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Periodic Progress Report Year 1

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PROFUNDIS:
Periodic Progress Report Year 1
Part A (Executive Summary)

January 8, 2003

1 Summary

PROFUNDIS is a FET GC project with the main goal to advance the state of the art of formal modelling and verification techniques to the point where key issues in mobile distributed systems can be treated rigorously and with considerable automatic support. The partners are Uppsala (co-ordinator), Lisbon, INRIA and Pisa. In this Periodic Progress Report we present the developments in Year 1 (2002).

The project started slowly during the first half year due to problems in recruiting and because the co-ordinator moved from Stockholm to Uppsala. The second half year it has picked up speed and partly recovered lost ground. Manpower for the whole year is 71% of the plan but all main technical achievements have been fulfilled or are close to fulfillment, and the prognosis for coming years is good.

We have had one formal PROFUNDIS meeting (at INRIA, April 2002), and several minor meetings and visits related to specific tasks. On the whole interaction and collaboration have exceeded expectations. We have also formed links with other GC projects and with other relvant efforts worldwide.

Dissemination of our progress has followed established scientific channels. We have published in international conferences and journals with a peer review system to a degree that conforms to and sometimes exceeds our expectations. Dissemination of a less formal nature through visits, both between partners and to external sites, has also been significant.

In Part B of this report we explain in more details our technical achievements. Other related documents are the Self Assessment, where we compare our achievements against the goals in the Self Evaluation Plan, and the Summary of Dissemination Activities.

2 Project Overview

We here recall the structure of the project and its main goals. The objective is to advance the state of the art of formal modelling and verification techniques to the point where key issues in mobile distributed systems, such as security protocols, authentication, access rights and resource management can be treated rigorously and with considerable automatic support. We shall implement automatic and partly automatic analysis methods for ascertaining correct behaviour of such systems. For this purpose we shall integrate and focus several strands of ongoing theoretical work.

PROFUNDIS consists of three technical Work Packages (WPs) outlined below. A fourth WP is devoted to project management. The project is divided among four sites: Uppsala (UU), Lisbon (FFCT), INIRIA Sophia Antipolis and Pisa. Each site is active in all work packages, to a degree that varies between sites and over years. Each work package has an appointed leader. The Steering Committee consists of the co-ordinator and all site and work package leaders.

The technical work packages are:

WP1: Models

The objectives of the work package consist of the development of a HD-Automata model, suitable for finite-state verification, enhanced with additional capabilities like name fusions and substitutions. Also, versions of mobile calculi should be defined, e.g. for the symbolic analysis of security protocols. A verification environment should be designed and implemented, equipped with a general, open architecture and consisting of new tools realizing the models and the verification methods above. Several case studies should show the flexibility and effectiveness of our approach.

WP2: Specifications

The objectives of the work package are to develop new logics to support the verification of structural (spatial) and behavioural properties of concurrent mobile systems, and to develop proof systems for these logics based on sequent calculi. A tool for the logical framework should be built, integrated in the verification environment developed together with other tasks. The usefulness of the approach should be illustrated by several case studies.

WP3: Types

The objectives are to develop new type systems to control interferences among processes and the resources used by the processes; to integrate the type techniques with operational and logic techniques; to investigate the robustness of the type techniques and their algorithmic definitions; to assess the applicability of the techniques by means of case studies, and to implement some of the type algorithms and proof techniques.

3 Management Information

In this section we detail the manpower spent in each work package and how it relates to the plan in the Technical Annex (TA). We also explain in detail the collaboration and cooperation between different sites.

