**INFORMATION SOCIETIES TECHNOLOGY**
**(IST)**
**PROGRAMME**


# *REVIEW REPORT*

## IST-004527 - ARTIST2

## Embedded Systems Design

## Interim Review

### Covering project month M1 to M12: 01/09/2004 – 30/08/2005

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| Reviewers: | Bob MALCOLM<br>Michel RUFFIN<br>Joe SVENTEK<br>Martin TIMMERMAN |
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# 1 Executive Summary

## 1.1 Project summary:

The long-term objective of ARTIST2 is to build a durable European research community on Embedded Systems Design, by integrating the topics, teams and competencies around 7 essential topics: Modelling and Components, Hard Real-Time, Adaptive Real-Time, Compilers and Timing Analysis, Execution Platforms, Control for Embedded Systems, and Testing and Verification. The NoE will act as a Virtual Centre of Excellence in the area of Embedded Systems Design. It is structured into clusters (virtual teams), corresponding to these topics.

The integration into joint research activities occurs at two levels:

- Integration within clusters. Currently, the efforts on the identified topics are fragmented, and there is no European research team that would gather the sufficient critical mass needed. The integration of a topic is a first step towards integrating the area as a whole.
- Integration between cluster topics to create the multi-disciplinary community that will pilot the embedded systems design area. This will be achieved through integration activities that will bring together teams from different clusters.

The Joint Programme of Research Activities includes research both within the clusters, and between clusters. Intra-cluster research aims to create critical mass and excellence on each essential topic. Inter-cluster research aims to integrate the area as a whole. The implementation of the Joint Programme of Research Activities is supported by the Joint Programme of Integrating Activities, including research platforms and mobility of personnel.

A central mission for the NoE is spreading excellence to the community at large, through an ambitious Joint Programme of Activities for Spreading Excellence, including Education and Training, Dissemination and Communication, Industrial Liaison, and International Collaboration.

The project duration is four years, starting on 1st September 2004, with an EC contribution of €6.5 Million.

### 1.2 Period under review and main review objective

The Year 1 review was conducted in October 2005. At that time, several of the technical and management deliverables were either REJECTED or CONDITIONALLY ACCEPTED. The objective of this interim review is to assess these revised deliverables and the plan of work for the next 18 months.

In particular, the following deliverable documents were assessed:

- D2.1: Components Platform for Component Modelling and Verification
- D10: Component Modelling and Composition
- D5: Semantic Framework for Hard Real-Time Design Flow
- D6: Merging the Event-triggered and Time-triggered Paradigms
- D12: Diagnosis in Distributed Hard Real-Time Systems
- D2.2 A Common Infrastructure for Adaptive Real-time Systems
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- D20 Quantitative Testing and Verification
- D21 Verification of Security Properties
- D1.1: Periodic Management Report
- D1.2: Periodic Activity Report
- D4: Spreading excellence
- Gender Action Plan
- 18-month Work Programme

All deliverables with the exception of the 18-month Work Programme are now ACCEPTED for this project. Subsequent sections provide commentary on those deliverables, and any recommendations for modifications are expected to be incorporated in the corresponding deliverable produced at the end of Year 2.

The 18-month Work Programme deliverable is CONDITIONALLY ACCEPTED. The recommended modifications are enumerated in the subsequent section; these were also communicated verbally at the end of the interim review.

### 1.3 Overall reviewers' conclusion.

The technical deliverables have been modified to a uniform level, addressing the issues raised in the Year 1 review report; they now document the outcomes achieved using NoE funding, as required.

The reviewers recommend that the consortium continues working in the same collaborative spirit. The project should continue its efforts with regard to integration and spreading excellence in accordance with the principles of a Network of Excellence. It is especially important that spreading of excellence beyond the consortium be a high-priority focus.

This report is a combined effort of all the reviewers and there are no points of disagreement between them on its content.

## 2 Organisation and logistics

This interim review was held in BRUSSELS, at DG Information Society and Media premises on 23 January 2006, and lasted for one day.

Each cluster was represented throughout the review; individuals responsible for management deliverables (VERIMAG and CDC) were also present. See list of participants, list of reports and deliverables & agenda (appended to this report).

An electronic copy of each presentation was available before each presentation.

## 3 Project Management

The Management deliverables reviewed now adequately cover the management aspects of the project. The subsequent sections on each management deliverable may contain comments/ criticisms of the latest document reviewed; in such cases, these comments/criticisms should be taken into account when generating the corresponding deliverable at the end of Year 2.

At the last review, frequent mention was made by many partners of the difficulty that they had in providing administrative information for a management tool provided by the co-ordinator. The reviewers were glad to hear that CDC is working with the partners to come up with a lighter-weight process for capturing this information.

The reviewers are also pleased that progress is being made toward EPFL's membership in the network, and hope to see this concluded just as soon as possible. The reviewers have no objections to the addition of two SME partners: ACE and Tidorum. Due to the movement of researchers, Pavia will be replaced by Scuola Sant'Anna in Pisa and Kaiserslautern will join the consortium. These changes will be undertaken as part of a contract amendment.

## 4 Deliverables

### 4.1 General comments on presentations

The presentations by each cluster regarding the 18-month plan were homogeneous, following a template.

### 4.2 General comments on deliverables

All deliverables have now been accepted. To avoid difficulties in the future, it is important that all future deliverables document outcomes achieved through NoE funding relative to the current 18-month plan of work, making a clear distinction between outcomes resulting from NoE funding and outcomes resulting from external funding.

### 4.3 Management deliverables

#### 4.3.1 D1.1: Periodic Management Report: ACCEPTED

*Report Word file created 16/12/2005, with two Excel files created 15 & 16/12/2005*

This document relates to the financial reporting of the project including the actual effort per partner across the network. The missing financial statements (form C) have now been delivered and the information should be complete. The document follows a standard format.

#### 4.3.2 D1.2: Periodic Activity Report: ACCEPTED

*Report PDF file created 16/12/2005, updated version 18/01/2006*

This report is now in the correct format and has been accepted. The following comments should be taken into account when preparing this report for the Year 2 review.

