Project no. 288570

PARAPHRASE

Strategic Research Partnership (STREP)
PARALLEL PATTERNS FOR ADAPTIVE HETEROGENEOUS MULTICORE SYSTEMS

Report on community building activities
D7.2

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Executive Summary

The objective of work package 7 is to promote the use of ParaPhrase tools and technologies by establishing an active user community and by providing technical documentation as well as elaborated tutorials and training materials. Some of the community building activities specifically cater for users from an industrial background.

User community building activities in the third year have progressed as planned. A second major community building activity has been held in Dublin, Ireland. The International Summer School in Parallel Patterns saw roughly 35 participants including industrial practitioners. In addition, various presentations, workshops and other related events have been run by project participants.

Also, ParaPhrase has produced and revised a range of technical documentation and training materials, including online videos, for the tools and software frameworks developed. Part of the revisions were triggered by a newly implemented quality control system.

Finally, this document itemizes concrete plans for community building activities to be implemented in the final months of the project.
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1. Introduction

The ParaPhrase project aims to disseminate results in two very different groups: the academic community and a user community. Intrinsic scientific results are disseminated in the various academic communities through work package 8. In contrast, the objective of work package 7 is to promote the use of ParaPhrase tools and technologies by establishing an active user community (T7.1), and by providing technical documentation as well as elaborated tutorials and training materials (T7.2). While ParaPhrase also addresses users with an academic background, the community building activity originally were aimed at users from an industrial environment.

As MLNX has pull-out of the project in the second year, the project had to revise its strategy for community building activities. As laid out in D7.1 the project would give higher emphasis on training activities, as we could no longer rely on MLNX getting industrial users engaged directly with ParaPhrase technologies. Accordingly, the second major community building action was conducted as a summer school, involving industrial participation on both sides, i.e. as trainees and trainers. The International Summer School in Parallel Patterns was hosted by NCI in Dublin as planned in project month 33.

Other activities related to community building during the third year include the realization of presentations at major technical conferences, and the organization of technical workshops and conferences related to ParaPhrase topics. The aim of this activities was to reach out to practitioners and show the advantages of the ParaPhrase approach, rather than presenting scientific results. Also, as ParaPhrase technologies matured, ParaPhrase technologies and tools have been increasingly used in regular lectures and course work by the academic partners. The second task of this work package produced and revised a range of technical documentation and training material such as podcasts and online videos on tool usage. Also, some of the key technologies and tools have been made available to the user community for evaluation.

This document firstly reports on the user community building activities that have been put into effect so far. Secondly, it details the community building plans for the final months of the project.
2. Community building activities

2.1 International Summer School in Parallel Patterns

The Cloud Competency Centre at National College of Ireland recently hosted the International Summer School in Parallel Patterns[1], which saw 35+ PhD students, researchers, lecturers, and industry practitioners come together to share best practices in structured parallel computing.

Press coverage of the event has already been reported in deliverable D8.10.

In addition to ParaPhrase members, the list of delegates included the following institutions:

- Spain (Barcelona Supercomputing Center, Universidad de Valladolid, University Carlos III of Madrid)
- Italy (University of Pisa, University of Torino, University of Padua)
- UK (University of Abertay Dundee)
- Germany (Kiel University, Johannes Gutenberg - Universität Mainz)
- France (University Paris-East)
- Sweden (Linkoping University)
- Hungary (Eötvös Loránd University)
- Ireland (Dublin City University, IBM Research Labs)

The keynote presentations were given by representatives of IBM Ireland and by representatives of the ParaPhrase members University of St. Andrews, University of Torino, and HLRS. Lectures of specific topics related to Parallel Patterns were given by ParaPhrase personell from University of Pisa, Queen’s University Belfast, National College of Ireland, SCCH, Eötvös Loránd University, University of St. Andrews, and Erlang Solutions. Finally, the participants of the school were given the opportunity to present their own work and research projects. The workshop left ample room to allow for discussions amongst participants during lunch, coffee breaks and the social event.
Keynotes:

- Prof. K. Hammond, University of St. Andrews, presented the concepts behind the ParaPhase approach, i.e. high-level parallel programming patterns and their efficient usage through automatic lowering onto architecture specific low-level algorithmic skeletons.

- Prof. M. Aldinucci, University of Torino, presented FastFlow as an example of a high-level parallel patterns runtime system and the benefits of lock-free implementations.

