

# **COST**

Domain Committee "Information and Communication Technologies"

**COST Action IC1201**  
**Start Date 26<sup>th</sup> October 2012**

*Behavioural Types for Reliable Large-Scale Software  
Systems (BETTY)*

## **MONITORING PROGRESS REPORT**

**Reporting Period:** *from 26<sup>th</sup> October 2012  
to 30<sup>th</sup> April 2013*

This Report is presented to the relevant Domain Committee.  
It contains three parts:

- I. Management Report prepared by the COST Office/Grant Holder***
- II. Scientific Report prepared by the Chair of the Management Committee of the Action***
- III. Previous versions of the Scientific Report; i.e., part II of past reporting periods***

The report is a "cumulative" report, i.e. it is updated annually and covers the entire period of the Action.

Confidentiality: the documents will be made available to the public via the COST Action web page except for chapter *II.D. Self evaluation*.

Based on the monitoring results, the COST Office will decide on the following year's budget allocation.

**Executive summary (max.250 words):**

Participation in the Action has increased from 12 to 22 countries and there are now approximately 110 members. Action members organised a successful workshop at POPL (Principles of Programming Languages), a major conference, in January 2013; this was not funded by the Action as it was before the establishment of the budget. The first WG and MC meetings took place in Rome at the end of March, as part of the post-conference workshops at ETAPS, a major federated conference. The WG meetings were attended by more than 50 people and made progress towards the state-of-the-art reports which will be the first deliverables of the Action. A call for STSM proposals was issued in April, and 4 STSMs have been approved so far. Action members have been active in publishing papers at major conferences during 2013, although most of these papers were submitted before the beginning of the Action or in its very early stages. The first annual open workshop of the Action, together with WG and MC meetings, will be held as part of the SEFM conference in Madrid in September 2013.



### **I.A. COST Action Fact Sheet**

- **COST Action IC1201** – *Behavioural Types for Reliable Large-Scale Software Systems*
- **Domain** *Information and Communication Technologies*

- **Action details:**

**CSO Approval:** 07/06/2012

**End date:** 25/10/2016

**Entry into force:** 05/07/2012

**Extension:**

- **Objectives** *(from DB as in About COST)*

Modern society is increasingly dependent on large-scale software systems that are distributed, collaborative and communication-centred. Correctness and reliability of such systems depend on compatibility between components and services that are newly developed or may already exist. The consequences of failure are severe, including security breaches and unavailability of essential services. Current software development technology is not well suited to producing these large-scale systems, because of the lack of high-level structuring abstractions for complex communication behaviour. This Action will use behavioural type theory as the basis for new foundations, programming languages, and software development methods for communication-intensive distributed systems. Behavioural type theory encompasses concepts such as interfaces, communication protocols, contracts, and choreography. As a unifying structural principle it will transform the theory and practice of distributed software development. The significance of behavioural types has been recognised world-wide during the last five years. European researchers are internationally leading. There is an urgent need for European co-ordination to avoid duplication of effort, facilitate interactions among research groups, and ensure that the field proceeds efficiently from academic research to industrial practice. This Action will provide the co-ordination layer and leverage the efforts of European researchers, to increase the competitiveness of the European software industry.

• **Parties:** *list of countries and date of acceptance*

Bosnia and Herzegovina	12/03/2013
Croatia	27/08/2012
Cyprus	21/01/2013
Denmark	04/07/2012
Estonia	28/03/2013
France	25/07/2012
Germany	04/07/2012
Greece	11/09/2012
Ireland	05/07/2012
Italy	19/07/2012
Lithuania	07/05/2013
Malta	28/07/2012
Netherlands	29/08/2012
Norway	16/11/2012
Poland	31/08/2012
Portugal	10/09/2012
Romania	22/10/2012
Serbia	25/06/2012
Spain	11/10/2012
Sweden	20/09/2012
FYR of Macedonia	13/07/2012
United Kingdom	12/06/2012

• **Intentions to accept:** *none*

• **Other participants:** *none*

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• **Action Web site:** *<http://www.behavioural-types.eu>*

• **Grant Holder Representative** Dr Simon Gay      [Simon.Gay@glasgow.ac.uk](mailto:Simon.Gay@glasgow.ac.uk)

• **Working Groups** (*list of WGs and names and affiliations of participants*)