3.1 Manpower Resources

3.1.1 Summary

TOTAL	Year 1 Planned		Year 1 Actual		Year 2 Planned	
	Tot	Paid	Tot	Paid	Tot	Paid
UU	18	12	14	6	35	24
FFCT	45	33	22	7	45	33
INRIA	23	23	18	18	23	23
PISA	30	12	30	18	35	18
Total	116	80	82	49	138	98

As can be seen there is a discrepancy between planned and actual figures in that not as much work has been done as originally planned; on average only 71% of the planned person months have actually happened, and only 61% of the person months paid by the project. The reason for this is mainly the difficulty in recruiting personell, leading to an extremely low activity during the first half year. However, as explained in later sections, almost all the planned results have been obtained. Overall we have by now succeeded in recruiting and we anticipate no severe problems for coming years. During Year 2 Uppsala will have a paid activity corresponding to 24 person months (the original plan in the TA called for 18 months) and in this way recover lost ground. The other three sites will for Year 2 follow the plan in the TA and recover person months during Year 3.

In the following we comment on the deviations from plan per work package.

3.1.2 WP1: Models

WP1	Year 1 Planned		Year 1 Actual		Year 2 Planned	
	Tot	Paid	Tot	Paid	Tot	Paid
UU	16	12	12	6	21	16
FFCT	14	11	3	0	14	11
INRIA	6	6	4	4	6	6
PISA	18	7	18	13	23	12
Total	54	36	37	23	64	45

The work in Uppsala and Lisbon has been significantly delayed due to the difficulties of recruiting personnel. In Uppsala, two postdocs (Baldamus, Valencia) started their positions in October: they have strong research backgrounds and can be expected to produce significant results soon. Hence, the total efforts on WP1 of Uppsala and Lisbon are significantly less than planned.

Instead, the work in Pisa has progressed at least as planned, and in fact Task 1.3 (for tool development and verification environment) has surpassed the plans. Accordingly, the number of paid man-months for Pisa has been larger than expected. However the corresponding expense did not increase, since the activity has taken advantage of researchers younger than planned.

3.1.3 WP2: Specifications

WP2	Year 1 Planned		Year 1 Actual		Year 2 Planned	
	Tot	Paid	Tot	Paid	Tot	Paid
UU	0	0	0	0	6	4
FFCT	24	18	12	3	24	18
INRIA	6	6	5	5	6	6
PISA	5	2	5	2	5	3
Total	35	26	22	10	41	31

The main deviation from what was specified in the TA concerns the activities planned in Lisbon. One Ph.D. and one postdoc positions were expected for the whole of the first year, but only one Ph.D. student was recruited starting September. This difficulty, however, did not have a significant effect on the research that was produced as it was compensated by additional manpower not directly paid by the Commission.

3.1.4 WP3: Types

WP3	Year 1 Planned		Year 1 Actual		Year 2 Planned	
	Tot	Paid	Tot	Paid	Tot	Paid
UU	0	0	0	0	6	4
FFCT	6	4	6	4	6	4
INRIA	10	10	8	8	10	10
PISA	6	3	6	3	6	3
Total	22	17	20	15	28	21

The effort is reasonably close to plan.

3.1.5 WP4: Managment

WP4	Year 1 Planned		Year 1 Actual		Year 2 Planned	
	Tot	Paid	Tot	Paid	Tot	Paid
UU	2	0	2	0	2	0
FFCT	1	0	1	0	1	0
INRIA	1	1	1	1	1	1
PISA	1	0	1	0	1	0
Total	5	1	5	1	5	1

The effort corresponds to plan.

3.2 Partner Cooperation and Coordination

The PROFUNDIS kickoff meeting in April 2002 at INRIA attracted around 30 participants and other interested scientists. All sites gave presentations explaining their points of departure and extended discussion were conducted leading to firm plans for the coming year.

Subsequently we have had a few smaller meetings on specific topics and numerous informal visits between sites. These are mainly connected with progress in specific work packages and are accounted for below. As expected, the strongest intersite cooperation can be found in the efforts to develop the PROFUNDIS tools.

3.2.1 WP1: Models

The cooperation among the partners has been centered and focused on the issues related to the design of the architecture of the PROFUNDIS verification environment. After the the PROFUNDIS kickoff meeting, two meetings have been scheduled to address these issues.