- Dr. J. Gracia, HLRS, discussed the potential benefits of HPC usage in industrial applications, show examples of current industrial projects at HLRS, and detailed services that HPC centers can provide to industrial customers.

- Dr. B. Nicolae, IBM Research Ireland, discussed techniques to improve the scalability of checkpoint-restart mechanisms for HPC applications at large scale.

Lectures:

- Prof. M. Danelutto, University of Pisa, gave a concise introduction into algorithmic skeletons and design patterns.

- Prof. P. Kilpatrick, Queen’s University Belfast, introduces parallel programming concepts.

- Prof. H. González-Vélez, National College of Ireland, gave an introduction on elastic deployment of patterns in distributed systems.

- Dr. M. Torquati, University of Pisa, lectured on the usage of FastFlow’s recent extensions for distributed systems.

- Dr. H. Schöner, SCCH, discussed the application of patterns in industrial machine learning projects.

- Dr. T. Kozsik, Eötvös Loránd University, gave an introduction into the functional language Erlang and the development tool Wrangler.

- Dr. C. Brown, University of St Andrews, gave lectures and interactive sessions on using the Erlang skeleton library, Skel, and the parallel refactorings for Erlang.

- E. Tate, Erlang Solutions, gave an introduction into offloading OpenCL code from Erlang.

Discussions during the summer school clearly demonstrated a need for training in parallel programming, which is still not part of standard teaching curriculum at
most universities, etc. Participants also acknowledged, that the abstraction of high-level patterns coupled with an optimized architecture specific runtime, as provided by ParaPhrase technology, is a promising approach to maintainability and performance portability, but mandatory when dealing with today’s heterogeneous parallel architectures as multi-cores, multi-cores, many-cores, accelerators, GPGPU, and massive parallel clusters.

2.2 Other activities

Events

Further activities related to community building during the third year include the realization of presentations and the organization of workshops at major technical conferences with the aim to reach out to practitioners and show the advantages of the ParaPhrase approach, rather than presenting scientific results. In particular:

AGH co-organized the Lambda Days conference in Kraków, Poland[5]. This long running conference series is a forum to exchange experiences with functional programming languages. Noticeably, a high fraction of the participants come from an industrial background. ParaPhrase contributed 3 presentations to this event. HLRS gave a presentation on programming models for large scale, heterogeneous systems, ESL discussed how parallel patterns in Erlang matches business needs, and finally, USTAN presented a methodology for advances refactoring of parallel functional programs.

HLRS and SICOS jointly organized two events for potential industrial HPC users[4,7]. SICOS is a public-private joint venture with the aim to foster HPC usage in industry. The is targeted towards decision makers in companies that would like to learn more about the advantages of using high performance computers in their field of business. They are given extensive information about the properties and the capabilities of the computers as well as access methods and security aspects. The presentation of real world examples allows an interesting insight into current activities at HLRS.

In May, 2014, Dr C. Brown, USTAN, visited the University of Valladolid, Spain, and gave a series of lectures to MSc students on heterogeneous skeletal programming using the Fastflow library[10].

USTAN was invited by the Budapest Erlang User Group to give a talk on using advanced refactoring techniques developed in ParaPhrase to develop parallel Erlang programs[2].

USTAN organized a workshop on high-level programming concepts for heterogeneous architectures at HiPEAC 2014[3]. A total of 10 technical papers were presented at the workshop. Details of this workshop are reported in a separate deliverable.

UNITO contributed a talk on parallel patterns for efficient GPGPU computations at the NVidia GPU Technology conference[6]. Further UNITO was invited
to give a keynote on data-centric, heterogeneous computing using parallel patterns at HPCC[8].

RGU was invited to give a presentation on dynamic scheduling for parallel patterns at British Telecom’s Business Modelling and Operational Transformation Research Group[9].

Finally, USTAN gave invited talks at the Erlang User Conference [11] and the Glasgow Parallelism Group[12].

In addition, the academic partners are teaching concepts as those used in ParaPhrase in regular university courses. Particularly UNITO, UNIPI, and AGH have included parallel patterns and skeletons into their teaching curriculum and use ParaPhrase tools in course exercises and lab work.

Material production

The second task produced new and revised existing technical documentation and training material on tool usage. Details on documentation will be reported in deliverable D7.3. The project has implemented a quality control system for documentation and training materials. Student assistants, which are unfamiliar with ParaPhrase technologies, have been asked to review and assess all available documentation and training material. These assessments were taken into account in subsequent revision of documentation.