**WG1: Foundations**

**Co-chairs:** Hans Hüttel (University of Aalborg)  
Vasco Vasconcelos (University of Lisbon)

**Vice-Chair:** Ivan Lanese (University of Bologna)

Bogdan Aman (Academia Romaina Filiala Iasi)  
Davide Ancona (University of Genova)  
Franco Barbanera (University of Catania)  
Massimo Bartoletti (University of Cagliari)  
Michele Boreale (University of Firenze)  
Johannes Börgstrom (University of Uppsala)  
Mario Bravetti (University of Bologna)  
Roberto Bruni (University of Pisa)  
Marzia Buscemi (IMT Institute for Advanced Studies Lucca)  
Luís Caires (New University of Lisbon)  
Marco Carbone (IT University of Copenhagen)  
Giuseppe Castagna (University of Paris 7)  
Ilaria Castellani (INRIA Sophia-Antipolis)  
Gian Luca Cattani (Maps)  
Samir Chouali (University of Franche-Comte)  
Gabriel Ciobanu (Institut of Computer Science, Romanian Academy)  
Mario Coppo (University of Torino)  
Ugo de'Liguoro (University of Torino)  
Mariangiola Dezani (University of Torino)  
Pietro Di Gianantonio (University of Udine)  
Cinzia Di Giusto (University of Evry)  
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Elena Giachino (University of Bologna)  
Matthew Hennessy (Trinity College Dublin)  
Thomas Hildebrandt (IT University of Copenhagen)  
Daniel Hirschkoﬀ (ENS de Lyon)  
Furio Honsell (University of Udine)  
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Viviana Mascardi (University of Genova)  
Fabrizio Montesi (IT University of Copenhagen)  
Dimitris Mostrous (University of Lisbon)  
Hassan Mountassir (University of Franche-Comte)  
Samir Omanovic (University of Sarajevo)  
Luca Padovani (University of Torino)  
Jovanka Pantovic (University of Novi Sad)  
Jorge Perez (New University of Lisbon)  
Julian Rathke (University of Southampton)  
António Ravara (New University of Lisbon)  
Jakob Rehof (Technical University of Dortmund and Fraunhofer Institute for Software and Systems Engineering)  
Davide Sangiorgi (University of Bologna)  
Alceste Scalas (University of Calabria)  
João Seco (New University of Lisbon)  
Vaclavas Sirius (University of Siauliai)  
Bernardo Toninho (New University of Lisbon)  
Emilio Tuosto (University of Leicester)

Betti Venneri (University of Firenze)  
Björn Victor (University of Uppsala)  
Hugo Vieira (University of Lisbon)  
Philip Wadler (University of Edinburgh)  
Nobuko Yoshida (Imperial College London)  
Gianluigi Zavattaro (University of Bologna)

#### • **WG2: Security**

**Chair:** Iliaria Castellani (INRIA Sophia-Antipolis)  
**Vice-Chair:** Hugo Vieira (University of Lisbon)

Bogdan Aman (Academia Romaina Filiala Iasi)  
Karthikeyan Bhargavan (INRIA Paris-Rocquencourt, France)  
Viviana Bono (University of Torino)  
Michele Boreale (University of Firenze)  
Luís Caires (New University of Lisbon)  
Sara Capecchi (University of Torino)  
Marco Carbone (IT University of Copenhagen)  
Gabriel Ciobanu (Institute of Computer Science, Romanian Academy)  
Mario Coppo (University of Torino)  
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Mariangiola Dezani (University of Torino)  
Cinzia Di Giusto (University of Evry)  
Tihana Galinac Grbac (University of Rijeka)  
Simon Gay (University of Glasgow)  
Silvia Ghilezan (University of Novi Sad)  
Hans Hüttel (University of Aalborg)  
Jelena Ivetic (University of Novi Sad)  
Svetlana Jaksic (University of Novi Sad)  
James Leifer (INRIA Rocquencourt)  
Luigi Liquori (INRIA Sophia-Antipolis)  
Aleksandra Mileva (Goce Delcev University)  
Luca Padovani (University of Torino)  
Jovanka Pantovic (University of Novi Sad)  
Jorge Perez (New University of Lisbon)  
Simona Ranauskaite (University of Siauliai)  
Davide Sangiorgi (University of Bologna)  
João Seco (New University of Lisbon)  
Vaclav Sirius (University of Siauliai)  
Peter Thiemann (University of Freiburg)  
Bernardo Toninho (New University of Lisbon)  
Betti Venneri (University of Firenze)

