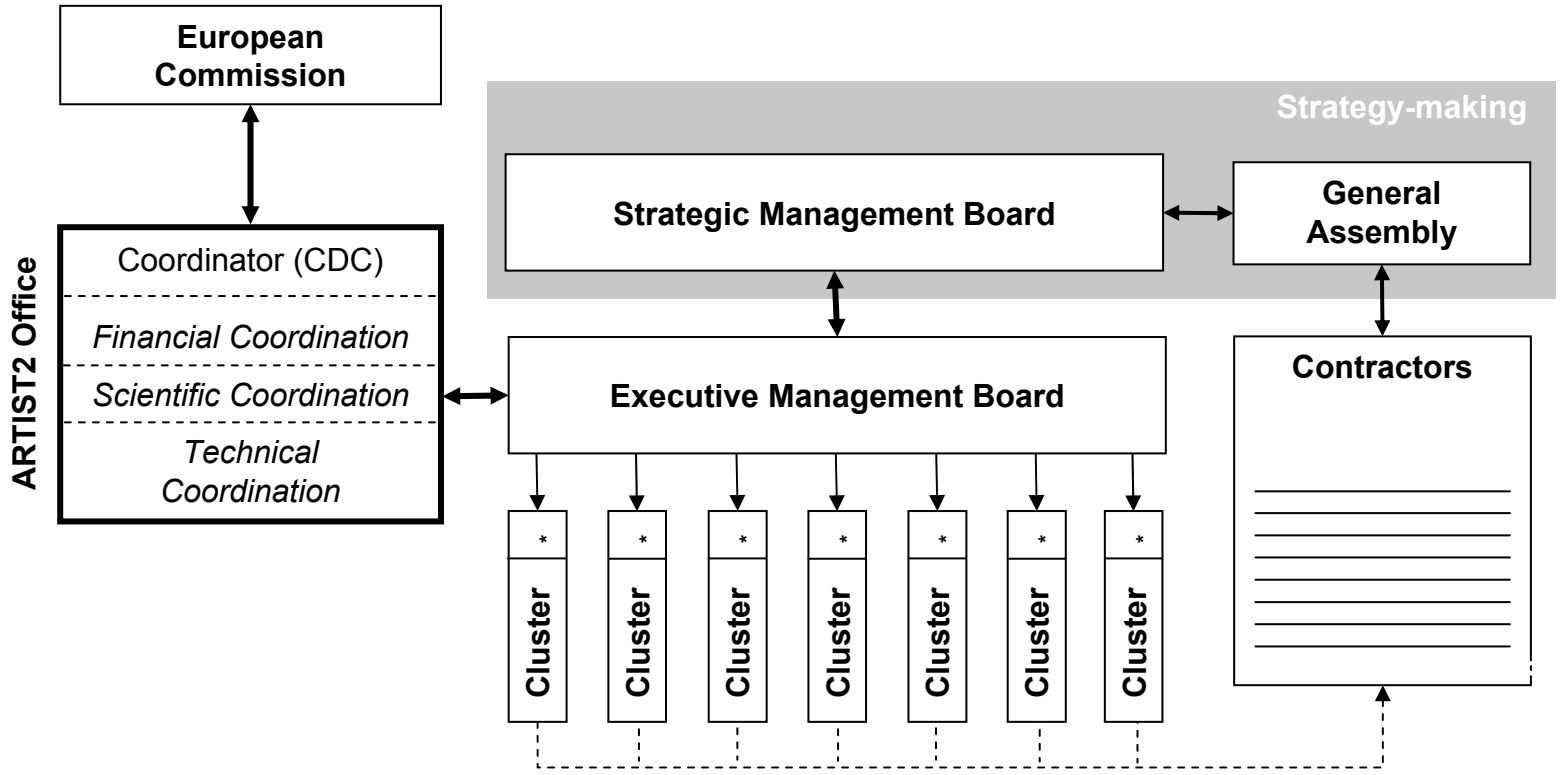
Execution Platforms
Lothar Thiele – ETH Zurich
Jan Madsen –DTU (TU Denmark)
Luca Benini – UoB
Petru Eles – ESLAB/Liu
Rolf Ernst – UBR
Josef Hooman - Eindhoven

Joint Programme of Activities



Management Structure

Joint Programme of Management Activities (JPMA)



Budget Distribution – Year 4

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 €	TU Berlin	19 125,00 €
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

Management of the NoE

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 – has been the right one for managing such a large research entity.