The discussion of the first meeting (Pisa, June 10 - 11) focused on the following items:

1. the overall architectures of the PROFUNDIS Verification Environment;
2. components of the environments;
3. integration issues and component composition.

The main results of this meeting was the identification of and the preliminary design of the PROFUNDIS Verification Environment.

The participants of the first cooperation meeting are listed in the following table.

UU	B. Victor, M. Baldamus, M. Johansson,
FFCT	L. Caires, L. Monteiro,
INRIA	D. Hirschkoff
PISA	U. Montanari, S. Gnesi, G. Ferrari, E. Tuosto,
	M. Boreale, R. Raggi, G. Buscemi

The second meeting (Pisa, September 16) focused mainly on the issues of interoperability among the components of the PROFUNDIS Verification Environment. The main result of the meeting was the design of the format for data exchange among the components of the PROFUNDIS Verification Environment.

The participants of the second cooperation meeting are listed in the following table.

UU	B. Victor, M. Baldamus, M. Johansson,
FFCT	L. Monteiro,
PISA	U. Montanari, S. Gnesi, G. Ferrari, E. Tuosto,
	M. Boreale, R. Raggi, G. Buscemi

Finally, the following list details the visits related to partner collaboration.

- September 2002: Yemane (UU) visited Pisa for one month. During this visit we started work on HD automata with fusions and substitutions.
- September 2002: Monteiro (FFCT) visited Pisa for three weeks. During this visit we started work on models for spatial logics based on variations of HD-automata.
- November 2002: Baldamus (UU) visited Pisa for two weeks. During this visit we completed and experimented on data formats for interoperation among components of the PROFUNDIS Verification Environment.

3.2.2 WP2: Specifications

The cooperation between partners in WP2 in the first year assumed mainly three forms:

1. Design of the PROFUNDIS verification environment. Two meetings were held in Pisa for that purpose, in June and September, with representatives of all partners. A more detailed description of the meetings appears in the section for WP1 above.
2. Joint supervision of Lozes' Ph.D. by Lisbon and Lyon (a subsite of Sophia) on expressiveness of spatial logics. Lozes spent six months in Lisbon, and Hirschkoff and Lozes visited Lisbon for three days in December.
3. Work on models of spatial logic. This is a collaboration between Lisbon and Pisa. To start the work, Monteiro visited Pisa for three weeks in September.

3.2.3 WP3: Types

Several visits between sites and to other GC projects have contributed to the progress in WP3:

- Ravara (Lisbon) has visited Inria Sophia Antipolis for 6 months, to discuss with the local people several issues related to types for mobile processes.
- Levi (Pisa site) has visited Inria Sophia Antipolis for 2 weeks, to continue the work on control of interferences using types with Sangiorgi.
- Ferrari (Pisa site) has visited several times, for a few days each time, Florence and Genova, to discuss type issues with the local people (projects Mikado and Darts, respectively)
- Hirschkoff (INRIA site) has visited Turin for 1 week, to discuss type issues with the local people (project Darts).
- Sangiorgi (INRIA site) has visited Cambridge for 1 week, to discuss with the local people (some of which of the project Pepito) the problem of process termination.
- Amadio (INRIA site) has visited Munich for 6 months to discuss issues of control of resources using types with the local people (project MSR)
- Sangiorgi (INRIA site) has visited UPenn and Paris VI, 1 week each, to to discuss with the local people the problem of process termination.

Not all the visits listed above have been funded by PROFUNDIS. However, all of them, scientifically, concern the topics of WP3.

4 Major Technical Achievements

Strong advances have been made in all three work packages. This is further elaborated in Part B of this report, here we indicated just the main lines. In deliverable 15, "Self Assessment Year 1", we compare our achievements in detail to the plan. A conclusion is that all major results have been obtained, with a slight and not worrying delay in WP1 and WP2.