The current document structure is not sufficiently supportive of critical review and needs to be improved. The list of deliverables must contain the due date and actual date for each, and there must be an equivalent discussion on achievement of milestones. Where amplifying discussion is delegated to a cluster report (as in section 2.2), the management team must ensure that this discussion actually is included in said report. Finally, a more supportive structure for this document would be to organize it by milestones enumerated in the DoW/18-month plan, and to then discuss what was achieved with respect to each milestone. This structure also provides the opportunity to introduce additional milestones that were achieved, and to discuss why certain milestones that were documented were not pursued.

With regards to quality control, in addition to ensuring that discussions delegated to cluster reports have actually been included, the management team must also ensure that the individual cluster reports are generally presented in a form that enables reviewers to compare progress with that planned in the DoW/18-month work plan.

The NoE must spread excellence ***in a coherent, co-ordinated fashion***. Individual cluster activity is sometimes excellent –for example the industrial forums proposed by the Real-time Components Cluster for the next 18-month work-programme. However, there is little evidence of any top-level management of these issues – encouraging the clusters to identify the needs, specific objectives, and appropriate mechanisms; monitoring that the clusters are progressing appropriately; and helping them when they are not. In essence, there must be some top-down management activity in order to integrate the activities of the partners. It is recommended that the team clarify NoE level objectives (integration, spreading excellence, etc.) and in future report against these rather than compiling 'bottom up' reports.

On 'standards', reviewers suggested a global plan based on some kind of road-map. The PAR considers that this was taking the review process beyond the context of the DoW. However, the DoW repeatedly emphasises the importance of standards and states that: *"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"*. This promise is repeated in the revised *'Spreading Excellence'* report. These measures and incentives are not clear. A global plan could help the consortium to structure their approach to standardisation beyond the current piece-meal participation in standardisation activities. If the team does not wish to follow this suggestion, it is not enough to reject it: an alternative should be provided that shows that the NoE is achieving more than would be achieved in its absence.

#### 4.3.3 D4: Spreading excellence: ACCEPTED

*Report PDF file created 15/12/2005*

The resubmitted version is a distinct improvement over the previous one distributed at the first review. It is noticeable that the JPASE budget is significantly underspent.

**Dissemination and communication**. The reviewers expect a NoE to have a strategy for communication. This would have mechanisms for identifying publication needs and encouraging, facilitating, structuring and monitoring publication. It would not comprise simply the collation of bottom-up reports in a clerical fashion.

The web site is *still* not being used to communicate the state-of-the-art, research results, or the current thinking of the consortium. The site indicates that the most recent technical meeting 'planned' is in July 2005. No links could be found from the descriptions of work planned in each cluster to the latest results, publications, or meetings. The reviewers do not agree with the statement in the 'Spreading Excellence' report which states that the web site "*will be improved over the course of year 2. But here again, this is a matter of focus and available resources.*" It is a clear promise in the DoW (cf. section 5.2) and therefore in the contract. The reviewers are surprised at the lack of progress on this issue, especially for an NoE like Artist2, after 16 months. The reviewers expect to see some clear progress on the website between now and the next review.

#### 4.3.4 Gender Action Plan: ACCEPTED

The activities reported make sense and are interesting. The document state that 5% of Artist people are women, that it is low and that there is a potential of women ready for working on the subject. One aspect which is not really treated is what are the reason for such situation (this might be part of future work). They want to use Internet to get answers to questionnaires during the second year. There are references to psychological studies and methods but it's not clear how these will be used. Good progress was made in the first year and the future plans make sense. A good dynamic website would be needed to do the study.

The document is accepted.

### 4.4 Components & Modelling cluster deliverables

Two deliverables were due from this cluster at the end of Y1:

- Deliv-JPIA-a Y1: Report on Sharing research platforms, tools and facilities (WP1).
- Deliv-JPRA-Cluster Integration – Modelling and Components Y1 (WP4)

Instead three deliverables have been produced:

- D2.1 "Components Platform for Component Modelling and Verification" (the Component & modelling part of WP1),
- D10 "Component Modelling and Composition",
- D11 "Development of UML for Real-time Embedded Systems".

These last two deliverables correspond to the 2 activities of WP4.

#### 4.4.1 D2.1: Components Platform for Component Modelling and Verification: ACCEPTED

*Report PDF file created 15/12/2005, updated version 18/01/2006*
This task aimed to define a common kernel language for modelling real-time systems and translation from UML notation to this language. Analysis tools should be integrated with each others around three platforms and adapted according to the common language. The objective has been partly redefined replacing the common language by a semantic level approach.

This deliverable has been previously rejected for the following reasons: no global picture existed in term of state of the art, convergence of work between partners and the interaction between partners was not mentioned. The steps to reach the announced goal: “defining a common kernel language for modelling real-time systems and translation from UML notation to this language” did not appear.

The changes compared to the initial plans are now explained: merging of clusters component and modelling with real-time that should increase the importance of one of the three platforms, revision of the objective of a common language for modelling real-time systems that is now replaced by a semantic approach and reduction of objective on standardisation.

The state of the art now shows partners contributions as requested in the first review report.

The activity of integration among partners appear more clearly and should concentrate in the next months around the three component platforms, the integration of tools and the definition of semantic profile for analysis and simulation tools.

The deliverable is accepted, and it is expected that the technologies commons to this activity together with the integration tasks will be stressed in the Year 2 report.

#### 4.4.2 D10: Component Modelling and Composition: ACCEPTED

*Report PDF file created 15/12/2005*
This task aims at defining concepts and technologies for representing resource usage, timing and QoS and the means to check compatibility between components.

The state of the art has been strengthened. The industrial needs now cover a large set of industries showing a broad understanding of requirements.

The list of ongoing work of partners now shows the relationship between partners’ efforts and gives an overall picture of a programme.

The deliverable is accepted.

#### 4.4.3 D11: Development of UML for Real-time Embedded Systems: ACCEPTED

*Report PDF file created 26/09/2005*
This report was accepted in the previous year-end review.

### 4.5 Hard Real-Time cluster deliverables

Three deliverables were due from this cluster at the end of Y1:

- Deliv-JPRA-NoE Integration-a-Y1 (this cluster’s contribution as planned in the DoW.)
- Deliv-JPRA-NoE Integration-b-Y1 (this cluster’s contribution as planned in the DoW.)
- Deliv-JPRA-Cluster Integration – Hard Real Time - Y1

It should be noted that the cluster has done an excellent job in critically summarizing the outcomes of the various ARTIST2-funded meetings associated with the cluster’s tasks, and are to be applauded for providing these as addenda to the three required deliverables.

