



Probabilistically Analyzable Real-Time Systems

## D6.5 Period 2 Dissemination and Use Report Version 2.0

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## Change Log

<b>Version</b>	<b>Description of Change</b>
v1.0	Initial Draft released to the European Commission
v1.1	Updates following reviewers' comments from the Brussels review meeting and Dissemination in the academia section (1.4)
v2.0	Proof-reviewed version

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## Executive Summary

This document, D6.5 Period 2 Dissemination and Use Report, describes the PROARTIS Project activities related to dissemination that occurred during Period 2 of the PROARTIS Project and additional plans for Period 3. It is intended to complement the high level summary of Dissemination progress provided in the D5.6 Period 2 Project Activity Report and includes a detailed list of project-focused dissemination activities, events and publications as well as a complete list of scientific (peer-reviewed) publications and submissions for the second period of the project.

The number of dissemination activities achieved to date show that despite a slow start-up of dissemination activity in period 1, the project is seeing wider visibility, especially in the areas of scientific publications.

One of the challenges that we addressed was the notion of mixing statistics, probability and random behavior with the culture of the real-time scientific community which has a rather different expectation. During this period we have seen significant take-up and interest of this new area.

During the second period of the PROARTIS Project, the main activities of WP6, in line with the Dissemination Strategy (D6.1), included a variety of activities:

- From a technical perspective, we disseminated project progress and results via key scientific publications (3 accepted) and major events including keynote talks in main academic events.
- In addition, we promoted the project to members of industry through various project-oriented dissemination activities and events.
- Finally, we have begun to revise the project website to make PROARTIS accessible to a more general audience, and provide a portal to hold the technical information now that the technical directions and mathematical problems have been resolved.

## 1. Dissemination Activities in Period 2

During period 2, there have been significant dissemination results, particularly in the area of Scientific Publications, but also in a number of more general dissemination activities.

### 1.1. *Scientific publications*

During this period, there has been a major effort within the project, now that key scientific principles have been established, to promote and publish the project results. Several scientific papers have been written, following a tremendous effort during period 2. Three of these are now accepted for publication:

- “Measurement-Based Probabilistic Timing Analysis For Multi-Path Programs”. This paper is now accepted for publication at ECRTS 2012, the major European conference in this area. This paper is a cross-project paper with authors from most partners that focuses on the foundations of Measurement-Based Probabilistic Timing analysis including its requirements and results with well-known benchmark suites.
- “PROARTIS: Probabilistically Analysable Real-time Systems”. This journal was accepted for publication in ACM TECS (Transactions on Embedded Computing Systems). This paper is a summary of the PROARTIS project itself, including several areas of work spanning the different work packages.
- “A Time Composable Operating System”, a paper reporting the work in WP2 is accepted for publication in June 2012 in the proceedings of WCET 2012, a satellite workshop to the ECRTS conference, the flagship workshop of the WCET analysis community.

Currently four other publications are under submission to top-tier conferences in this area including two submissions to RTSS 2012, one to CASES 2012 and to RTNS 2012. These are:

- “Processor Architectures with Probabilistically Analysable Timing Behaviour” has been submitted to RTSS 2012. This paper is a cross-project paper with authors from most partners that focuses on the hardware requirements to design a PTA friendly processor and the possibilities resulting from that.
- “Hardware randomization for the cache”, considering the hardware and impact of cache randomization has been submitted to CASES 2012
- “Resampling techniques for probabilistic real-time systems” covering an aspect of analysis from WP3 has been submitted to RTNS 2012
- “Enabling Probabilistic Timing Analysis Through Compiler and Run-time support” has been submitted to RTSS 2012

It is worth noting that the “Processor Architectures with Probabilistically Analysable Timing Behaviour” submission to RTSS 2012 was based on a rejected submission to ECRTS 2012. The main reason given for the rejection was to avoid two papers on similar topics at the same conference. Other than that, the reviews were positive which gives us confidence about the chances of the paper being accepted in RTSS.

### 1.2. *Printed Materials*

During Period 2, the project factsheet was updated and published. It is an A4 leaflet that has been distributed at several events including at other EU project events. The factsheet is also available from the website.

### **1.3. Press Activity**

No press releases or related activities were reported during P2 as planned. Press releases were planned at the beginning of the project to announce the start of the project and in P3 to promote the main results of the project.

### **1.4. Dissemination in Academia**

PROARTIS dissemination activities during the second year of the project included a variety of presentations at scientific/academic events. This included keynote speeches invitations and workshops.