It provided the right combination of flexibility and accountability, while leaving room for innovation and evolution.

Over the course of the NoE, the partners have learned to work well and efficiently together to achieve the aims.

Real Time Components

Very significant results, on modelling heterogeneous systems:

- Work by INRIA, PARADES, and VERIMAG, on the theory of tagged systems.
- Work on the BIP component framework, introduces a notion of expressiveness for component-based formalisms, which provides a basis for their comparison.
- Significant progress has been achieved in methods for distributed implementation of non-distributed specifications.

We have also obtained significant results on Interfaces and Composability, including:

- The development of interface theories supporting component reuse (EPFL).
- The development of contract-based verification techniques for the heterogeneous rich component (HRC) model (INRIA, PARADES, VERIMAG), in the framework of the SPEEDS project.
- In joint work, ETHZ and Uppsala propose modular performance analysis techniques, based on the real-time calculus and timed automata.
- Compositional deadlock verification of BIP programs, and its implementation in the DeadlockFinder tool.

Adaptive Real Time

"Flexible Resource Management for Real Time Systems":

- Architectural model redesigned for: energy management, disk bandwidth management services, feedback control, and memory management (Thalès Communications France).
- Implementation of flexible traffic scheduling for switched Ethernet, in collaboration with the University of Pennsylvania and CMU.
- Theoretical developments on hierarchical scheduling, a multiframe extension to fixed priority scheduling, and adaptive algorithms for flexible resource management.

"Real Time Languages":

- Production of a survey on Real-Time Programming Languages. http://www.artist-embedded.org/artist/ARTIST-Survey-of-Programming.html
- Work on Ada 2005, and RT-Java.

"Dynamic and Pervasive Networking":

- *Analysis and implementation of Wireless Sensor Networks* and *Wired Networks,* including topologies for robust communication in CAN and Ethernet networks and schedulability analysis techniques.

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Platform for " Flexible Resource Management".

Compilers and Timing Analysis

Timing Analysis

In addition to experimental work, we developed important results on Timing Analysis.

- A notion of time predictability for cache architectures – results applied to the PREDATOR FP7 project.
- Study of Timing anomalies, where local worst-case choices may not lead to the global worst-case scenario, is essential for time predictability.
- Parametric Timing Analysis.

Compilers

We developed research in the following directions:

- study of the influence of scratchpad memory allocation techniques on worst case execution times (WCET).
- Optimization and verification methods for compilers applied in a compilation platform based on Cosy by ACE.
- Scalable source-level analysis and annotation-based timing analysis methods.

Execution Platforms

"Communication-centric Systems" :

- New compositional performance evaluation techniques and tools.
- Combination of analytical and computational models.
- Fault tolerance techniques for real-time systems (guarantee the deadlines even in the presence of faults).
- Analysis techniques for distributed wireless sensor networks.
- Programming models for NOC-based systems.

"Design for Low Power":

- Modelling and optimisation of a miniaturized solar energy harvester.
- Scheduling-based energy optimisation techniques for energy-scavenging wireless sensor networks.
- Temperature-aware system level power optimisation techniques.

Control for Embedded Systems

“Control in Real-Time Computing” :

- techniques for feedback-based resource management in cellular devices, and for control and optimisation of networked systems, in collaboration with Ericsson and ABB.

“Real-time techniques in control system implementations” :

- Work on event-based control systems. including higher-order systems, the implementation of PI controllers, state estimation techniques.
- A control kernel, which plays a role similar to an OS kernel.
- A modular control design methodology, ensuring maximal performance, stability, and adaptability.
- New results on optimal flow routing in multi-hop sensor networks.

“Design Tools for Embedded Control“:

- TrueTime, a Matlab/Simulink -based tool for co-simulation of real-time control systems – widely distributed and used in several industrial projects.

Testing and Verification

- We have further developed UPPAAL, extended and improved its functionality, as well as the Tiga tool for controller synthesis.
- IRISA have improved the symbolic test generation tool, STG, and a new version can be downloaded from INRIA Gforge:
- VERIMAG have applied their test generation tool TTG for the automatic generation of robotics observers.
- Game-theoretic approaches to real-time system testing.
- Quantitative model checking techniques for timed models, including timed automata, linear hybrid automata and general non-linear hybrid systems.
- Compositional synthesis and verification techniques. These include modular supervisory control, as well as the verification of component-based systems.