#### 4.5.1 D5: Semantic Framework for Hard Real-Time Design Flow: ACCEPTED

*Report PDF file created 15/12/2005*

This task is focused on unification of approaches and tools used for systems design in the automotive and aeronautics industries. There were two primary work items for Y1:

- enumerate key research directions in this area; this was achieved by conducting a workshop at which this activity and "Merging ET with TT" were discussed with relevant industrial organizations
- explore the intersections of this activity with other clusters; this was achieved by conducting another workshop together with the Execution Platform and Components clusters.

The deliverable document summarizes the main findings of the two workshops and guides the interested reader to the two workshop reports.

#### 4.5.2 D6: Merging the Event-triggered and Time-triggered Paradigms: ACCEPTED

*Report PDF file created 15/12/2005*
This task is focused on integration of the two approaches for designing and implementing synchronous hard real-time systems – event-triggered and time-triggered. There were two primary work items for Y1:

- enumerate key research directions in this area; this was achieved by conducting a workshop at which this activity and "Semantic Framework for Hard Real-Time Design Flow" were discussed with relevant industrial organizations
- explore the intersections of this activity with other clusters; this was achieved by conducting another workshop together with the Execution Platform and Components clusters.

The deliverable document summarizes the main findings of the two workshops and guides the interested reader to the two workshop reports.

#### 4.5.3 D12: Diagnosis in Distributed Hard Real-Time Systems: ACCEPTED

*Report PDF file created 15/12/2005*
This task is focused on providing an integrated approach to diagnosis of distributed real-time systems, in particular with respect to transient anomalies. There were two primary work items for Y1:

- enumerate key research issues in performing this integration; this was achieved by conducting a workshop at which members of this cluster discussed various aspects of the problem area, with a special focus on the approach taken by the DECOS IP to diagnosis
- expend research effort addressing the issues enumerated at the previous workshop; this was summarized at another workshop.

The deliverable document summarizes the main findings of the two workshops and guides the interested reader to the two workshop reports.

### 4.6 Adaptive Real-Time cluster deliverables

Three deliverables were due from this cluster at the end of Y1:

- Deliv-JPIA-a Y1: Report on Sharing research platforms, tools and facilities (WP1).
- Deliv-JPRA-NoE Integration-3-Y1 (WP3)
- Deliv-JPRA-Cluster Integration – Adaptive real-time – Y1

Instead four deliverables have been produced:

- D2.2 "Common infrastructure for Adaptive real-time" (the Common infrastructure for Adaptive real-time part of WP1),
- D8 "QoS aware Components",

- D13 “Flexible Scheduling Technologies”,
- D14 “Adaptive Resource Management for Consumer Electronics”.

These last two deliverables correspond to the 2 activities of WP6.

#### 4.6.1 D2.2 A Common Infrastructure for Adaptive Real-time Systems: ACCEPTED

*Report PDF file created 15/12/2005*
This task is focused on the selection of a common real-time environment and to the porting of various components on this environment to share a common real-time platform for experimentation.

The requirements that led to the selection of the SHARK kernel are now clearly stated.

The work reported is substantial and is clearly a work of integration between several European teams around a common infrastructure and repository.

The deliverable is accepted as it is.

#### 4.6.2 D8 QoS aware Components: ACCEPTED

*Report PDF file created 28/09/2005*
This report was accepted in the previous year-end review.

#### 4.6.3 D13 Flexible Scheduling Technologies: ACCEPTED

*Report PDF file created 15/12/2005*

The goal of this activity was to integrate various scheduling algorithms into a coherent set.

The activity progress report now clearly states the achievements and relationship between partners.

As mentioned in previous reports some techniques such as symmetric multiprocessing and virtualisation of operating systems might be considered in the future as potential for solving part of the issues addressed here, for instance power consumption reduction.

The deliverable is accepted as it is.

#### 4.6.4 D14 Adaptive Resource Management for Consumer Electronics: ACCEPTED

*Report PDF file created 15/12/2005*

The goal of this task was to define techniques for adaptive resource management according to QoS by identifying requirements from consumer electronics and automation.

The activity progress from months 1-6 and months 7-12 is now clear, but the funding is not defined. The partner relationship and collaboration and steps taken to build a network of excellence are now appearing. The industrial needs and experience are now showing perspectives.

The deliverable is accepted as it is.

### 4.7 Compilers and Timing Analysis cluster deliverables

Three deliverables were due from this cluster at the end of Y1:

- Deliv-JPIA-a3-Y1

- Deliv-JPIA-a4-Y1
- Deliv-JPRA-Cluster Integration – Compilers and Timing Analysis – Y1

The initial first two deliverables were light on any details of outcomes/results, though the presentations at the review went into more depth on the outcomes/results. These two deliverables had to be revised to expand the outcomes/results as described in the presentations, and describe how those outcomes/results were due to ARTIST funding.

The third deliverable was conditionally accepted previously. The comments on the reviewed reports are below.

#### 4.7.1 D2.3 Timing Analysis Platform: ACCEPTED

*New report PDF file created 15/12/2005*
This task is focused on combining the best components of existing European Timing-Analysis tools and prototypes in a standard tool architecture with well-defined textual interfaces. The primary effort for Y1 was to agree standard tool architecture and a set of textual interfaces.

The deliverable documents high-level bullets of outcomes; the presentation at the review expanded upon these bullets to better document the outcomes.

The revised document incorporates some more outcomes shown in the presentation. A limited separation between the foreground (integrative) outcomes from the background outcomes is now achieved.

However, only minor effort was done to enhance the quality of the deliverable. The introduced picture is unreadable – please correct this. More care should be exercised on checking the quality of the document.

The revised document is accepted for the time being, but it needs to be updated.

#### 4.7.2 D2.4 Compilers Platform: ACCEPTED

*New report PDF file created 15/12/2005*
This task is focused on providing world-class code-synthesis and compiler tools for the generation of efficient machine code. Goals of the cluster include the integration of existing compiler-generation approaches allowing compilers for new architectures to be built quickly, efficiently and reliably. The primary effort for Y1 was to integrate compiler tools with the CoSy platform.