Two invited keynote talks given by Francisco Cazorla (BSC), include presentation of the project at two of the most relevant workshops in the real-time community:

- Keynote “Hardware Support for Time Composable CRTE systems” was given at the WCET workshop held at ECRTS 2011 in Porto (July).
- Keynote “Hardware Support for Time Composable CRTE systems” was given at the CRTS workshop held at RTSS 2011 in Vienna (December).

Further invited at academic institutions have been used a dissemination platform for PROARTIS:

- HiPEAC Thematic Session (Goteborg). Francisco Cazorla (BSC) gave a talk entitled “PROARTIS: approach and results”
- University of Granada. Guillem Bernat (RPT) gave an invited talk on timing analysis from an industrial perspective, which included PROARTIS.
- University Alcala de Henares. Guillem Bernat (RPT) gave an invited talk on issues in DO-178B, which included overviews of the PROARTIS approach.
- At the 17th IEEE International On-Line Testing Symposium, Athens, Guillem Bernat (RPT) gave a talk entitled “Industrial Requirements for Timing Analysis of Real-Time Embedded Systems”.
- Lilliana Cucu (INRIA) has been attending to 3 workshops (in Massy and Paris) organized by the French statistical society (SFdS). These meetings allow to update the knowledge of the INRIA team and also to interact with the statistical community. This interaction is essential for later dissemination (and networking) of the theoretical results of PROARTIS

It is extremely positive that we have seen a change research direction in the academic community during the PROARTIS project. The paper published in 2009 at ECRTS “Using Randomized Caches in Probabilistic Real-time Systems”, which was the foundation of this project, was originally criticized for mixing probabilities with critical real-time systems. Since then, due in part to the work of PROARTIS, we are now seeing other papers centred on this topic appearing in academic proceedings from various authors in Europe and beyond.

### **1.5. Dissemination in Industry**

Several talks about PROARTIS and related work have been given to key European industries. In most cases, the main probabilistic approach taken by PROARTIS was introduced to the audience together with the advantages it offers, plus the approach the project takes to reach the PROARTIS objectives. Invited industrial talks were presented to:

- Infineon, Bristol. “Real-Time Multicore Systems”, by Francisco J. Cazorla (BSC) and Jaume Abella (BSC).

- ARM, Cambridge. “Reliable and Time Predictable multicores for Real-Time Systems”. Francisco J. Cazorla (BSC) and Jaume Abella (BSC).
- European Space Agency (ESA) - workshop on Avionics Data, Control and Software Systems (ADCSS). “Results from PROARTIS” by Francisco J. Cazorla (BSC) and Jaume Abella (BSC).
- “Hardware Support for Time Composable CRTE systems”. IBM T.J Watson Research Center in New York USA, by Francisco J. Cazorla (BSC).

Further discussions with departments within Airbus have taken place to disseminate the technology wider within the company. The intention is to encourage longer-term exploitation of the technologies; see the exploitation section for further detail.

RPT is developing tool qualification products for DO178B and ISO26262, both of which have benefited from the R&D in PROARTIS. This has been acknowledged in the marketing collateral available for download and given out to customers. RPT also takes PROARTIS flier/factsheet information for use at trade shows.

## **1.6. Relations with other E.C. Research Programmes**

The PROARTIS team also made links with other on-going European Commission Programmes.

- HIPEAC. As part of a Thematic Session of the HiPEAC network of excellence the Technical Coordinator presented the PROARTIS approach to researchers from ACROSS, T-CREST, HiPARTES, multiPARTES and parMERASA. After the presentations the presenters participated in a panel in which some key issues on real-time system (some of them covered by PROARTIS) were discussed.
- In May 2012, during a parMERASA project technical workshop was held in York, UK, Ian Broster (RPT) and Francisco J. Cazorla (BSC) were invited to give a 30-minute talk about the vision and main results obtained by the PROARTIS project so far. parMERASA comprises 8 partners including 4 industrial partners so it is an interesting dissemination event for PROARTIS. Some future collaboration is expected.
- PROARTIS will seek to join a meeting with TIMMO2USE (ITEA) project during 2012.

Minor interactions with ACROSS, T-CREST, HiPARTES, multiPARTES have are also noted, but these are not significant threads of interaction.