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: European School, 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

Within the NoE, we have achieved a strongly integrated community, recognised internationally that has a significant impact on European R&D on Embedded systems.

Strong convergence between attested by joint projects, publications, collaborations:

- Real Time Components + Testing and Verification
  + Execution Platforms
- Adaptive Real Time + Control for Embedded Systems
- Execution Platforms + Compilers and Timing Analysis

End Results - Integration of the Area

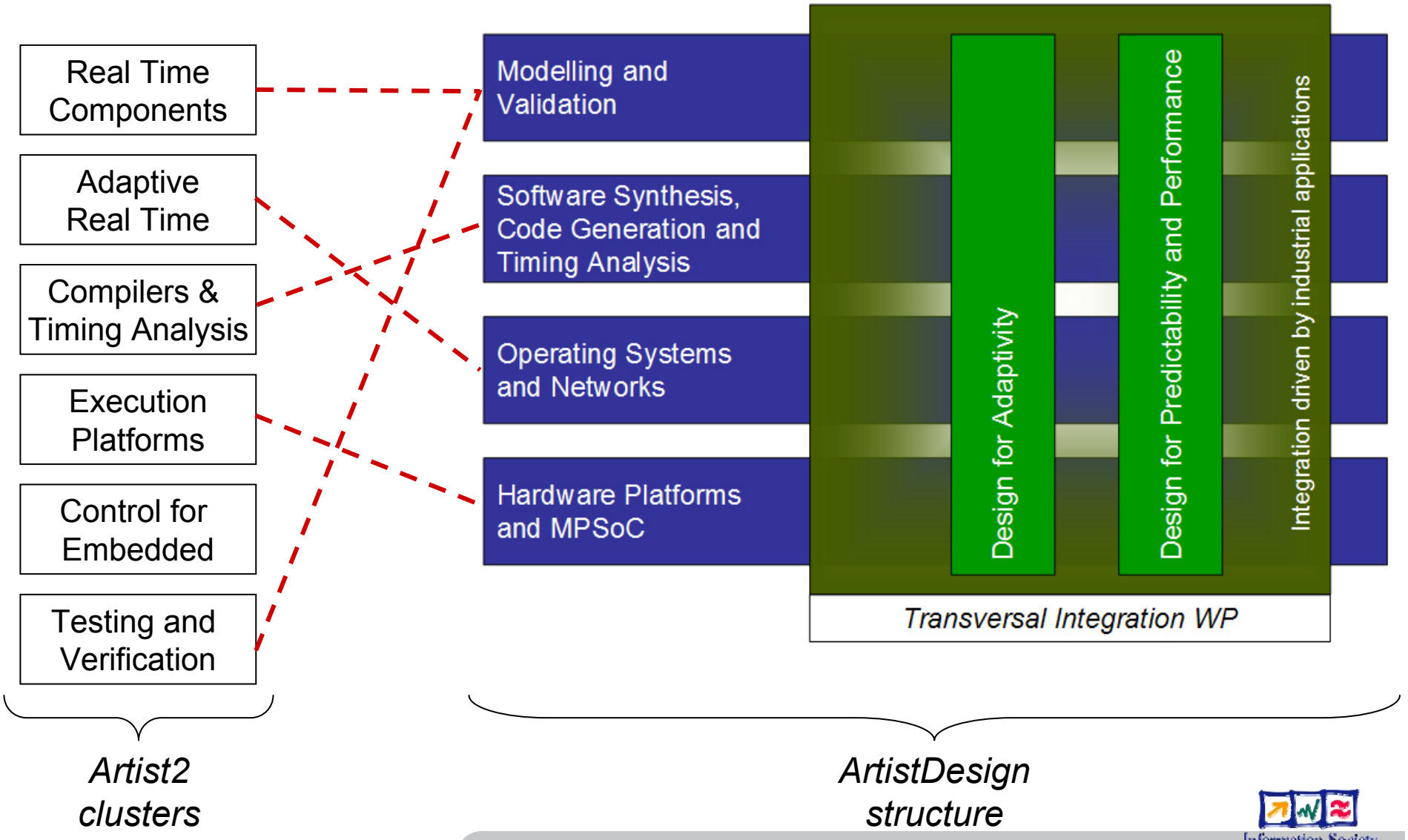
Artist2 has acted to integrate the area of Embedded Systems Design, and promote the emergence of the discipline:

- 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 numerous and significant 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.