This revised document incorporates clearly separation between the foreground (integrative) outcomes from the background outcomes with a new paragraph.

The revised document is accepted.

#### 4.7.3 D15 Architecture-aware compilation: ACCEPTED

*New report PDF file created 15/12/2005*
This task is focused on exploiting the world-leading position and expertise of academic and industrial cluster partners in order to integrate and further develop the technology currently available with the partners, so as to provide a unified, architecture-aware, code-synthesis and compiler methodology to a variety of users. The primary effort for Y1 was to initiate collaborative activities between the cluster partners to pursue this goal.

This revised document now incorporates the discussion of the requirements analysis that was done by the cluster.

The revised document is accepted.

## 4.8 Execution Platforms cluster deliverables

Four deliverables were due from this cluster at the end of Y1:

- Deliv-JPIA-a-EP-Y1
- Deliv-JPRA-NoE Integration-e-Y1
- Deliv-JPRA-Cluster Integration – Execution Platforms – a – Y1
- Deliv-JPRA-Cluster Integration – Execution Platforms –b – Y1

Most of the deliverables were of accepted during the previous review. One of the documents was rejected, and has been modified.

Comments on the revised documents are below.

### 4.8.1 D2.5 System Modelling Infrastructure: ACCEPTED

*Report PDF file created 26/09/2005*
This task is focused on integration of ongoing research efforts on infrastructure modelling. The primary effort for Y1 was to progress integrative efforts in two areas:

- simulation-based modelling (UoB, DTU, Linköping University).
- formal modelling (TU Braunschweig, ETHZ)

The deliverable provides a good high-level description of the activities. However, it is difficult to distinguish between the integrative work funded by the NoE and the background research that is funded externally.

This document is accepted, but should be modified to separate the foreground outcomes from the background research results.

### 4.8.2 D9 Resource-aware Design: ACCEPTED

*Report PDF file created 16/01/2006*
This task is focused on integration of ongoing research efforts on resource-aware design. The goals are to produce two concrete deliverables: 1) a set of tools that can interact and work together, and demonstrate the achievable optimizations on a particular hardware platform; and 2) a methodology that enables the design of predictable embedded systems with a special focus on issues that cut across several layers of abstraction, such as hardware and compiler design.

The primary work items for Y1 were to initiate integrative efforts in two areas:

- integration of the memory-aware compiler developed at the University of Dortmund with the multi-processor platform simulator developed at Università di Bologna
- extension of the modelling capabilities of the Bologna platform simulator to heterogeneous multi-core architectures by exploiting the Application-specific Processor framework based on the LISA architecture description language developed at Aachen University.

The deliverable provides a reasonable description of the activities. However, it lacks any discussion of real integrative outcomes or results. The presentation at the review, on the other hand, did present integrative outcomes and results.

The document has been modified to incorporate the technical and integrative achievements described in the Year 1 review presentation.

#### 4.8.3 D16 Communication-centric systems: ACCEPTED

*Report PDF file created 26/09/2005*
This report was accepted in the previous year-end review.

#### 4.8.4 D17 Design for low power: ACCEPTED

*New report PDF file created 15/12/2005*
This task is focused on the development, promotion and integration of methods that address power dissipation issues across several layers of abstraction. Research efforts were progressed on a number of fronts.

This revised document now incorporates the outcomes shown in the presentation. The document now shows the technical achievements from the cluster activity. It is a pity that the separation between the foreground (integrative) outcomes from the background outcomes is to be interpreted by the reader.

The revised deliverable is accepted.

### 4.9 Testing and Verification cluster deliverables

3 Deliverables were due from this cluster at the end of Y1:

- DELIV-JPIA-a-TV-Y1 (this cluster's contribution to DELIV-JPIA-TV-Y1 as planned in the DoW.)
- DELIV-JPRA - Cluster Integration - Testing and Verification - a -Y1
- DELIV-JPRA - Cluster Integration - Testing and Verification - b -Y1

#### 4.9.1 D2.7 Testing & Verification Platform for Embedded Systems: ACCEPTED

*Report PDF file created 30/09/2005*
This report was accepted in the previous year-end review.

#### 4.9.2 D20 Quantitative Testing and Verification: ACCEPTED

*Report PDF file created 16/01/2006*

The document has been modified to incorporate the changes requested in the Year 1 review report.

#### 4.9.3 D21 Verification of Security Properties: ACCEPTED

*Report PDF file created 30/09/2005, updated 15/12/2005*
The original report had not been accepted. The resubmitted document now contains considerable substantive material, including interesting interim results indicated in 3.1, 3.2 and 4.1 (concerning the nature of the symbolic semantic model). The provision of *"A publicly available database of security protocols and their analysis .. [at] .. http://www.lsv.ens-cachan.fr/spore/."* is *excellent*.

Even the 'brief state of the art' is worthy of publication on the ARTIST2 web site, as an introduction to the subject.

However, although the 'Indicators for integration' have been updated appropriately, the 'Evolution' section has still not been updated to reflect the latest position. Nor has the statement in 3.4 on 'Milestones'.

These are relatively minor elements of the deliverable, but they should nevertheless be updated to reflect the current status of the work.

### 4.10 Control for Embedded Systems cluster deliverables

Four deliverables were due from this cluster at the end of Y1:

- Deliv-JPIA-a-Control-Y1
- Deliv-JPRA-NoE Integration-c-Y1 (this cluster's contribution as planned in the DoW.)
- Deliv-JPRA - Cluster Integration – Control for Embedded - a -Y1
- Deliv-JPRA - Cluster Integration – Control for Embedded - b -Y1

The deliverables were of uniformly excellent quality. The deliverable documents themselves described the problem to be addressed, the current state of the art, what was achieved using ARTIST2 funds in the past year, and natural integrative next steps for the coming 12/18 months. Where Roadmaps (or other collateral documents) were developed as part of a particular task, such documents were succinctly summarized in the deliverable, with pointers to the more complete document for the interested reader.

#### 4.10.1 D2.6 Platform: Design Tools for Embedded Control: ACCEPTED

*Report PDF file created 26/09/2005*
This report was accepted in the previous year-end review.

#### 4.10.2 D7 Adaptive Real-time, HRT and Control: ACCEPTED

*Report PDF file created 26/09/2005*
This report was accepted in the previous year-end review.