4.1 WP1: Models

Theoretical results have been established about HD automata modeled as coalgebras. Also coalgebraic models (not necessarily finite state) of mobile calculi have been defined, equipped with operations of parallel composition and restriction. Symbolic verification techniques have been developed and applied to security protocols. In particular, the control reachability problem has been studied. The theoretical results have provided the firm foundations needed for the experimental development, and they have driven the design and the prototype implementation. Tool prototypes have been developed for HD automata minimization wrt. bisimilarity. Verification toolkits exploiting symbolic techniques have been designed, implemented and tested. Also, the distributed infrastructure of the PROFUNDIS Verification Environment has been designed and a preliminary implementation has been developed.

4.2 WP2: Specifications

The general contributions of the work developed in WP2 in Year 1 are:

- Spatial logics for pi-calculi, that can describe not only behavioural properties, but also other key features of modern distributed systems (*e.g.,* resource control, distribution, and secrecy).
- Study of fundamental meta-theoretic properties of spatial logics for ambient and pi-calculi (*e.g.,* expressiveness, separation).
- Logics for semi-structured data and related decision procedures.
- Logical formalization of the secure composition of web services.

4.3 WP3: Types

New type systems have been introduced that, we think, significantly enlarge the collection of properties of mobile processes that can be handled with types. For other properties in which types alone seemed to be insufficient, we have developed techniques and models that combine ideas from types with ideas from other fields (modal logics, logical relations). The study of the impact of type systems on implementations, and the transfer to types developed in calculi of mobile processes to other languages, closer to high-level programming languages, has begun.

5 Dissemination

The main form of dissemination in PROFUNDIS is through established scientific channels. We have published in international conferences and journals with a peer review system to a degree that conforms to and sometimes exceeds our expectations. Dissemination of a less formal nature through visits, both between partners and to external sites, has also been important for us in order to follow and influence related developments in the community. In particular some strong links have been formed to other GC projects. Below we elaborate on the dissemination and present a full list of publications for each work package. This is also explained in full in Deliverable 11, "Summary of Dissemination Activities Year 1."

5.1 WP1: Models

Formal certification (i.e. formal specification and verification) of network applications is an important issue since by now many European countries have incorporated Information and Telecommunication Technologies (ITC) in their administrative structure (e.g. e-government). The problem of formal certification of properties has been addressed by a number of FET GC projects exploiting different techniques and methodologies. (e.g. Darts, Myths, Socks, Mikado, Pepito, Agile). Within PROFUNDIS we closely follow what happens in the other GC projects on this topic.

Cross fertilization among the research efforts carried on by different FET GEC projects takes place during standard academic occasions:

- regular meeting at conferences and workshops,
- exchange of visits among people involved in differented projects.

Moreover, cross-fertilization takes further advantage from the fact that at some sites (FFCT, INRIA and PISA) other research groups, closely linked to those active in PROFUNDIS, are involved in different research projects about related topics. We can mention that in Pisa four research groups are active on FET GC projects AGILE, DEGAS, PROFUNDIS and SOCKS. In particular, a joint research activity (PROFUNDIS and SOCKS) on the issues of proof techniques for certification of security properties has recently started. Also cooperation between Pisa and Florence (active on MIKADO and AGILE) is tight. In particular, a joint research activity (PROFUNDIS and MIKADO) is going on about analysis of security protocols, including tool STA.

Most international actors involved in the theme of properties certification of network applications are within the FET GC projects. The main relevant research activity outside the FET GC projects is the work at Stony Brook (Smolka, Cleaveland) on XMC/MMC (a model checker to verify properties of mobile systems specified in the π-calculus). Contacts with this group have been already established and will have more emphasis when case studies will be considered.

