

COST Action IC1201  
Behavioural Types for Reliable Large-Scale Software Systems  
(BETTY)  
Activity Report 2012/13

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## 1 Introduction

This report describes the activities of COST Action IC1201 (Behavioural Types for Reliable Large-Scale Software Systems) during its first year. The period covered is 26th October 2012 to 25th October 2013. Most of the information in this report can also be found on the Action's web site at [www.behavioural-types.eu](http://www.behavioural-types.eu), along with the complete programmes of the meetings and workshops.

## 2 Membership

The number of participating countries has increased from 12 at the time of the original proposal, to 17 at the time of the kick-off meeting (26th October 2012), to 22 at the end of the first year (25th October 2013). The email list for the Action has 122 subscribers. The numbers of subscribers to the email lists for each Working Group are: WG1 (Foundations): 62; WG2( Security): 35; WG3 (Languages): 56; WG4 (Tools & Applications): 41. Most people are members of more than one Working Group. The total number of people who have attended at least one WG/MC meeting is 72.

## 3 Working Group Meetings

We held two Working Group meetings during the year: a one-day meeting in March 2013, co-located with the ETAPS conference in Rome, and a two-day meeting in September 2013, co-located with the SEFM conference in Madrid. Both of these were combined meetings of all of the WGs, because of the large overlap in the membership. Each meeting also included a Management Committee meeting. The meeting in September was immediately after the BEAT 2 workshop (Section 4

### 3.1 First WG Meeting: 24th March 2013

This meeting focused on understanding the scope of each WG, and identifying connections between the WGs. The aim was to start working towards the state-of-the-art reports (SOARs), which are the deliverables for the first year of the Action (Section 5). The day was divided into four sessions, one for each WG, and each session was planned by the WG chair. The sessions used a common structure, consisting of an introduction by the WG chair and then a number of short presentations by WG members, followed by discussion. This format enabled all participants to gain an overview of the whole of the Action. A few of our industrial contacts attended, which enabled us to discuss potential case studies and application domains.

The participants enjoyed a productive meeting. The only significant problem was that the one-day format did not allow as much time for discussion as many people would have liked.

### **3.2 Second WG Meeting: 25th–26th September 2013**

A large part of this meeting was devoted to presentation of progress with the SOARs, and discussion of how to complete them. There was a session for each WG, during which each writing team presented the current draft SOAR and then there was general discussion about missing material or connections between topics. We also discussed the best way to proceed with publication of the SOARs as journal articles.

Another session during the meeting was used for presentation of several proposals to organise a Summer School in 2014. After the presentations and discussion, an informal vote was taken in order to provide a basis for the Management Committee’s subsequent decision.

The final session was for discussion of future activity, including the schedule and format for future WG meetings, the future of the BEAT workshop, the plans for second year activity from the original proposal for the Action, and the possibility of submitting funding applications to the Horizon 2020 programme.

This meeting was successful and productive. The sessions for discussion of the SOARs were a little longer than they needed to be, but the extra time was used for technical discussions between participants.

### **3.3 Plans for Future WG Meetings**

We agreed to organise two WG meetings in 2014, each for a single day, again combining all four WGs. We will continue the practice of co-locating WG meetings with major conferences: ETAPS (April, in Grenoble) and CONCUR (September, in Rome).

The format will be a mini-workshop for most of the day, allowing participants to present current research, including research that is not yet sufficiently complete to be presented at a standard workshop or conference. We will also allocate some time for discussion of Horizon 2020 proposals.

## **4 Open Workshops**

We organised two open workshops, with the title BEAT (Behavioural Types). The first, BEAT 2013, was co-located with POPL on 22nd January 2013, in Rome. The second, BEAT 2, was co-located with SEFM on 23rd–24th September 2013, in Madrid, and took place immediately before a WG meeting (Section 3). Each workshop issued an open call for papers.

### **4.1 BEAT 2013: 1st International Workshop on Behavioural Types**

This was a one-day workshop. It was originally intended to use Action funding for invited speakers and organisational support, but this was not possible because the Action budget did not start until 1st March. Nevertheless, the workshop was an activity of the Action.

The number of submissions was disappointing, and not enough to fill a one-day programme. The programme was completed by inviting extra contributions from Action members and others. In the end, the workshop was a success, with a full and interesting programme and an attendance of around 25 people. The preliminary proceedings has been published on the Action web site, but because of the small number of submissions we did not publish a more formal post-workshop proceedings.