#### 4.10.3 D18 Control in real-time computing: ACCEPTED

*Report PDF file created 26/09/2005*
This report was accepted in the previous year-end review.

#### 4.10.4 D19 Real-time techniques in control system implementations: ACCEPTED

*Report PDF file created 26/09/2005*
This report was accepted in the previous year-end review.

## 5 Work plan and resources

The deliverables documenting the work done in relation to the objectives of each work package have all been accepted. Each of the partners involved in the technical work packages is contributing commensurate with its level of funding.

Within the limits of the dynamics of NoE membership documented in the Periodic Activity Report, the resources employed are consistent with those forecasted in Annex I to the contract.

The effort spent is in accordance with the work carried out and results achieved, as documented in the deliverable documents.

All Work Packages have progressed as one might expect in an NoE. The inter-cluster deliverables document a sound level of interaction between work packages. There is a good balance between the work packages and the global coherence of the work plan.

## 6 Future work – 18-month Work Programme

*Report PDF file created 16/12/2005*

The team failed to provide a plan for the ensuing 18 months at the first review, but have since provided the document *'18-month Work-programme, Sep 2005 – Feb 2007'*.

Section 1.2 of this document satisfactorily explains (and implicitly justifies) structural changes from the end of Year 1.

Section 1.3 also states that *"interaction with the Industrial Advisory Board needs refinement"* (as also stated in the PAR). Several clusters report difficulties in achieving effective engagement of industry. This network may well be primarily a network of academic institutions, but that makes achievement of effective engagement with industry even more problematic and even more necessary.

Section 1.3 also states that *"The NoE is moving forward with plans for setting up a sustainable structure for continuing interaction between research and industry, after the end of the NoE contract."* This sounds very interesting, but the report says nothing more about what this structure might be, nor what its 'parameters' might be.

This *refinement* of the IAB was discussed during the review, and the arguments presented by the management team were compelling. The reviewers agreed that the IAB could be eliminated ***if*** its objectives can be met in some other way. We note from the DoW that the IAB was intended to play an important role in the following:

(i) redefinition of action lines between clusters

(ii) industrial liaison
- organization of specific events
- provide direct contact between leading figures in research and leading figures in industry

(iii) promote approaches, techniques, etc. to meeting current and future industrial needs

(iv) JPASE industrial liaison

(v) input to the strategic management board

The reviewers emphasized that point (iii) is critical and point (iv) is very important

Given the importance of embedded, real-time systems in numerous industries, it is critical that the ARTIST2 community have solid, strategic input from industrial advisers. Without such input, the research may be based upon RT kernels that have little or no appeal to prospective industrial users. Examples of the type of strategic input that one would expect are:

- the ARTIST2 community is heavily focused on standards such as Posix and Osek, while some industries prefer real-time variants of Linux due to the support provided by vendors.

- Virtualization techniques are potentially usable in soft-real-time situations to support migration and legacy systems; the work in the soft-real-time cluster does not address such needs.

- Another looming opportunity/problem is with regards to asymmetric multiprocessing; such systems have potential for addressing some of the problems studied by the members of the NoE (e.g. power consumption), but potentially require innovations in the RT kernels that manage such systems. Note that some of this work is being done in Artemis.

Therefore, if ARTIST2 is to replace or remove the Industrial Advisory Board, it is critical that the alternative provides the strategic scanning that can guide the integration efforts to best effect.

Section 2 provides updated milestones for each cluster. Some of these are described well - e.g. 2.1 'Real-Time Components', that clearly and succinctly explains changes from Year 1. Some are 'too succinct' – which is to say that they provide too little information for reviewers to judge whether there are changes from Year 1 or whether those changes are justified (e.g. 2.2, 2.3 – and several others). Some are obscure and/or free of meaningful content - e.g. 2.7 Non-cluster Activities: *"Each year, we expect to have a significant number of students and staff members exchanged between the partners" "Each year, we will organise, participate in, and provide support to a number of conferences, workshops and seminars." "The ARTIST2 researchers will publish research results widely."* Such statements have little predictive value.

Given the reviewers continuing concern over the lack of Network-level management of the JPASE activities, the 18-month work-programme requires at least a strategy to indicate how the DoW obligations will be addressed better in future.

In summary, the detailed cluster-level plans are adequate, but the description of the intentions for Network-level management are not.

The following amendments must be incorporated into this deliverable to convert it from CONDITIONALLY ACCEPTED to ACCEPTED:

- The NoE must produce some form of regular newsletter to inform interested parties outside of the partners; the reviewers recommend a monthly electronic newsletter, with each edition providing a list of URLs pointing to recent publications/workshop reports/other documentation on the web site, and with an enumeration of upcoming events of interest to the wider community, either sponsored by the NoE or others.
- It is time to stop thinking about the web site; a basic, web site accessible to those external to the consortium must be operational by 1 April 2006.
- This initial web site must contain documentation on the state-of-the-art upon which the NoE is basing its work. This state-of-the-art collection could include the various roadmap documents that have been produced in ARTIST and ARTIST2, or could be extracted from the existing deliverables; it should be noted that there is considerable variability in the state-or-the-art discussions in the deliverables, so populating it in this way is likely to create significant extra work for the consortium members.
- Statistics on web accesses and mail addresses registered with the site should be collected and summarised on a regular basis (e.g. monthly) for inclusion in the next management deliverables and discussion at the Year 2 review. It is expected that trends in the collected statistics will provide a metric for success in "spreading excellence".
- It should be easy for anyone navigating the web site to discover the requirements that must be met and the process that must be followed to join the network as an affiliate.
- All ARTIST2-affiliated authors are encouraged to indicate this affiliation in published papers.
- Some cleanup is necessary in section 2.1 which references a WP4 which has disappeared from the table of section 2.10

# 7 Assessment of objectives

The project continues to be relevant and the original objectives, as expressed in the DoW, are still valid and will be for the foreseeable future. However the consortium might consider some additional improvements in the future.

## 7.1 Standardisation strategy

The standardisation efforts fall into two categories: reactive and proactive. The reactive efforts consist of existing actions by partners, and attempts to make these individual actions cohesive by encouraging interaction between the interested partners. The proactive actions, such as with regards to AutoSAR, are coherent activities by the involved partners to influence new standards efforts. The NoE is encouraged to continue to be involved in both categories.