Finally, the PROFUNDIS group in Pisa has recently established a collaboration with two industrial partners - Telecom Italia Lab and Think3 – within the context of a national research project. These two industrial partners will test and exploit the prototype implementation of the PROFUNDIS Verification environment to specify and verify properties of two case studies. The first case study concerns the issues of *Network Intelligence* in the field of telecommunications. The other case study deals with distributed collaborative design of complex digital documents. We expect to report on the results of this activity in the continuation of PROFUNDIS in the next years.

Publications:

1. R. Amadio and W. Charatonik. On name generation and set-based analysis in Dolev-Yao model (extended abstract). In *Proc. CONCUR'02*, volume 2421 of *LNCS*. Springer Verlag, 2002.

2. R. Amadio, D. Lugiez and V. Vanackere. On the symbolic reduction of processes with cryptographic functions. *Theoretical Computer Science*, To appear.

3. R. Amadio and C. Meyssonnier. On decidability of the control reachability problem in the asynchronous pi-calculus. *Nordic Journal of Computing*, 9(2):70–101, 2002.

4. M. Boreale and M. Buscemi. A framework for the analysis of security protocols. In *Proc. CONCUR'02*, volume 2421 of *LNCS*. Springer Verlag, 2002.

5. M. Boreale and M. Buscemi. *STA, a Tool for the Analysis of Cryptographic Protocols (Online version).* Available at http://www.dsi.unifi.it/~boreale/tool.html.

6. M. Buscemi and U. Montanari. A first order coalgebraic model of pi-calculus early observational equivalences. In *Proc. CONCUR'02*, volume 2421 of *LNCS*. Springer Verlag, 2002. Full version in Technical Report TR-02-14, Dipartimento di Informatica, Universitá di Pisa, August 2002.

7. G. Ferrari, S. Gnesi, U. Montanari, R. Raggi, G. Trentanni and E. Tuosto. Verification on the web. Technical Report TR-02-18, Dipartimento di Informatica Universita' di Pisa, 2002.

8. G. Ferrari, S. Gnesi, U. Montanari and M. Pistore. A model checking verification environment for mobile processes. Submitted to *ACM TOSEM (under revision)*, 2002.

9. G. Ferrari, U. Montanari and M. Pistore. Minimizing transition systems for name-passing calculi: A co-algbraic formulation. In *Proc. FOSSACS'02*, volume 2303 of *LNCS*. Springer Verlag, 2002.

10. G. Ferrari, U. Montanari, R. Raggi and E. Tuosto. From coalgebraic specification to toolkit development. Technical Report TR-02-19, Technical Report, Dipartimento di Informatica Universita' di Pisa, 2002.

11. L. Monteiro. Transition systems with spatial structures: A coalgebraic framework. Manuscript, 2002.

12. R. Raggi and E. Tuosto. *HD-Reducers (Online version).* Dipartimento di Informatica, Universita' di Pisa, http://jordie.di.unipi.it:8080/mihda, 2002.

13. V. Vanackère. *The TRUST protocol analyser.* Lab. Informatique de Marseille, http://www.cmi.univ-mrs.fr/~vvanacke/trust.html, 2002.

14. V. Vanackère. The trust protocol analyser, automatic and efficient verification of cryptographic protocols. In *Verification Workshop - Verify02*, 2002.

5.2 WP2: Specifications

The use of logics for the specification and validation of software is a general concern of the discipline of software engineering. The field of distributed and mobile systems presents new challenges though, that have been addressed by other FET GC projects like Darts, Myths, Socks, Mikado, Pepito, Agile. In PROFUNDIS we closely follow the results produced by those projects and exchange views regularly with their researchers in scientific meetings and through exchange of visits. Furthermore, some researchers are in more than one FET GC project, which makes cross-fertilization between projects easier.

The main innovation of the approach followed by PROFUNDIS is that to the usual consideration of behavioural properties of systems is added an equal concern for intensional, structural or spatial properties (for instance, properties related to resource usage, or to the locality of names like secrecy and non-interference properties). This outlook is relatively recent, and does not seem to be found in other FET GC projects. In PROFUNDIS, all sites have contributed in the first year to the development of different aspects of spatial logic, and cooperation in subsequent years is expected to increase substantially.