#### • **WG3: Languages**

**Chair:** Giuseppe Castagna (University of Paris 7)  
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Gian Luca Cattani (Maps)  
Ugo de'Liguoro (University of Torino)  
Mariangiola Dezani (University of Torino)  
Cinzia Di Giusto (University of Evry)  
Adrian Francalanza (University of Malta)

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Marco Giunti  
Hans Hüttel (University of Aalborg)  
Vasileios Koutavas (Trinity College Dublin)  
Cosimo Laneve (University of Bologna)  
Luigi Liquori (INRIA Sophia-Antipolis)  
Cveta Martinovska (Goce Delcev University)  
Rafael Mayo Garcia (CIEMAT)  
Fabrizio Montesi (IT University of Copenhagen)  
Dimitris Mostrous (University of Lisbon)  
Jorge Perez (New University of Lisbon)  
José Quesada  
Julian Rathke (University of Southampton)  
António Ravara (New University of Lisbon)  
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João Seco (New University of Lisbon)  
Nikolaos Sismanis (Aristotle University of Thessaloniki)  
Peter Thiemann (University of Freiburg)  
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Vasco Vasconcelos (University of Lisbon)  
Hugo Vieira (University of Lisbon)  
Philip Wadler (University of Edinburgh)  
Pawel Wojciechowski (Poznan University of Technology)  
Peter Wong (Fredhopper)  
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#### • **WG4: Tools and Applications**

**Chair:** vacancy

**Vice-Chair:** Nikolaos Sismanis (Aristotle University of Thessaloniki)

Cesare Accomazzo (Etica)  
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Davide Ancona (University of Genova)  
Gary Brown (Red Hat)  
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Ivan Scagnetto (University of Udine)  
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### **I.B. Management Committee member list**

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## I.C. Overview activities and expenditure

01/03/2013 -28/02/2014

### Budget

Total Action Budget: €129490

#### Meetings

Meeting Type	Date	Place	Cost	Total
WG / MC	24/03/2013	Rome, Italy	24030	
WG / MC + Workshop	23-26 /09/2013	Madrid, Spain	39000	
Promotion of Action at ECOOP conference	1-2 /7/2013	Montpellier, France	1000	
Promotion of Action at other conferences	various	various	2000	
Surplus ( Rome meeting)			7970	
				<b>74000</b>

#### STSM

Beneficiary	Date	Place	Cost	Total
Marco Carbone	13/5/2013 – 17/5/2013	Bologna, Italy	800	
Jorge Perez	13/5/2013 – 17/5/2013	Bologna, Italy	800	
Svetlana Jaksic	19/5/2013 – 31/5/2012	Torino, Italy	1600	
Luca Padovani	16/6/2013 – 22/6/2013	Sophia- Antipolos, France	750	
Not yet allocated			29650	
				<b>33600</b>

#### Dissemination

Title	Date	Place	Total
Leaflets and posters			
Website			
			<b>5000</b>

#### Others

FSAC	<b>16890</b>
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**II. Scientific Report** prepared by the Chair of the Management Committee of the Action, describing results achieved during the Action operation in this period, in no more than 3 pages (the report is “cumulative”). All items listed in Sections A, B, and C, below, must be addressed.

Additional documentation such as extended scientific reports, proceedings of workshops, seminars or conferences may be provided separately as an annex to this report, and should be referenced in the report.

### **II.A. Innovative networking**

- *Innovative knowledge resulting from COST networking through the Action.*  
It is too early to attribute any innovative knowledge to the Action.
- *Significant scientific breakthroughs as part of the COST Action.*  
Although Action members are publishing papers in major conferences (see Annex 1), it is too early to attribute any of this work to the Action.
- *Tangible medium term socio-economic impacts achieved or expected.*  
Later in the Action, we expect to develop programming languages and software engineering tools, and work with industrial partners to apply them to realistic case studies. Although several Action members are already working with industrial partners, it is too early to attribute any of their achievements to the Action.
- *Spin off of new EC RTD Framework Programme proposals/projects.*  
We intend to develop collaborative research proposals between Action members, but none have been produced yet.
- *Spin off of new National Programme proposals/projects.*  
As the first Working Group meetings took place only at the end of March 2013, it is too early to directly attribute any new nationally funded projects to networking within the Action. For example, the project “From Data Types to Session Types: A Basis for Concurrency and Distribution” has been funded by EPSRC in the UK (starting date: 22<sup>nd</sup> May 2013). Its investigators are Prof. Philip Wadler (University of Edinburgh), Prof. Nobuko Yoshida (Imperial College London) and Dr Simon Gay (University of Glasgow), its funding is approximately €4.6 million over 5 years, and its topic is directly related to the Action. However, the original submission of the first stage of the proposal was in July 2012, before the beginning of the Action.