Success at the proactive category of standardisation efforts may be substantially enhanced if the consortium would prepare a tentative roadmap of standards activities, given the progress being made in each of the clusters and the standards interests of the various partners. This does not imply that ARTIST2 is attempting to drive standards, nor to push standards proposals that are acceptable to every member of the consortium; it simply means that the NoE is looking forward, in much the same way that the semi-conductor industry roadmap provides a backdrop for research and development efforts over a long period of time. This could help the consortium achieve impact in a standardisation body in which lobbying is as important as technical participation.

## 7.2 Artist2 International promotion

In order to better market the Artist2 network of excellence outside Europe, the consortium might consider presentations of Artist2 consortium and results in group such as the OMG RTESS or during one of the numerous real-time workshop organised by the OMG on the topic. The OMG RTESS task force gathers most US industries around this topic - DoD, Raitheon, MITRE, LockheadMartin, Boeing, … and also the Japanese robotic companies. Today it seems that Artist2 contribution are presented in various groups by the partners: RTESS (Martes), Analysis and Design task force (some UML related specification), MARS task force (Data Distribution) but without showing the existence behind of a European Network of Excellence.

# 8 Recommendations

## 8.1 Recommendation 1: Policy for Year 2 Deliverables

The end of the reporting period is 31st August. Deliverables should be available in good time for reviewers to (pre)assess them prior to the review meeting. In order to clarify the deadlines for the submission of deliverables and reports, the following contractual deadlines must be respected:

- All technical deliverables should be available on the ARTIST2 web site by 30 September 2006. The DoW says that the deliverables are due on 31st August.
- All technical deliverables available on the ARTIST2 web site by 30 September 2006 will be pre-assessed by the reviewers by 15 October 2006.
- All technical deliverables MUST be available on the ARTIST2 web site by 15 October 2006. This is a contractual obligation (see articles 6 and 7 of the contract; and article II.7 of Annex II to the contract).
- All technical deliverables NOT available on the ARTIST2 web site by 15 October 2006 are REJECTED.
- All management deliverables (Periodic Management Report, Periodic Activity Report, Spreading Excellence and 18 Month Plan) MUST be available on the ARTIST2 web site or via email by 15 October 2006. This is a contractual obligation (see articles 6 and 7 of the contract; and article II.7 of Annex II to the contract).
- If any management deliverables (Periodic Management Report, Periodic Activity Report, Spreading Excellence and 18 Month Plan) are NOT available by 15 October 2006, the review meeting is CANCELLED.

## 8.2 Recommendation 2: Deliverables

The 18-month plan document must be updated and resubmitted before 6th March 2006.

## 8.3 Recommendation 4: Reporting

The structure of the PAR should be improved to help the review process and a strategic approach to standardisation should be considered (sections 4.3.2 and 7.1). This is expected in the next report.

An alternative approach to the current IAB should be presented at the next review meeting (see section 6).

All technical deliverables should include relationship diagrams; these should also be used in the presentation materials at the next review.

Simply enumerating papers published during the period are insufficient to show integration. We recommend that papers that resulted from NoE-financed integration activities be shown in the activity report using a table with the following form:

| Paper | Clust1 | Clust2 | ... | ClustN |
|---|---|---|---|---|
| Auth1, Auth2, …, AuthN, “Title of paper”,<br>Conference/Journal,<br>Other details, YYYY. | 2 | | | 1 |
| | | | | |

Where the numbers in the Cluster columns indicate the number of authors in the author list that are affiliated with that particular cluster. If only a single Cluster column is non-empty, then this shows intra-cluster integration activity; if two or more Cluster columns are non-empty, this is indicative of inter-cluster integration activity.

## 9 Review conclusion

The proposed integration of the research community continues to be very relevant. The consortium is performing its technical work in a satisfactory manner.

The reviewers feel that the consortium must more strongly focus on the aims of integration and of spreading excellence beyond participants in the NoE to “*the research and industrial communities in the large”*.

The reporting has improved, but can be substantially strengthened if various recommendations in this report are followed in the production of the Year 2 deliverables.

Reviewer’s signature:

## 10 Appendix: state of project deliverables

| No. | Deliverable | M | Due Date | Date Received | State | Resubmission Date | Resubmission State | Cluster | Partner |
|---|---|---|---|---|---|---|---|---|---|
| **Management** | | | | | | | | | |
| D1.1 | Deliv-JPMA-Y1 Periodic Management Report | M12 | 12 | Not received | Rejected | 16/12/2005 | ACCEPTED | | 1 CDC |
| D1.2 D3 | Deliv-JPMA-Y1-b Scientific Management Report Fused with: Deliv-JPIA-b-Y1 Report on Staff Mobility and Exchange | M12 | 12 | 03/10/2005 | Rejected | 16/12/2005 | ACCEPTED | | 2 UJF/verimag |
| D4 | Deliv-JPASE-Y1 Report on Spreading Excellence | M12 | 12 | 04/10/2005 | Rejected | 15/12/2005 | ACCEPTED | | 2 UJF/ VERIMAG |
| **Components & Modelling** | | | | | | | | | |
| D2.1 | Deliv-JPIA-a-Components-Y1 Report on Components Platform for Component Modelling and Verification | M12 | 12 | 26/09/2005 | Rejected | 15/12/2005 | ACCEPTED | Components & Modelling | 2 UJF/ VERIMAG |
| D10 | Deliv-JPRA-Cluster Integration – Modelling and Components – a - Y1 Report on Component Modelling and Composition | M12 | 12 | 26/09/2005 | Rejected | 15/12/2005 | ACCEPTED | Components & Modelling | 32 Uppsala |
| D11 | Deliv-JPRA-Cluster Integration – Modelling and Components – b - Y1 Report on Development of UML for Real-time Embedded Systems | M12 | 12 | 26/09/2005 | Accepted | | | Components & Modelling | 8 CEA |