## **1.7. Relations with other Research Programmes**

RPT has been collaborating with the University of York, disseminating the PROARTIS ideas with two groups:

- CosMoS project (UK funded project) [www.cosmos-research.org](http://www.cosmos-research.org), involving Dr Fiona Polack and Teodor Ghetiu. This collaboration is related to the use of safety arguments of probabilistic features in software.
- TEMPO project (UK funded project) involving Prof Alan Burns and David Griffiths. This project has done some research on the use of statistics in software timing.

## **1.8. Web Presence**

Minor work on the PROARTIS Public website ([www.proartis-project.eu](http://www.proartis-project.eu)) has continued in P2. The aim of this work is to provide information to a wider audience, including scientific and more general viewers. Now that the vision of the project and scientific principles are much

clearer, we are revising the content of the website to reflect the latest status. Figure 1 shows a page from the website.

Specific changes include a shorter, clearer explanation of the relevance of the project for the home page and separating technical and non-technical parts of the website.

RPT have promoted the project through an article on its blog ([www.rapitasystems.com/blog](http://www.rapitasystems.com/blog)) which has received a good response so far.



Figure 1: The PROARTIS Public Website



## 2. Plans for Dissemination in Period 3

During the third period of the project, the aim for dissemination activities is to continue to ensure that the core ideas of PROARTIS are made known beyond the consortium. This will be achieved mostly through:

- Continuing to publish scientific publications
- Presentation of the results to industrial partners and contacts, to encourage exploitation
- A dissemination event

### 2.1. *Scientific Publications*

There are currently four publications pending review and publication in top-tier conferences and journals. Following excellent reviewer feedback from previous papers, we hope that most of these will be accepted.

We plan to submit at least a further 4 scientific papers during Period 3.

### 2.2. *Industrial and Academic Dissemination*

We intend to present the PROARTIS work at several conferences/trade shows including MAE show 2012 and Ada-Europe 2012 (<http://www.cister.isep.ipp.pt/ae2012/>) where RPT will be providing a tutorial on software optimization. As part of this tutorial, we will cover probabilistic analysis techniques from PROARTIS.

RPT also plans to submit a semi-technical paper to an industry focused magazine during the period.

Guillem Bernat (RPT) will present PROARTIS at a training course that RPT are providing to be held at the University of Waterloo, Canada, in May 2012 to industrial and academic partners.

### 2.3. *Cross-project Dissemination*

Links with the automotive critical systems projects TIMMO2USE, and VeTESS are planned. This will initially take the form of reciprocal presentations at plenary meetings to encourage joint collaborative work.

Further collaboration with parMERASA and T-CREST are likely following the initial presentations. In particular, following the presentation of PROARTIS at the parMERASA workshop, some of the technologies may be relevant for the analysis of rare-events on the parMERASA multi-core architecture.

### 2.4. *PROARTIS Dissemination Workshop*

As noted in D6.1, a significant dissemination event will be the organization of a PROARTIS workshop to disseminate the results to a wider community.

The event will be opened to any participant from both industry and academia and will include talks and presentations from the PROARTIS members, but also from invited speakers that have studied related topics.

The date is planned for the end of the project (actual date, location and format of the PROARTIS will be decided by the Executive Board before the final phase, month 27.)

## 3. Exploitation activities

At this point in the project, the partners are actively looking for exploitation opportunities. There are some patent opportunities, support in tools and use in future product proposed.

### 3.1. Patent Opportunities

BSC have started a patent process on the cache design that BSC has done to support the PROARTIS requirements on a cache system. In the future, BSC will try to establish bilateral projects with IAB members to further explore PROARTIS solutions on specific industrial environments (i.e. space or aerospace).

### 3.2. Tools

RPT is actively incorporating the technology into its core toolset. We plan to improve our tool by providing better support for probabilities within RapiTime by including extreme value statistics in our reporting. To achieve this, it needs to extend the current PROARTIS work to apply not just on randomized hardware, but to create an argument, and quantitative reasoning why this is a valid and reasonable approximation.

A tool demonstration is in preparation of the results of the PROARTIS research, which is based on analysis of a medium-sized system.

INRIA intends to extend the R package for analysis of randomized architectures to support utilization on common architectures. The package may become open source if there is sufficient interest from the community.

### 3.3. Software

UNIPD are investigating plans to release the time-composable POK from WP2 activities as an open-source project for wider use, initially targeted to the academic research community.