### **II.B. Inter-disciplinary networking**

We do not yet have any inter-disciplinary activities. We expect inter-disciplinarity to arise through the development of case studies in a range of application domains, later in the Action.

### **II.C. New networking**

- *Additional new members joining the Action during its life.*  
The original proposal for the Action listed 64 members from 12 countries. Since the beginning of the Action, this has increased to approximately 110 members from 22 countries.
- *Total number of individual participants involved in the Action work.*  
There are approximately 110 people on the Action email list. It is too early to say how many of these people will be active participants. The first Working Group meetings were attended by 54 people. The proportion of female participants is 21%. The proportion of early stage researchers is estimated to be at least 24%.
- *Involvement of Early Stage Researchers in the Action, in particular with respect to STSMs, networking activities, and Training Schools.*  
Four STSMs have been approved so far, of which three are by early stage researchers. The Vice-Chairs of the Working Groups are early stage researchers. At the first Working Group

meetings, several early stage researchers were among those who gave short presentations on the themes of each WG (see Annex 3).

- *Involvement of researchers from outside of COST Countries. (Number of participants from non-COST Countries approved by the CSO. Give % of such participants from countries with reciprocal agreements. Specify their contribution)*

We do not yet have any involvement by researchers from non-COST countries. We have recently identified potential collaborators in Argentina and New Zealand but have not yet discussed participation with them.

- *Advancement and promotion of scientific knowledge through publications and other outreach activities.*

Annex 1 lists 18 papers published by Action members at major conferences during 2013. However, most of these papers were submitted before the beginning of the Action or during its very early stages, and it would not be correct to attribute them to collaboration within the Action.

- *Activities and projects with COST network colleagues.*

Several STSMs are already planned, to continue existing collaborations and begin new collaborations. The BEAT workshop at POPL in January 2013 was an open meeting which involved Action members and other researchers (see Annex 2). The Working Group meetings in March 2013 resulted in productive interaction between Action members, including the establishment of many new contacts between research groups.

- *The capacity of the Action members to raise research funds.*

Action members are applying for nationally-funded research projects, but it is too early to attribute any such applications directly to the Action.

#### ***II.D. Self evaluation***

#### ***III. Previous scientific report(s)***

There are no previous reports.

## **Annex 1: List of Conference Publications by Action Members in 2013**

### **40<sup>th</sup> ACM SIGACT-SIGPLAN Symposium on Principles of Programming Languages (POPL)**

*Deadlock-freedom-by-design: Multiparty Asynchronous Global Programming.*  
Marco Carbone and Fabrizio Montesi

*Static and Dynamic Semantics of NoSQL Languages.*  
Véronique Benzake, Giuseppe Castagna, Kim Nguen and Jérôme Siméon

*The Type Discipline of Behavioral Separation.*  
Luis Caires and Joao Seco

### **22<sup>nd</sup> European Symposium on Programming Languages and Systems (ESOP)**

*Behavioral Polymorphism and Parametricity in Session-Based Communication.*  
Luís Caires, Jorge A. Pérez, Frank Pfenning, Bernardo Toninho

*Higher-Order Processes, Functions, and Sessions: A Monadic Integration*  
Bernardo Toninho, Luís Caires, Frank Pfenning

*Concurrent Flexible Reversibility.*  
Ivan Lanese, Michael Lienhardt, Claudio Antares Mezzina, Alan Schmitt, Jean-Bernard Stefani

### **2<sup>nd</sup> International Conference on Principles of Security and Trust (POST)**

*A Theory of Agreements and Protection.*  
Massimo Bartoletti, Tiziana Cimoli, Roberto Zunino

### **15th International Conference on Coordination Models and Languages (COORDINATION)**

*Inference of Global Progress Properties for Dynamically Interleaved Multiparty Sessions.*  
Mario Coppo, Mariangiola Dezani-Ciancaglini, Luca Padovani and Nobuko Yoshida.