End Results – Integration of the Area

- CEA and U Bologna are members of the Steering Board of ARTEMISIA
- Verimag was the first chair of ARTEMISIA's Chamber B
- Active participation in WGs for the definition of the ARTEMIS SRA
- Very active role in setting up the EICOSE (European Institute for COmplex and Safety Critical Embedded Systems Engineering) Cluster of Excellence - CEA, INRIA, OFFIS

Evolution: tighter integration in ArtistDesign



THANK YOU

Deliverables

partner	ID	Title	WP
WP0 JPMA: Joint Programme of Management Activities			
CDC	D1-Mgt-Y4	**Year 4 Project Management Report**	
UJF/VERIMAG	D2-Mgt-Y4	Year 4 Project Activity Report	
	chapter 1	**Executive Summary and Overview**	
	chapter 2	**Real Time Components**	RTC
	chapter 3	**Adaptive Real Time**	ART
	chapter 4	**Compilers&Timing Analysis**	Compilers&TA
	chapter 5	**ExecPlatforms**	Execution Platforms
	chapter 6	**Control for ES**	Control
	chapter 7	**Testing&Verification**	Test&Verif
		Artist2 Final Plan for Use and Dissemination of Knowledge	
WP1 JPIA: Joint Programme of Integration Activities			
UJF/ VERIMAG	D4-RTC-Y4	**Component Modelling and Verification** (Platform)	RTC
Scuola Sant'Anna	D7-ART-Y4	**A common infrastructure for adaptive Real-time Systems** (Platform)	ART
Saarland	D12-CTA-Y4	**Timing Analysis** (Platform)	Compilers&TA
Berlin	D13-CTA-Y4	**Compilers** (Platform)	Compilers&TA
DTU	D14-EP-Y4	**System Modelling Infrastructure** (Platform)	ExecPlatf
KTH	D18-Control-Y4	**Design Tools for Embedded Control** (Platform)	Control
Aalborg	D22-TV-Y4	**Testing and Verification Platform for Embedded Systems** (Platform)	Test&Verif
WP2 JPASE: Spreading Excellence			
UJF/ VERIMAG	D3-Mgt-Y4	**Report on Spreading Excellence**	Global
WP3 JPRA : NoE Integration - Research Activities			
UP Madrid	D8-ART-Y4	**QoS aware Components** (NoE Integration)	ART
Bologna	D15-EP-Y4	**Resource-aware Design** (NoE Integration)	ExecPlatf
Lund	D19-Control-Y4	**Adaptive Real-time, HRT and Control]** (NoE Integration)	Control
Twente	D23-TV-Y4	**Quantitative Testing and Verification** (NoE Integration)	Test&Verif
Workpackage 4 (Modelling and Components) was halted at the end of Year 1			
Please note that workpackages WP5-WP10 concern only Cluster Integration (not NoE Integration), and do not include the Platforms (which are in WP1).			

partner	ID	Title	WP
WP5 JPRA: Real-Time Components			
CEA	D5-RTC-Y4	**Development of UML for Real-time Embedded Systems** (Cluster Integration)	RTC
Uppsala	D6-RTC-Y4	**Component-based Design of Heterogeneous Systems** (Cluster Integration)	RTC
WP6 JPRA: Adaptive Real-time			
Kaiserslautern	D9-ART-Y4	**Flexible Resource Management** (Cluster Integration)	ART
York	D10-ART-Y4	**Real-Time Languages** (Cluster Integration)	ART
Porto	D11-ART-Y4	**Dynamic and Pervasive Networking** (Cluster Integration)	ART
Please note that the only activity in WP7 was merged into the the Timing Analysis Platform at the end of Year2.			
WP8 JPRA: Execution Platforms			
TUBS	D16-EP-Y4	**Communication-centric Systems** (Cluster Integration)	ExecPlatf
Linkoping	D17-EP-Y4	**Design for Low Power** (Cluster Integration)	ExecPlatf
WP9 JPRA: Control for Embedded Systems			
Lund	D20-Control-Y4	**Control in real-time computing** (Cluster Integration)	Control
UPVLC	D21-Control-Y4	**Real-time techniques in control system implementations** (Cluster Integration)	Control
Please note that the only activity in WP10 was halted at the end of Year 3.			