### 3.4. Use in Product

AFS has started discussions internally to disseminate the results of the PROARTIS project to relevant sections with the aim of promoting these results for future product use. In particular, meetings with Hervé Delseny, head of office software processes definition & assurance and Jean-Claude Laperche, a full-time Airbus Expert on computer architecture and dependability, have taken place. Airbus plans to evaluate the exploitability of the technologies in more detail later in the project.

### 3.5. Education and Research

UNIPD is considering the introduction of PROARTIS technologies and results to a PhD-level class, to expose PhD students to alternative and new ways of designing and analyzing embedded systems. This will enable UNIPD to help the students appreciate that, whereas multiple ways may exist to derive trustworthy upper-bounds on the execution time of software programs, it is decisive to attain a comprehensive system view of the factors of influence as well as to ensure that the hypotheses and assumptions on which any level of the execution stack bases, be it hardware, operating system, application, provably compose with those that hold at the other levels. This is precious education value that PROARTIS is confirming from its own innovative angle. UNIPD plans to start this activity in Q4 2012.

INRIA will incorporate the theoretical vision of PROARTIS within a Masters degree lecture course on real-time systems within the University of Lorraine from the first semester of 2012.

Future research planned by INRIA on this topic will use the PROARTIS results as motivation and reference. Probabilistic analysis of real-time systems has been previously criticized, and the results from PROARTIS will act as a baseline and reference for future work. The results of PROARTIS are the basis of a new probabilistic vision for real-time systems.

## 4. Industrial Advisory Board

Having progressed beyond Requirements Definition, we solicited initial industry feedback by having members of our Industrial Advisory Board (IAB) to attend our Design Review meeting held in April 2011.

The meeting participants included industry representatives from silicon manufacturers, automotive users, space users, a compiler vendor and research, plus project partners. During this 1-day event, the IAB provided feedback on the technical design but also on the procedures to further the design and implementation progress of the PROARTIS results. The meeting resulted in a lively design discussion, in particular on the methods of implementation possible in silicon.

As well as a management role, the IAB has a role to play in dissemination activities. The main work of the IAB is to support the project in order that the technology has a high impact in their market. The IAB include people who are both potential users and in touch with others who are potential users of the technology. Therefore the IAB meetings provide a good opportunity to bring them into touch with the project.

As of the end of Period 2, we are also now in the planning stages of another IAB Meeting scheduled for May 2012 in Barcelona. Ahead of this meeting, we will circulate some material resulting from the work in Period 2 to prepare the IAB members.

The following table summarizes the key comments and resulting actions from the IAB meeting in April 2011.

ISSUE	RESULTING ACTION
IAB wants a standard methodology to certify their systems that does not require re-certifying everything on a change (thus, composability)	PROARTIS solutions provide significant composability, more than standard deterministic architectures as shown D3.4.
Automotive industry may tolerate some deadline misses. Automotive IAB members are not particularly concerned about the probabilities provided by PROARTIS. What really matters is trusting the method and the tools used to derive results	PROARTIS enable tight WCET estimations, leading to reduce number of processor resources to run all the required functionality. The process followed to derive true probabilities is based on solid identification of the premises on which the results of the approach can be applied. This is a major advance with respect to the state of the art that applies probabilistic timing analysis techniques on architectures without properly understanding the timing behavior of that architecture.
SW-only solutions are very interesting because they could be used in current HW. Incremental solutions (e.g., first SW-only, then SW+HW) have higher chances to be adopted.	A significant effort has been done in PROARTIS to develop and implement compiler and run-time randomization solutions. Results of those techniques are shown in D1.2 and will be presented to the IAB during the next meeting in May.
Validation and verification (V&V) are key concerns.	PROARTIS designs provide observability so that faulty experiments can be repeated for debug/maintenance purposes. This is done by using Pseudo-Random Number Generators (PRNG) instead of purely random ones. Though, the level of randomization provided is good enough to provide safe pWCET estimations.
Abrupt performance changes introduced by current hardware must be avoided or mitigated to provide predictability	PROARTIS has identified the requirements on processor resources to prevent this behaviour: Resources timing behaviour have to be bounded from above or time randomised. This ensures that changes in the execution time of programs are probabilistically predictable.
Automotive industry is reluctant to the use of caches due to their hard-to-predict impact in timing	The results shown in the technical deliverables show that the PROARTIS time-randomized cache can be used such that not only average performance but guaranteed performance is reduced with the presence of caches. There is a solid argumentation of why this performance is guaranteed.
Automotive industry uses rudimentary means to estimate WCET and CPU load allowed	PROARTIS cheapens systems time analysis by using (safe) measurement-based approach. This dramatically reduces the amount of information required to provide safe pWCET estimations.
IAB expects results for real applications.	The IAB meeting was in m14 so results were not yet available. During the next

	IAB meeting results on both real case studies and benchmarks will be provided.
IAB wonders whether other techniques different to randomisation can be used to remove the effect of history	In theory, yes. In practice, we have not found any different solution yet, but we cannot discard it.
IAB is concerned about how many times applications must be run to obtain meaningful results with useful probabilities	Our results shown that with several hundreds of observations (runs) it is enough to provide enough information to the MBPTA technique to provide tight pWCET estimations.