| No. | Deliverable | M | Due Date | Date Received | State | Resubmission Date | Remarks | Cluster | Partner |
|---|---|---|---|---|---|---|---|---|---|
| **Hard Real-Time** | | | | | | | | | |
| D5 | Deliv-JPRA-NoE Integration-a-Y1 Report on Semantic Framework for Hard Real-Time Design Flow | M12 | 12 | 28/09/2005 | Rejected | 15/12/2005 | ACCEPTED | **Hard Real-Time** Adaptive Real-Time Control for Embedded Systems | 15 INRIA |
| D6 | Deliv-JPRA-NoE Integration-b-Y1 Report on Merging the Event-triggered and Time-triggered Paradigms | M12 | 12 | 28/09/2005 | Rejected | 15/12/2005 | ACCEPTED | **Hard Real-Time** Adaptive Real-time Execution Platforms | 2 UJF/verimag |
| D12 | Deliv-JPRA-Cluster Integration – Hard Real Time - Y1 Report on Diagnosis in Distributed Hard Real-Time Systems | M12 | 12 | 28/09/2005 | Rejected | 15/12/2005 | ACCEPTED | Hard Real Time | 28 TU Vienna |
| **Adaptive Real-Time** | | | | | | | | | |
| D2.2 | Deliv-JPIA-a-ART-Y1 Report on ART Platform: A Common Infrastructure for Adaptive Real-time Systems | M12 | 12 | 26/09/2005 | Rejected | 15/12/2005 | ACCEPTED | Adaptive Real Time | 2 UJF/ VERIMAG |
| D8 | Deliv-JPRA-NoE Integration-d-Y1 Report on QoS aware Components | M12 | 12 | 28/09/2005 | Accepted | | | **Adaptive Real-Time** Modelling and Components | 24 UP Madrid |

| No. | Deliverable | M | Due Date | Date Received | State | Resubmission Date | Remarks | Cluster | Partner |
|---|---|---|---|---|---|---|---|---|---|
| **Adaptive Real-Time (cont)** | | | | | | | | | |
| D13 | Deliv-JPRA-Cluster Integration – Adaptive Real Time – a – Y1 Report on Flexible Scheduling Technologies | M12 | 12 | 26/09/2005 | Rejected | 15/12/2005 | ACCEPTED | Adaptive Real Time | 23 Pavia |
| D14 | Deliv-JPRA-Cluster Integration – Adaptive Real Time – b – Y1 Report on Adaptive Resource Management for Consumer Electronics | M12 | 12 | 28/09/2005 | Rejected | 15/12/2005 | ACCEPTED | Adaptive Real Time | 20 Mälardalen |
| **Compilers & Timing Analysis** | | | | | | | | | |
| D2.3 | Deliv-JPIA-a3-Y1 Report on Timing Analysis Platform | M12 | 12 | 26/09/2005 | Rejected | 15/12/2005 | ACCEPTED | Compilers & Timing Analysis | 2 UJF/ VERIMAG |
| D2.4 | Deliv-JPIA-a4-Y1 Report on Compilers Platform | M12 | 12 | 28/09/2005 | Rejected | 15/12/2005 | ACCEPTED | Compilers & Timing Analysis | 2 UJF/ VERIMAG |
| D15 | Deliv-JPRA-Cluster Integration – Compilers and Timing Analysis – Y1 Report on Architecture-aware compilation | M12 | 12 | 28/09/2005 | Conditionally Accepted | 15/12/2005 | ACCEPTED | Compilers and Timing Analysis | 3 RWTH Aachen |

| No. | Deliverable | M | Due Date | Date Received | State | Resubmission Date | Remarks | Cluster | Partner |
|---|---|---|---|---|---|---|---|---|---|
| **Execution Platforms** | | | | | | | | | |
| D2.5 | Deliv-JPIA-a-EP-Y1 Report on EP Platform: System Modelling Infrastructure | M12 | 12 | 26/09/2005 | Conditionally Accepted | 15/12/2005 | ACCEPTED | Execution Platforms | 2 UJF/ VERIMAG |
| D9 | Deliv-JPRA-NoE Integration-e-Y1 Report on Resource-aware Design | M12 | 12 | 26/09/2005 | Conditionally Accepted | 16/01/2006 | ACCEPTED | **Execution Platforms** Compilers and Timing Analysis | 31 Bologna |
| D16 | Deliv-JPRA-Cluster Integration – Execution Platforms – a – Y1 Communication-centric systems | M12 | 12 | 26/09/2005 | Accepted | | | Execution Platforms | 29 TUBS |
| D17 | 7 Deliv-JPRA-Cluster Integration – Execution Platforms –b – Y1 Design for low power | M12 | 12 | 26/09/2005 | Rejected | 15/12/2005 | ACCEPTED | Execution Platforms | 31 Bologna |
| **Testing And Verification** | | | | | | | | | |
| D2.7 | Deliv-JPIA-a-TV-Y1 Report on T&V Platform for Embedded Systems | M12 | 12 | 30/09/2005 | Accepted | | | Testing and Verification | 2 UJF/ VERIMAG |
| D20 | Deliv-JPRA-Cluster Integration – Testing and Verification – a – Y1 Quantitative Testing and Verification | M12 | 12 | 26/09/2005 | Conditionally Accepted | 16/01/2006 | ACCEPTED | Testing and Verification | 30 Twente |
| D21 | Deliv-JPRA-Cluster Integration – Testing and Verification – b – Y1 Verification of Security Properties | M12 | 12 | 30/09/2005 | Rejected | 15/12/2005 | ACCEPTED | Testing and Verification | 1 UJF/VERIMAG |

| No. | Deliverable | M | Due Date | Date Received | State | Resubmission Date | Remarks | Cluster | Partner |
|---|---|---|---|---|---|---|---|---|---|
| **Control for Embedded Systems** | | | | | | | | | |
| D2.6 | Deliv-JPIA-a-Control-Y1<br>Report on Control Platform: Design Tools for Embedded Control | M12 | 12 | 26/09/2005 | Accepted | | | Control for Embedded Systems | 2 UJF/ VERIMAG |
| D7 | Deliv-JPRA-NoE Integration-c-Y1<br>Report on Adaptive Real-time, HRT and Control | M12 | 12 | 26/09/2005 | Accepted | | | **Control for Embedded Systems**<br>Hard Real-Time Adaptive Real-Time | 19 Lund |
| D18 | Deliv-JPRA-Cluster Integration – Control for Embedded – a – Y1<br>Control in real-time computing | M12 | 12 | 26/09/2005 | Accepted | | | Control for Embedded Systems | 19 Lund |
| D19 | Deliv-JPRA-Cluster Integration – Control for Embedded – b – Y1<br>Real-time techniques in control system implementations | M12 | 12 | 26/09/2005 | Accepted | | | Control for Embedded Systems | 33 UPVLC |