### **4.2 BEAT 2: 2nd International Workshop on Behavioural Types**

This was a two-day workshop. The Action budget supported an invited speaker, Dr Achim Brucker from SAP. He is involved in the FP7 project ANIKETOS, which has some concerns in common with our Action. He participated actively in the whole workshop and we hope to be able to involve him in future activities.

The number of submissions was larger than for BEAT 2013, and would have been enough to fill a one-day programme, but was not quite enough for a two-day programme. The original call for papers

allowed presentation of papers that had been published elsewhere, as well as original research papers, and there were a few papers in this category. To complete the programme, other Action participants were invited to present their current research, and we included a tutorial presentation.

The workshop was a success, and was attended by around 30 people. Its participants, and the participants in the WG meeting immediately afterwards, seemed to be a significant proportion of the whole participation in the SEFM conference. Everyone appreciated the fact that there was plenty of time for discussion.

Authors of original research papers presented at BEAT 2 can publish revised versions in a Springer Lecture Notes in Computer Science volume covering all of the workshops co-located with SEFM.

### 4.3 The Future of BEAT

We agreed to continue the BEAT series, and BEAT 2014 has been accepted as a one-day workshop co-located with CONCUR 2014. We hope that a one-day format, with a WG meeting the previous day, will attract a suitable number of papers and give a good balance between presentation of completed research (at BEAT) and work-in-progress (at the WG meeting).

## 5 State-of-the-Art Reports (SOARs)

Each Working Group is producing a state-of-the-art report (SOAR) covering its area. These reports are the deliverables for the first year of the Action. They are being written by a small team from each WG, coordinated by the WG chairs and vice-chairs, with additional input from other Action members.

In order to give due recognition to the work of the writing teams, we intend to publish each SOAR as a journal article. These survey articles will provide a valuable picture of the whole field of behavioural types; this has not been done before. We have decided to submit each SOAR, in a suitably edited form, to ACM Computing Surveys.

## 6 Short-Term Scientific Missions (STSMs)

Participants in the Action have enthusiastically taken advantage of the funding for Short-Term Scientific Missions (STSMs). This was expected, as an established style of collaboration in our community is to make one or more short visits and follow up with online communication. Some people have undertaken more than one STSM; some people have hosted more than one STSM; some people have been both host and visitor in different STSMs; there have been some “multi-party” STSMs involving two or more simultaneous visits to the same host.

Because the first budget period did not start until 1st March 2013, we did not issue a call for STSM proposals until after the Management Committee meeting at the end of March. The first STSM took place in May.

### 6.1 STSMs Completed During the First Year

A total of 11 STSMs were completed before 25th October 2013, involving 10 different visitors and 7 different hosts.

- **Enhanced process abstractions for runtime session adaptation**

*Visitor:* Cinzia Di Giusto (Universite d’Evry, France)

*Host:* Jorge Perez (Universidade Nova de Lisboa, Portugal)

*Dates:* 26th to 30th August 2013.

- **Guaranteeing responsiveness with behavioural types**

*Visitor:* António Ravara (Universidade Nova de Lisboa, Portugal)

*Host:* Thomas Hildebrandt (IT University of Copenhagen, Denmark)

*Dates:* 4th to 10th August 2013.

- **Liveness in behavioural types**

*Visitor:* Nobuko Yoshida (Imperial College London, UK)

*Host:* Thomas Hildebrandt (IT University of Copenhagen, Denmark)

*Dates:* 28th July to 12th August 2013.

- **Deductive verification of MPI programs against session types**

*Visitor:* Nicholas Ng (Imperial College London, UK)

*Host:* Vasco Vasconcelos (University of Lisbon)

*Dates:* 22nd to 28th July 2013.

- **A behavioural theory for sessions**

*Visitors:* António Ravara (Universidade Nova de Lisboa)

Marco Giunti (Universidade Nova de Lisboa)

*Host:* Adrian Francalanza (University of Malta)

*Dates:* 21st to 27th July 2013 (Ravara), 22nd July to 16th August 2013 (Giunti)

- **Behavioural permissions in role-based access control**

*Visitor:* Jovanka Pantovic (University of Novi Sad, Serbia)

*Host:* Hugo Torres Vieira (University of Lisbon, Portugal)

*Dates:* 7th to 14th July 2013.