## 5. List of Dissemination Activities

The following table shows all PROARTIS dissemination activities.

	PERIOD	Type	Main leader - Presenter Name (Partner)	Title	Date	Place	Type of audience	Size of Audience	LINK
1	P0.5 (M01-M06)	Publication	Fran Cazorla (BSC)	In the Spotlight: FP7 PROARTIS Project	01-Jul-10	HiPEACinfo23 Compilation Architecture Quarterly Newsletter	Scientific Community	N/A	<a href="http://www.hipeac.net/newletter">http://www.hipeac.net/newletter</a>
2	P0.5 (M01-M06)	Publication	Guillem Bernat (RAPITA)	FP7 PROARTIS Project	TBD	EC Embedded Portfolio 2010	Civil Society, Medias	N/A	<a href="http://www.proartis-project.eu/">http://www.proartis-project.eu/</a>
3	P0.5 (M01-M06)	Press Release	Mike Towers (RAPITA), Renata Giménez / Gina Alioto (BSC)	PROARTIS Press Release (General Release) European research project promotes increased performance and reliability in the avionics industry	18-Jun-10	PROARTIS Website / Various European and UK Publications	Civil Society, Medias	N/A	<a href="http://www.proartis-project.eu/">http://www.proartis-project.eu/</a>
4	P0.5 (M01-M06)	Press Release	Mike Towers (RAPITA), Renata Giménez / Gina Alioto (BSC)	PROARTIS Press Release (Wide) New research could herald revolution in flight systems	18-Jun-10	PROARTIS Website / Various European and UK Publications	Civil Society, Medias	N/A	<a href="http://www.proartis-project.eu/">http://www.proartis-project.eu/</a>
5	P0.5 (M01-M06)	<i>Related Link</i>			23-Jun-10	<a href="http://www.prlog.com">www.prlog.com</a>	Civil Society, Medias	N/A	<a href="http://www.prlog.org/10754366-new-research-could-herald-revolution-in-flight-systems.html">http://www.prlog.org/10754366-new-research-could-herald-revolution-in-flight-systems.html</a>
6	P0.5 (M01-M06)	<i>Related Link</i>			23-Jun-10	<a href="http://www.docstoc.com">www.docstoc.com</a>	Civil Society, Medias	N/A	<a href="http://www.docstoc.com/docs/47046116/PR-Log---New-research-could-herald-revolution-in-flight-systems---rossir24-0004">http://www.docstoc.com/docs/47046116/PR-Log---New-research-could-herald-revolution-in-flight-systems---rossir24-0004</a>