## 11 List of PO and reviewers

| Name | Organisation | Email |
|---|---|---|
| Javid Khan | European Commission | javid.khan@cec.eu.int |
| Bob Malcolm | ideo ltd. | bobm@ideo.co.uk |
| Michel Ruffin | Alcatel | Michel.Ruffin@alcatel.com |
| Joseph Sventek | University of Glasgow | joe@dcs.gla.ac.uk |
| Martin Timmerman | Dedicated Systems Experts | m.timmerman@dedicated-systems.info |

## 12 Agenda

| | | |
|---|---|---|
| 09:30 | Meeting with reviewers | |
| 10:00 | Introduction | Project Officer |
| 10:10 | Discussion on revised technical deliverables | |
| 11:15 | Break | |
| 11:30 | Discussion on management deliverables | |
| 11:50 | Spreading Excellence activity , discussion | |
| 12:30 | Lunch | |
| 13:40 | Next 18 Month JPA<br>- Next phase of current activities<br>- New activities<br>- Roles of new partners<br>- International collaboration | Cluster leaders |
| 14:40 | Management issues<br>- Administrative<br>- Contractual<br>- Financial | Financial co-ordinator |
| 15:00 | Break | |
| 15:10 | Reviewer's meeting | Review team |
| 15:50 | Reviewer's feedback | |
| 16:15 | Next meeting | |

## 13 Attendees

Javid Khan (DG Information Society and Media)
Alkis Konstantellos (DG Information Society and Media)
Bob Malcolm (Reviewer – ideo, ltd.)
Michel Ruffin (Reviewer - Alcatel)
Joe Sventek (Reviewer – University of Glasgow)
Martin Timmerman (Reviewer – Dedicated Systems Experts)
Joseph Sifakis (VERIMAG)
Bruo Bouyssounouse (VERIMAG)
Albert Benveniste (INRIA)
Gerhard Fohler (Kaiserslautern University)
Reinhard Wilhelm (Saarland University)
Karl-Erik Arzen (Lund University)
Kim Larsen (Aalborg University)
Lothar Thiele (ETHZ)
Ed Brinksma (Twente University)
Jean-Noel Forget (CDC)
Frédéric Vollé (CDC)

## 14 Partner list

| Role | N° | Name | Short Name | Country |
|---|---|---|---|---|
| CO | 1 | Caisse des Dépots et Consignations | CDC | FR |
| CR | 2 | University Joseph Fourrier / Verimag | UJF / Verimag | FR |
| CR | 3 | RWTH Aachen | Aachen | DE |
| CR | 4 | BRICS – Aalborg University | Aalborg | DK |
| CR | 5 | AbsInt Angewandte Informatik GmbH | AbsInt | DE |
| CR | 6 | University of Aveiro | Aveiro | PT |
| CR | 7 | Universidad de Cantabria | Cantabria | ES |
| CR | 8 | Commissariat à l'Énergie Atomique Laboratoire LIST | CEA | FR |
| CR | 9 | Centre Fédéré en Vérification, Université de Liège | CFV | BE |
| CR | 10 | Czech Technical University | Czech TU | CZ |
| CR | 11 | Dortmund University | Dortmund | DE |
| CR | 12 | Technical University of Denmark | DTU | DK |
| CR | 13 | Swiss Federal Institute of Technology | ETHZ | CH |
| CR | 14 | France Telecom R&D | FTR&D | FR |
| CR | 15 | Institut National de Recherche en Informatique et Automatique | INRIA | FR |
| CR | 16 | Royal Institute of Technology | KTH | SE |
| CR | 17 | Linköping University | Linköping | SE |
| CR | 18 | Centre National de la Recherche Scientifique / Laboratoire LSV | LSV / CNRS | FR |
| CR | 19 | Lund University (Sweden) | Lund | SE |
| CR | 20 | University of Mälardalen | Mälardalen | SE |
| CR | 21 | Kuratorium OFFIS e. V. | OFFIS | DE |
| CR | 22 | PARADES EEIG | PARADES | IT |
| CR | 23 | University of Pavia | Pavia | IT |
| CR | 24 | Universidad Politecnica de Madrid | UP Madrid | ES |
| CR | 25 | Saarland University | Saarland | DE |
| CR | 26 | ST Microelectronics - Central R&D | STM | FR |
| CR | 27 | Technical University of Eindhoven | Eindhoven | NL |
| CR | 28 | Technical University of Vienna | TU Vienna | AT |

| | | | | |
|---|---|---|---|---|
| CR | 29 | Technical University Braunschweig | TUBS | DE |
| CR | 30 | University of Twente | Twente | NL |
| CR | 31 | University of Bologna | UoB | IT |
| CR | 32 | Uppsala University | Uppsala | SE |
| CR | 33 | Universidad Polytecnica de Valencia | UPVLC | ES |
| CR | 34 | University of York | York | UK |
| CR | 35 | Polytechnic Institute of Porto | Porto | PT |
| Role | N° | Name | Short Name | Country |
| CO | 1 | CDC | CDC | |
| CR | 2 | | | |
| CR | 3 | | | |
| CR | 4 | | | |
| CR | 5 | | | |
| CR | 6 | | | |
| CR | 7 | | | |

## 15 Project calendar

| **Month** | **2004** | **2005** | **2006** | **2007** | **2008** |
|---|---|---|---|---|---|
| Jan | | 5 | 17 | 29 | 41 |
| Feb | | 6 | 18 | 30 | 42 |
| Mar | | 7 | 19 | 31 | 43 |
| Apr | | 8 | 20 | 32 | 44 |
| May | | 9 | 21 | 33 | 45 |
| Jun | | 10 | 22 | 34 | 46 |
| Jul | | 11 | 23 | 35 | 47 |
| Aug | | **12** | **24** | **36** | **48** |
| Sep | 1 | 13 | 25 | 37 | |
| Oct | 2 | 14 | 26 | 38 | |
| Nov | 3 | 15 | 27 | 39 | |
| Dec | 4 | 16 | 28 | 40 | |