- **Information Flow Analysis in Systems with Liveness Properties**

*Visitor:* Luca Padovani (University of Torino, Italy)

*Host:* Ilaria Castellani (INRIA Sophia Antipolis, France)

*Dates:* 16th to 22nd June 2013.

- **Privacy for Linked Data**

*Visitor:* Svetlana Jaksic (University of Novi Sad, Serbia)

*Host:* Mariangiola Dezani (University of Torino, Italy)

*Dates:* 19th to 31st May 2013.

- **Robust Support for Adaptability in Behavioural Types**

*Visitors:* Jorge Perez (Universidade Nova de Lisboa, Portugal)

Marco Carbone (IT University of Copenhagen, Denmark)

*Host:* Mario Bravetti (University of Bologna, Italy)

*Dates:* 13th to 17th May 2013.

## 6.2 STSMs Approved for the Remainder of the First Budget Period

At the time of writing, a total of 11 STSMs have been approved for the remainder of the first budget period, including one that was in progress on 25th October. These 11 STSMs involve 11 different visitors and 5 different hosts.

## 7 Publications and Other Dissemination

Action members have produced 23 conference papers and 19 workshop papers in 2013. Some journal articles have also appeared, but these are not included here; the long lead time for journal publication means that the research was done before the beginning of the Action.

The Action was presented at the Research Projects Symposium at the European Conference on Object-Oriented Programming (ECOOP).

## 7.1 Conference Papers

- **Johannes Borgström, Ramunas Gutkovas, Joachim Parrow, Björn Victor and Johannes Aman Pohjola.** *A Sorted Semantic Framework for Applied Process Calculi.* In *Proceedings of the 8th International Symposium on Trustworthy Global Computing.* Springer Lecture Notes in Computer Science, to appear.
- **Hans Hüttel.** *Types for resources in psi-calculi.* In *Proceedings of the 8th International Symposium on Trustworthy Global Computing.* Springer Lecture Notes in Computer Science, to appear.
- **Marco Giunti and António Ravara.** *Static deadlock resolution in the pi-calculus.* In *Proceedings of the 8th International Symposium on Trustworthy Global Computing.* Springer Lecture Notes in Computer Science, to appear.
- **Adrian Francalanza and Aldrin Seychell.** *Synthesising Correct Concurrent Runtime Monitors in Erlang.* In *Proceedings of the 4th International Conference on Runtime Verification.* Springer Lecture Notes in Computer Science volume 8174, 2013.
- **Rumyana Neykova, Nobuko Yoshida and Raymond Hu.** *SPY: Local Verification of Global Protocols.* In *Proceedings of the 4th International Conference on Runtime Verification.* Springer Lecture Notes in Computer Science volume 8174, 2013.
- **Raymond Hu, Rumyana Neykova, Nobuko Yoshida and Romain Demangeon.** *Practical interruptible conversations: Distributed dynamic verification with session types and Python.* In *Proceedings of the 4th International Conference on Runtime Verification.* Springer Lecture Notes in Computer Science volume 8174, 2013.
- **Dimitrios Kouzapas and Nobuko Yoshida.** *Globally Governed Session Semantics.* In *Proceedings of the 24th International Conference on Concurrency Theory (CONCUR).* Springer Lecture Notes in Computer Science volume 8052, 2013.
- **Fabrizio Montesi and Nobuko Yoshida.** *Compositional Choreographies.* In *Proceedings of the 24th International Conference on Concurrency Theory (CONCUR).* Springer Lecture Notes in Computer Science volume 8052, 2013.
- **Laura Bocchi, Tzu-Chun Chen, Romain Demangeon, Kohei Honda, and Nobuko Yoshida.** *Monitoring Networks through Multiparty Session Types.* In *Proceedings of the IFIP Joint International Conference on Formal Techniques for Distributed Systems (33rd FORTE / 15th FMOODS).* Springer Lecture Notes in Computer Science volume 7892, 2013.
- **Viviana Bono, Luca Padovani, and Andrea Tosatto.** *Polymorphic Types for Leak Detection in a Session-Oriented Functional Language.* In *Proceedings of the IFIP Joint International Conference on Formal Techniques for Distributed Systems (33rd FORTE / 15th FMOODS).* Springer Lecture Notes in Computer Science volume 7892, 2013.
- **Massimo Bartoletti, Alceste Scalas, Emilio Tuosto, and Roberto Zunino.** *Honesty by Typing.* In *Proceedings of the IFIP Joint International Conference on Formal Techniques for Distributed Systems (33rd FORTE / 15th FMOODS).* Springer Lecture Notes in Computer Science volume 7892, 2013.
- **Mario Coppo, Mariangiola Dezani-Ciancaglini, Luca Padovani and Nobuko Yoshida.** *Inference of Global Progress Properties for Dynamically Interleaved Multiparty Sessions.* In *Proceedings of the 15th International Conference on Coordination Models and Languages (COORDINATION).* Springer Lecture Notes in Computer Science volume 7890, 2013.