7	P0.5 (M01- M06)	<i>Related Link</i>			24-Jun-10	<a href="http://www.sysgo.com">www.sysgo.com</a>	Industry	N/A	<a href="http://www.sysgo.com/nc/news-events/press/press/details/article/sysgo-supports-the-proartis-european-project/?cHash=c164597697&amp;sword_list%5B0%5D=sysgo&amp;sword_list%5B1%5D=proartis">http://www.sysgo.com/nc/news-events/press/press/details/article/sysgo-supports-the-proartis-european-project/?cHash=c164597697&amp;sword_list%5B0%5D=sysgo&amp;sword_list%5B1%5D=proartis</a>
8	P0.5 (M01- M06)	Press Release	Mike Towers (RAPITA), Renata Giménez / Gina Alioto (BSC)	PROARTIS Press Release (Technical) Probabilistic analysis takes critical real-time safety certification and verification to new level, says EU project	18-Jun-10	PROARTIS Website / Various European and UK Publications	Scientific Community	N/A	<a href="http://www.proartis-project.eu/">http://www.proartis-project.eu/</a>
9	P0.5 (M01- M06)	<i>Related Link</i>			21-Jun-10	<a href="http://www.cieonline.com">www.cieonline.com</a>	Industry	N/A	<a href="http://www.cieonline.co.uk/news/fullstory.php/aid/1771/Probabilistic_analysis_takes_critical_real-time_safety_certification_and_verification_to_new_level.html">http://www.cieonline.co.uk/news/fullstory.php/aid/1771/Probabilistic_analysis_takes_critical_real-time_safety_certification_and_verification_to_new_level.html</a>
10	P0.5 (M01- M06)	Press Release	Renata Giménez (BSC)	PROARTIS Press Release (Wide) Un proyecto europeo de investigación promueve alto rendimiento y fiabilidad en la industria aeronáutica	21-Jun-10	BSC Website / Various Spanish Publications	Civil Society, Medias	N/A	<a href="http://www.proartis-project.eu/">http://www.proartis-project.eu/</a>
11	P0.5 (M01- M06)	Press Release	Liliana Cucu (INRIA)	PROARTIS Press Release (Wide) Le projet européen PROARTIS : vers plus de performance et de fiabilité dans l'industrie avionique	21-Jun-10	Various French Publications	Civil Society, Medias	N/A	<a href="http://www.proartis-project.eu/">http://www.proartis-project.eu/</a>
12	P1 (M07- M12)	Web	Renata Giménez (BSC)	PROARTIS Team meets at INRIA in Nancy for week-long workshop	07-Jul-10	<a href="http://www.bsc.es">www.bsc.es</a>	Scientific Community	N/A	<a href="http://www.bsc.es">http://www.bsc.es</a>
13	P1 (M07- M12)	Other	Benoit Triquet (AFS)	PROARTIS Press Release (Wide) Le projet européen PROARTIS : vers plus de performance et de fiabilité dans l'industrie avionique	19-Oct-10	Targeted mailing to GIFAS (a trade union of French aeronautics, space and defence corporations)	Industry	N/A	N/A

14	P1 (M07-M12)	Workshop	Fran Cazorla (BSC)	Processor Architectures in Future Critical Real-Time Embedded Systems	03-Nov-10	Thales Workshop on Embedded Mission Critical Systems: New Perspectives in Engineering and Computing (Orly, FRANCE)	Industry	40 participants	N/A
15	P1 (M07-M12)	Web	Renata Giménez (BSC)	Spain: Probabilistically Analysable Real-Time Systems	05-Jan-11	<a href="http://www.tmcnet.com">www.tmcnet.com</a>	Industry	N/A	<a href="http://technews.tmcnet.com/news/2011/01/05/5226638.htm">http://technews.tmcnet.com/news/2011/01/05/5226638.htm</a>
16	P1 (M07-M12)	Publication	Santinelli, L., and L. Cucu-Grosjean, (INRIA)	Toward Probabilistic Real-Time Calculus	01-Nov-10	3rd Workshop on Compositional Theory and Technology for Real-Time Embedded Systems (CRTS 2010), in conjunction with IEEE RTSS 2010, San Diego, 11/2010.	Scientific Community	N/A	-
17	P1 (M07-M12)	Publication	Maxim, D., L. Santinelli, L. Cucu-Grosjean (INRIA)	Improved sampling for statistical timing analysis of real-time systems	4-Nov-10	4th Junior Researcher Workshop on Real-Time Computing (JRWRTC 2010) in conjunction with 18th International Conference on Real-Time and Network Systems (RTNS'2010)	Scientific Community		-
18	P1 (M07-M12)	Poster	Leonidas Kosmidis (BSC)	Use of Randomized Caches in Hard Real-Time Systems"	July 11-17 2010	ACACES 2010 6th International Summer School on Advanced Computer Architecture and Compilation for High-Performance and Embedded Systems Terrassa (Spain)	Scientific Community	100 participants	N/A
19	P2 (M12-M27)	Workshop	Liliana Cucu (INRIA)	Probabilistic day within the french real-time group (ACTRISS): SYSTEMES TEMPS REEL PROBABILISTES, Ordonancement temps réel probabiliste et l'estimation de durées d'exécution (travaux réalisés en collaboration avec les partenaires de PROARTIS, FP7 STREP)	10-Mar-11	<a href="http://www.loria.fr">www.loria.fr</a>	Scientific Community	40 participants	<a href="http://www.loria.fr/~cuculili/journeePTR.html">http://www.loria.fr/~cuculili/journeePTR.html</a> , <a href="http://www.ece.fr/ecole-ingenieur/lece-accueil-une-journee-recherche-sur-le-temps-reel-probabiliste/">http://www.ece.fr/ecole-ingenieur/lece-accueil-une-journee-recherche-sur-le-temps-reel-probabiliste/</a>
20	P2 (M12-M27)	Invited Talk (Keynote)	Fran Cazorla (BSC)	Hardware Support for Time Composable CRTE systems	05-Jul-11	11th Int'l Workshop on Worst-Case Execution-Time Analysis Analysis in conjunction with the 23rd Euromicro Int'l Conference on Real-Time Systems (Porto, PORTUGAL)	Scientific Community, Industry	30 participants	<a href="http://www.artist-embedded.org/artist/Overview.2317.html">http://www.artist-embedded.org/artist/Overview.2317.html</a>