Outside the FET GC projects there are several research groups working in logics that incorporate some form of spatial reasoning. Links have been established with those groups whose work has closer connections with our own. In particular, important aspects of the development of spatial logic have been done in collaboration between Lisbon and the Programming Principles and Tools Group at Microsoft Research Cambridge (with Cardelli). It is expected that this collaboration will continue in the future. Lisbon has also recently joined (as a subsite of U. Minho) the IST-2002-6.1.1 Working Group APPSEM II, task "Resource Models and Web Data", coordinated by Gardner (Imperial College) and O'Hearn (Queen Mary College). In this context a specialized workshop on spatial logics is already planned for early 2003. The theme of Resources and Web data is also closely related to work being developed in PROFUNDIS by the subsite at Marseille.

We expect the GC initiative to have a very positive impact in the dissemination of the main ideas of spatial logic among other researchers working on similar topics.

Publications:

(Note that number 2 is a common result with work package 3.)

1. L. Caires and L. Cardelli. A Spatial Logic for Concurrency (Part I). Accepted for publication in *Information and Computation*, 2002. Also as Technical Report 3/2002/DI/PLM/FCTUNL, DI/PLM FCT Universidade Nova de Lisboa, 2002.

2. A. Bracciali, A. Brogi, G. Ferrari and E. Tuosto. Security and dynamic compositions of open services. In *Proc. Int. Conference on Parallel and Distributed Processing Techniques and Applications (PDTA'02)*. CSREA Press, USA, 2002.

3. L. Caires and L. Cardelli. A Spatial Logic for Concurrency (Part II). In *CONCUR 2002: Concurrency Theory (13th International Conference)*, Lecture Notes in Computer Science. Springer-Verlag, 2002.

4. D. Hirschkoff, E. Lozes, and D. Sangiorgi. Separability, Expressiveness and Decidability in the Ambient Logic. In *17th Annual Symposium on Logic in Computer Science*, Copenhagen, Denmark, 2002. IEEE Computer Society.

5. L. Caires. Model-Checking of Spatial Properties in the pi-calculus. Research report 3, DI/FCT/UNL, December 2002.

6. D. Lugiez and S. Dal Zilio. Multitrees Automata, Presburger's Constraints and Tree Logics. Research report 08-2002, LIF, Marseille, France, June 2002. http://www.lim.univ-mrs.fr/Rapports/08-2002-Lugiez-DalZilio.html.

7. D. Lugiez and S. Dal Zilio. XML Schema, Tree Logic and Sheaves Automata. Research report 4631, INRIA, November 2002 (submitted). http://www.inria.fr/rrrt/rr-4631.html.

5.3 WP3: Types

Here we present the overall picture. Of course, the specific details can be quite different in each case (we refer for this to the the related work sessions in the papers in the deliverable).

Types is an important topic in a number of FET GC projects: Darts, Myths, MSR, Mikado, Pepito, Agile. Within PROFUNDIS we closely follow what happens in the other GC projects on this topic. We meet researchers from other GC projects in various occasions:

- regularly, at conferences and workshop
- through exchange of visits
- locally, as some sites (Pisa, Lisbon, Inria) are involved (with different persons) in 2 GC projects

These collaborations have given rise to a few joint works (the numbers refer to the list below):

- 8 is joint work with Mikado and Myths
- 9, 5, and 12 are joint works with Mikado
- 4 is joint work with Mikado and Darts
- 1 and 2 are joint works with Darts and Agile

The theme in WP3 with the closest relationship to the themes in other GC projects is the development of new types with security guarantees (in Task 3.1). Even within this theme, however, there are problems that are being tackled in PROFUNDIS only (resource allocation, classification of interference, for instance). Most of the work that PROFUNDIS is carrying out in the other tasks (theorem prover formalisations of type systems, combination of types and logical relations, for instance) has no direct correspondence in the other GC projects.