- **Hugo Torres Vieira and Vasco T. Vasconcelos.** *Typing Progress in Communication-Centred Systems.* In *Proceedings of the 15th International Conference on Coordination Models and Languages (COORDINATION)*. Springer Lecture Notes in Computer Science volume 7890, 2013.
- **Tiago Cogumbreiro, Francisco Martins and Vasco T. Vasconcelos.** *Coordinating phased activities while maintaining progress.* In *Proceedings of the 15th International Conference on Coordination Models and Languages (COORDINATION)*. Springer Lecture Notes in Computer Science volume 7890, 2013.
- **Daniel Hirschhoff, Jean-Marie Madiot and Davide Sangiorgi.** *Name-passing calculi: from fusions to preorders and types.* In *Proceedings of the 28th ACM/IEEE Symposium on Logic in Computer Science (LICS)*. IEEE, 2013.
- **Pierre-Malo Deniérou and Nobuko Yoshida.** *Multiparty Compatibility in Communicating Automata: Characterisation and Synthesis of Global Session Types.* In *Proceedings of the 40th International Colloquium on Automata, Languages and Programming (ICALP), Part II*. Springer Lecture Notes in Computer Science volume 7966, 2013.
- **Luca Padovani.** *Fair Subtyping for Open Session Types.* In *Proceedings of the 40th International Colloquium on Automata, Languages and Programming (ICALP), Part II*. Springer Lecture Notes in Computer Science volume 7966, 2013.
- **Roberto Di Cosmo, Jacopo Mauro, Stefano Zacchiroli and Gianluigi Zavattaro.** *Component Reconfiguration in the Presence of Conflicts.* In *Proceedings of the 40th International Colloquium on Automata, Languages and Programming (ICALP), Part II*. Springer Lecture Notes in Computer Science volume 7966, 2013.
- **Luís Caires, Jorge A. Pérez, Frank Pfenning and Bernardo Toninho.** *Behavioral Polymorphism and Parametricity in Session-Based Communication.* In *Proceedings of the 22nd European Symposium on Programming Languages and Systems (ESOP)*. Springer Lecture Notes in Computer Science volume 7792, 2013.
- **Bernardo Toninho, Luís Caires and Frank Pfenning.** *Higher-Order Processes, Functions, and Sessions: A Monadic Integration.* In *Proceedings of the 22nd European Symposium on Programming Languages and Systems (ESOP)*. Springer Lecture Notes in Computer Science volume 7792, 2013.
- **Massimo Bartoletti, Tiziana Cimoli and Roberto Zunino.** *A Theory of Agreements and Protection.* In *Proceedings of the 2nd International Conference on Principles of Security and Trust (POST)*. Springer Lecture Notes in Computer Science volume 7796, 2013.
- **Marco Carbone and Fabrizio Montesi.** *Deadlock-freedom-by-design: Multiparty Asynchronous Global Programming.* In *Proceedings of the 40th ACM SIGACT-SIGPLAN Symposium on Principles of Programming Languages (POPL)*. ACM, 2013.
- **Luís Caires and João Seco.** *The Type Discipline of Behavioral Separation.* In *Proceedings of the 40th ACM SIGACT-SIGPLAN Symposium on Principles of Programming Languages (POPL)*. ACM, 2013.

## 7.2 Workshop Papers

- **Bogdan Aman and Gabriel Ciobanu.** *Behavioural Types Inspired by Cellular Thresholds.* Presented at the 2nd International Workshop on Behavioural Types (BEAT 2), 2013.
- **Giovanni Bernardi and Matthew Hennesy.** *Compliance and testing preorders differ.* Presented at the 2nd International Workshop on Behavioural Types (BEAT 2), 2013.