21	P2 (M12-M27)	Invited Talk	Fran Cazorla (BSC)	Hardware Support for Time Composable CRTE systems	28-Jul-11	IBM Research, Watson Research Center (Watson, U.S.A.)	Industry	6 participants	N/A
22	P2 (M12-M27)	Invited Talk	Fran Cazorla (BSC)	Hardware Support for Time Composable CRTE systems	29-Nov-11	4th Workshop on Compositional Theory and Technology for Real-Time Embedded Systems co-located with CRTS Workshop 2011 (Vienna, AUSTRIA)	Scientific Community	30 participants	<a href="http://www.rapitasystems.com/crts2011/">http://www.rapitasystems.com/crts2011/</a>
23	P2 (M12-M27)	Publication	Mike Towers (RPT)	PROARTIS Factsheet	02-Dec-12	EC Embedded Portfolio 2012	Civil Society, Medias	N/A	www.proartis.eu
24	P2 (M12-M27)	Invited Talk	Guillem Bernat (RAPITA)	"Perspectivas actuales en control de procesos y sistemas empotrados de tiempo real en la industria"	31-May-11	University of Granada	Scientific Community	N/A	N/A
25	P2 (M12-M27)	Invited Talk	Guillem Bernat (RAPITA)	Automated tool support for structural code coverage and timing analysis to support software verification to meet DO-178B standard.	24-Oct-11	University of Alcalá de Henares	Scientific Community	N/A	N/A
26	P2 (M12-M27)	Invited Talk	Fran Cazorla (BSC), Jaume Abella (BSC)	Results from PROARTIS	25-27 Oct 11	European Space Agency (ESA) Workshop on Avionics Data, Control and Software Systems (ADCSS). Multi-Core Processors for Space Applications	Industry	40 participants	<a href="http://www.congrex.nl/11c22/pages/standaard/page_2900.html">http://www.congrex.nl/11c22/pages/standaard/page_2900.html</a>
27	P2 (M12-M27)	Flyer (Marketing Collateral)	Andrew Coombes (RAPITA)	RVS (Rapita Verification Suite) DO-178B/C Tool Qualification Product Brief	07-Sep-11	<a href="http://www.rapitasystems.com/downloads">http://www.rapitasystems.com/downloads</a>	Industry	N/A	<a href="http://www.rapitasystems.com/downloads">http://www.rapitasystems.com/downloads</a>
28	P2 (M12-M27)	Flyer (Marketing Collateral)	Andrew Coombes (RAPITA)	RVS (Rapita Verification Suite) ISO26262 Tool Qualification Product Brief	07-Sep-11	<a href="http://www.rapitasystems.com/downloads">http://www.rapitasystems.com/downloads</a>	Industry	N/A	<a href="http://www.rapitasystems.com/downloads">http://www.rapitasystems.com/downloads</a>
29	P2 (M12-M27)	Invited Talk	Benoit Triquet (AFS)	The PROARTIS Approach and Certification	20-Feb-12	AIRBUS Facilities in Toulouse, FRANCE	Industry	6	N/A
30	P2 (M12-M27)	Invited Talk	Fran Cazorla (BSC), Jaume Abella (BSC)	Reliable and Time Predictable multicores for Real-Time Systems	08-Mar-12	ARM	Industry		N/A