*Typing Progress in Communication-Centred Systems.*  
Hugo Torres Vieira and Vasco T. Vasconcelos.

*Coordinating phased activities while maintaining progress.*  
Tiago Cogumbreiro, Francisco Martins and Vasco T. Vasconcelos.

*Decidability Results for Dynamic Installation of Compensation Handlers.*  
Ivan Lanese and Gianluigi Zavattaro.

### **IFIP Joint International Conference on Formal Techniques for Distributed Systems (33rd FORTE / 15th FMOODS)**

*Monitoring Networks through Multiparty Session Types*  
Laura Bocchi, Tzu-Chun Chen, Romain Demangeon, Kohei Honda, and Nobuko Yoshida

*Polymorphic Types for Leak Detection in a Session-Oriented Functional Language*  
Viviana Bono, Luca Padovani, and Andrea Tosatto

*Honesty by Typing*  
Massimo Bartoletti, Alceste Scalas, Emilio Tuosto, and Roberto Zunino

#### **40<sup>th</sup> International Colloquium on Automata, Languages and Programming (ICALP)**

*Multiparty Compatibility in Communicating Automata: Characterisation and Synthesis of Global Session Types*  
Pierre-Malo Denielou and Nobuko Yoshida.

*Fair Subtyping for Open Session Types*  
Luca Padovani.

*Component Reconfiguration in the Presence of Conflicts*  
Roberto Di Cosmo, Jacopo Mauro, Stefano Zacchiroli and Gianluigi Zavattaro

#### **28<sup>th</sup> ACM/IEEE Symposium on Logic in Computer Science (LICS)**

*Name-passing calculi: from fusions to preorders and types*  
Daniel Hirschhoff, Jean-Marie Madiot and Davide Sangiorgi.

## ***Annex 2: Programme of the BEAT Workshop in Rome, January 2013***

David Pearce

*A Calculus for Constraint-Based Flow Typing*

Mario Coppo, Mariangiola Dezani-Ciancaglini, Luca Padovani, Nobuko Yoshida

*Inference of Global Progress Properties for Dynamically Interleaved Multiparty Sessions*

Thomas Hildebrandt, Marco Carbone, Tijs Slaats

*RSVP: Live Sessions with Responses*

Naoki Kobayashi

*Behavioral Type Systems for Program Analysis: A Tutorial*

Massimo Bartoletti, Alceste Scalas, Emilio Tuosto, Roberto Zunino

*Honesty by Typing*

Vasco Vasconcelos

*Linearity and Affinity in Refined Session Types (in memory of Kohei Honda)*

Jakob Rehof

*Towards Combinatory Logic Synthesis*



## ***Annex 3: Programme of Working Group Meetings in Rome, March 2013***

### **Working Group 1: Foundations**

Introduction and overview: Hans Hüttel

#### *Short Presentations*

Global Programming: Marco Carbone

Typing Progress in Communication Centred Systems: Hugo Torres Vieira

Adaptive Choreographies: Ivan Lanese

Logical Foundations of Session-Based Interaction: Luis Caires

Live Sessions with Responses: Marco Carbone

#### *Discussion*

### **Working Group 2: Security**

Introduction and overview: Ilaria Castellani and Hugo Torres Vieira

#### *Short Presentations*

Information Flow Control and Reputation in Multiparty Sessions: Sara Capecchi

Multiparty Sessions as a Security Protocol Abstraction: Pierre-Malo Deniérou

Security Types for Dynamic Web Data: Svetlana Jakšić

Proof-Carrying Code with Dependent Session Types: Bernardo Toninho

#### *Discussion*

### **Working Group 3: Languages**

Introduction and overview: Luca Padovani

#### *Short Presentations*

Modular Session Types for Objects: Nils Gesbert

Session Types in Functional Languages: Vasco Vasconcelos and Bernardo Toninho

Let's Scribble: Romyana Neykova

#### *Discussion*

### **Working Group 4: Tools and Applications**

Introduction and overview: Peter Wong

#### *Short Presentations*

Session Types for Cross-Organizational Workflows in Case Management Systems: Tijs Slaats

Towards Algorithmic Typechecking of Concurrent Programs with Behavioral-Separation Types:  
Luis Caires  
Electronic Exchange of Social Security Information (EESSI): Tim Hallwyl

*Discussion*