- **Mario Bravetti, Marco Carbone, Thomas Hildebrandt, Ivan Lanese, Jacopo Mauro, Jorge A. Pérez and Gianluigi Zavattaro.** *Towards Global and Local Types for Adaptation.* Presented at the 2nd International Workshop on Behavioural Types (BEAT 2), 2013.
- **Juliana Franco and Vasco Thudichum Vasconcelos.** *A concurrent programming language with refined session types.* Presented at the 2nd International Workshop on Behavioural Types (BEAT 2), 2013.
- **Ross Horne, Rustem A. Kamun and Timur Umarov.** *Ensuring Faultless Communication Behaviour in an E-Commerce Cloud Application.* Presented at the 2nd International Workshop on Behavioural Types (BEAT 2), 2013.
- **Dimitrios Kouzapas and Anna Philippou.** *A Typing System for Privacy.* Presented at the 2nd International Workshop on Behavioural Types (BEAT 2), 2013.
- **Nicholas Ng, Nobuko Yoshida and Wayne Luk.** *Scalable session programming for heterogeneous high-performance systems.* Presented at the 2nd International Workshop on Behavioural Types (BEAT 2), 2013.
- **Ross Horne, Vladimiro Sassone and Gabriel Ciobanu.** *Local Type Checking for Linked Data.* Presented at the 9th International Workshop on Automated Specification and Verification of Web Systems (WWV), 2013.
- **Ivan Lanese, Fabrizio Montesi and Gianluigi Zavattaro.** *Amending Choreographies.* Presented at the 9th International Workshop on Automated Specification and Verification of Web Systems (WWV), 2013.
- **Luca Padovani.** *From Lock Freedom to Progress Using Session Types.* Presented at the 6th International Workshop on Programming Language Approaches to Concurrency and Communication-Centric Software (PLACES), 2013.
- **Cinzia Di Giusto and Jorge A. Pérez.** *Session Types for Dynamically Evolvable Communicating Systems.* Presented at the 6th International Workshop on Programming Language Approaches to Concurrency and Communication-Centric Software (PLACES), 2013.
- **Romain Demangeon and Laura Bocchi.** *Embedding Session Types in HML.* Presented at the 6th International Workshop on Programming Language Approaches to Concurrency and Communication-Centric Software (PLACES), 2013.
- **Rumyana Neykova.** *Session Types Go Dynamic or How to Verify Your Python Conversations.* Presented at the 6th International Workshop on Programming Language Approaches to Concurrency and Communication-Centric Software (PLACES), 2013.
- **Eduardo R. B. Marques, Francisco Martins, Vasco T. Vasconcelos, Nicholas Ng and Nuno Dias Martins.** *Towards deductive verification of MPI programs against session types.* Presented at the 6th International Workshop on Programming Language Approaches to Concurrency and Communication-Centric Software (PLACES), 2013.
- **Mario Coppo, Mariangiola Dezani-Ciancaglini, Luca Padovani and Nobuko Yoshida.** *Inference of Global Progress Properties for Dynamically Interleaved Multiparty Sessions.* Presented at the 1st International Workshop on Behavioural Types (BEAT), 2013.
- **Thomas Hildebrandt, Marco Carbone and Tijs Slaats.** *RSVP: Live Sessions with Responses.* Presented at the 1st International Workshop on Behavioural Types (BEAT), 2013.
- **Massimo Bartoletti, Alceste Scalas, Emilio Tuosto and Roberto Zunino.** *Honesty by Typing.* Presented at the 1st International Workshop on Behavioural Types (BEAT), 2013.

- **Vasco Thudichum Vasconcelos.** *Linearity and Affinity in Refined Session Types (in memory of Kohei Honda)*. Presented at the 1st International Workshop on Behavioural Types (BEAT), 2013.
- **Jakob Rehof.** *Towards Combinatory Logic Synthesis*. Presented at the 1st International Workshop on Behavioural Types (BEAT), 2013.

## 8 Conclusion

The first year of the Action has been successful, with productive scientific meetings, a good number of STSMs, and many publications in international conferences and workshops. State-of-the-art reports have been produced in the area of each Working Group, and these will be valuable resources for researchers within and outside the field. The activities planned for the second year are broadly similar to those carried out in the first year, with two changes: (1) there will be a summer school in 2014; (2) we will not produce state-of-the-art reports.