31	P2 (M12- M27)	Invited Talk	Fran Cazorla (BSC), Jaume Abella (BSC)	Real-Time Multicore Systems	07-Mar-12	Infineon	Industry	5 participants	N/A
32	P2 (M12- M27)	Invited Talk	Fran Cazorla (BSC)	PROARTIS Approach and Results	24-Apr-12	HiPEAC'12, Thematic Session on Real-Time Goteborg, SWEDEN	Industry	40 participants	N/A
30	P2 (M12- M27)	Blog article	Ian Broster (RPT)	Statistics, Randomness and Timing	25-Apr-12	<a href="http://www.rapitasystems.com/content/statistics-randomness-and-timing">http://www.rapitasystems.com/co ntent/statistics-randomness-and- timing</a>	Industry	N/A	<a href="http://www.rapitasystems.com/content/statistics-randomness-and-timing">http://www.rapitasystems. com/content/statistics- randomness-and-timing</a>
31	P2 (M12- M27)	Research Seminar	Guillem Bernat (RPT)	Randomising the Timing Behavior for Safety Critical Real-Time Systems: the PROARTIS approach	25-May-11	<a href="http://www.cs.york.ac.uk/seminars/Past/11Summer/Bernat.php">http://www.cs.york.ac.uk/seminars /Past/11Summer/Bernat.php</a>	Scientific Community	30 participants	<a href="http://www.cs.york.ac.uk/seminars/Past/11Summer/Bernat.php">http://www.cs.york.ac.uk/s eminars/Past/11Summer/ Bernat.php</a>
32	P2 (M12- M27)	Flyer	Mike Towers (RPT)	PROARTIS Factsheet	02-Dec-12	EC Embedded Portfolio 2012	Civil Society, Medias	N/A	<a href="http://www.proartis.eu">www.proartis.eu</a>
33	P2 (M12- M24)	Interview	Fran Cazorla (BSC)	Entrevista a Francisco Cazorla, investigador del Barcelona Supercomputing Center (BSC)	April 2012	Interview published in a Journal. Theknos Col·legi d'enginyers tècs industrials de barcelona NÚMERO 162	Scientific Community	N/A	<a href="http://www.cetib.cat/serveis-colegiats/biblioteca/tipus/15/theknos">http://www.cetib.cat/servei s- colegiats/biblioteca/tipus/1 5/theknos</a>
34	P2 (M12- M24)	Publication	All partners	PROARTIS: Probabilistically Analysable Real-Time Systems	26-Jan-12	INRIA research report	Scientific Community	N/A	<a href="http://www.cs.umass.edu/~emery/pubs/PROARTIS-TECS.pdf">www.cs.umass.edu/~emer y/pubs/PROARTIS- TECS.pdf</a>
35	P2 (M12- M24)	IAB meeting	All partners	PROARTIS IAB meeting	12-Apr-2011	Gran Canaria	Industry	6	N/A
36	P2 (M12- M24)	Presentation	G. Bernat (RPT)	Industrial Requirements for Timing Analysis of Real-Time Embedded Systems	13-Jul-2011	17th IEEE International On-Line Testing Symposium (IOLTS conference), Athens	Scientific Community	100	<a href="http://tima.imag.fr/conferences/IOLTS/iolts11/index.htm">http://tima.imag.fr/confere nces/IOLTS/iolts11/index. htm</a>
37	P3 (M28- M42)	Invited talk	Ian Broster (RPT) Fran Cazorla (BSC)	PROARTIS: probabilistically analysable real-time systems	08-May-12	ParMERASA workshop, York	Scientific Community	30 participants	<a href="http://www.pamerasa.eu">www.pamerasa.eu</a>

38	P3 (M28- M42)	Invited talk	Guillem Bernat (RPT)	Probabilistically Analyzable Hard Real-Time Systems	22-May-12	IEEE Seminar, University of Waterloo, Canada		TBC	TBC
39	P3 (M28- M42)	Publication	All partners	PROARTIS: Probabilistically Analysable Real-Time Systems	TBC	ACM Transactions on Embedded Computing Systems (TECS) Special issue on Probabilistic Embedded Computing to appear in Spring/Summer 2012	Scientific Community	N/A	N/A
40	P3 (M28- M42)	Publication	All partners	Measurement-Based Probabilistic Timing Analysis for Multi-path Programs	11-Jul-12	ECRTS 2012, 24th Euromicro Conference on Real-Time Systems Pisa (Italy), July 11-13 2012	Scientific Community	TBC	<a href="http://ecrts.eit.uni-kl.de/index.php?id=74">http://ecrts.eit.uni-kl.de/index.php?id=74</a>
41	P3 (M28- M42)	Publication	T. Vardanega (UNIPD)	A Time Composable Operating System	10-Jul-12	12 <sup>th</sup> International workshop on Worst Case Execution Time Analysis, Pisa (Italy), July 10th 2012	Scientific Community	TBC	TBC