In conclusion: there a number of collaborations with other projects; the specificity of PROFUNDIS is its emphasis on the use of types for verification, where the verification should be mechanically carried out whenever possible, and where the techniques may combine methods based on types, operational semantics and logics.

On the theme of WP3 – types for mobile processes – all the main international actors are within the GC projects. Possible exceptions are Kobayashi's group in Tokyo, Honda and Yoshida in London. Contacts with these groups exist (for instance, Honda and Yoshida have visited Inria Sophia Antipolis for 1 week in 2002). Other relevant work outside the GC project, but that does not specifically target mobile processes, is that on types for control of resources; in particular, the work at CMU (Karl Crary), and UPenn (Stephanie Weirich). With the continuation of PROFUNDIS in next years, and with more emphasis being given to case studies and transfer to high-level programming languages, other international research groups will be more important for us: for instance, research groups on Smart cards and on Proof Carrying Code.

Publications:

(Note that number 3 is a common result with work package 2.

1. R. Pugliese G. Ferrari, E. Moggi. Guardians for ambient based monitoring. In *Proc. Foundations of Wide Area Network Programming*, ENTCS. Elseviers, 2002.
2. R. Pugliese G. Ferrari, E. Moggi. Metaklaim: A type safe multi-stage language for global computing. Technical Report Under revision for Mathematical Structures in Computer Science, 2002.
3. A. Bracciali A. Brogi G. Ferrari and E. Tuosto Security and dynamic compositions of WEB Services In Proc. Int. Conference on Parallel and Distributed Processing Techniques and Applications (PDTA'02), CSREA Press, 2002.

4. P. Giannini, D. Sangiorgi, and A. Valente. A distributed abstract machine for Safe Ambients. Extended and refined version of a paper appeared in *Icalp.01*, 2002.

5. S. Gay, V. T. Vasconcelos, and A. Ravara. Session types for inter-process communication. Preprint, Department of Computer Science, University of Lisbon, Campo Grande, Edifcio C5, 1749-016 Lisboa, Portugal, 2002. Submitted for publication.

6. F. Levi and D. Sangiorgi. Mobile safe ambients. To appear in the TOPLAS journal. Extended and refined version of a paper appeared in *Proc. 27th POPL*, ACM Press, 2002.

7. F. Martins and A. Ravara. Controling migration in lsdpi. Preprint, Section of Computer Science, Department of Mathematics, Instituto Superior Técnico, 1049-001 Lisboa, Portugal, 2002. In preparation.

8. G. Boudol, R. Amadio and C. Lhoussaine. On message deliverability and non-uniform receptivity. Research report 05-2002, LIF, Marseille, France, May 2002. Accepted for pubblication in Fundamenta Informaticae.

9. A. Ravara, P. Resende, and V. Vasconcelos. An algebra of behavioural types. Preprint, Section of Computer Science, Department of Mathematics, Instituto Superior Técnico, 1049-001 Lisboa, Portugal, 2002. Submitted for publication.

10. D. Sangiorgi. Types, or: Where's the difference between CCS and π? In *Proc. CONCUR '02*, volume 2421, 2002. accompanying paper for an invited talk.

11. D. Teller, P. Zimmer, and D. Hirschkoff. Using Ambients to Control Resources. In *Proceedings of the 13th Int. Conf. in Concurrency Theory (CONCUR'02)*, volume 2421 of *LNCS*, pages 288–303. Springer Verlag, 2002.

12. A. Vallecillo, V. T. Vasconcelos, and A. Ravara. Typing the behavior of objects and components using session types. In Antonio Brogi and Jean-Marie Jacquet, editors, *Electronic Notes in Theoretical Computer Science*, volume 68. Elsevier Science Publishers, 2002. presented at FOCLASA'02 - 1st International Workshop on Foundations of Coordination Languages and Software Architectures.