Online material produced by USTAN as videos and podcast[13, 14] has been revised. Further, most of the technologies developed by ParaPhrase have been made available to the wider user community for production. This includes the Erlang Skel package (ESL, USTAN)[15], the refactoring tool for Erlang and C++ (USTAN)[16]. The Performance Enhancement Infrastructure (PEI)(RGU)[17] has been integrated into the main FastFlow repository.

As a mature and well tested product, the FastFlow C++ library and training material therefore (UNITO, UNIPI)[18] are continuously released to the public and announced to the user community.


2.3 Activity details

[1] International Summer School in Parallel Patterns, June 9 - 12, National College of Ireland, Dublin, Ireland
https://www.ncirl.ie/Faculty-Depts/Cloud-Competency-Centre/International-Summer-School-in-Parallel-Patterns

Keynote: Generating Parallel Programs from High-Level Patterns. Kevin Hammond, University of St. Andrews

Keynote: FastFlow: high-level programming patterns with non-blocking
lock-free run-time support. Marco Aldinucci, University of Torino

Keynote: High-Performance Computing in an industrial setting. José Gra-cia, HLRS

Keynote: Techniques to improve the scalability of checkpoint-Restart for HPC applications at large scale. Bogdan Niculae, IBM Research Ireland

Lecture: Algorithmic Skeletons & Design Patterns: a Short Introduction. Marco Danelutto, University of Pisa

Lecture: Introduction to Parallel Computing Concepts. Peter Kilpatrick, Queen’s University Belfast

Lecture: Introducing Elastic Algorithmic Skeletons into Distributed Systems. Horacio González-Vélez, National College of Ireland

Lecture: Targeting distributed systems in FastFlow. Massimo Torquati, University of Pisa

Lecture: Patterns in Machine Learning. Holger Schöner, SCCH

Lecture: Introductions to Erlang & Wrangler. Tamás Kozsik, Eötvös Loránd University

Lecture: High-level patterns and parallel programming in Erlang Christopher Brown, University of St Andrews

Lecture: Erlang Offloading with OpenCL. Edward Tate, Erlang Solutions

Talk: Forming Parallel Erlang Programs using Advanced Refactoring. Kevin Hammond, University of St. Andrews
http://www.meetup.com/Budapest-Erlang-User-Group/events/159790022/

Organizer: Chris Brown, University of St. Andrews

[4] Industrial Services of HLRS, February 19, Stuttgart, Germany
Organizer: HLRS, SICOS

[5] Lambda Days 2014, February 27-28, Kraków, Poland
Talk: A Programming Model for Large Scale, Strongly Heterogeneous Infrastructures. Daniel Rubio Bonilla, HLRS

Talk: Erlang Patterns Matching Business Needs. Torben Hoffman, Erlang Solutions

Talk: ParaForming: Forming Parallel Functional Programs using Advanced Refactoring Techniques. Kevin Hammond, University of St. Andrews
[6] NVidia GPU Technology Conference (GTC 2014), March 24-27, San Jose, USA
   Talk: FastFlow: combining pattern-level abstraction and efficiency in GPGPUs. Marco Aldinucci, University of Torino

[7] Industrial Services of HLRS, July 16, Stuttgart, Germany
   Organizer: HLRS, SICOS

   Keynote: Parallel patterns, data-centric concurrency, and heterogeneous computing. Marco Aldinucci, University of Torino

[9] Business Modelling and Operational Transformation Research Group at British Telecom, October, Aberdeen, UK
   Talk: Dynamic Scheduling for Parallel Patterns. John McCall, Robert Gordon University

    Lecture series: Putting the Skeletons back in the Closet: Parallel Programming using High-Level Patterns. Chris Brown, University of St Andrews

    Talk: Bridging the Divide: A New Tool-Supported Methodology for Programming Heterogeneous Multi-Core Machines in Erlang. Chris Brown, University of St Andrews

    Talk: Bridging the Divide: A New Tool-Supported Methodology for Programming Heterogeneous Multicore Machines. Vladimir Janjic, University of St Andrews

    http://chrisb.host.cs.st-andrews.ac.uk/SkelRefactoring.mov

[14] Podcast on concepts as patterns and skeletons as used in ParapRease
    http://mostlyerlang.com/2013/09/04/014-mega-core-with-kevin-hammond/

[15] Erlang Skel website, including download, documentation, tutorial and short videos
    http://chrisb.host.cs.st-andrews.ac.uk/skel.html

[16] Erlang/C++ Refactoring Tool website
    http://chrisb.host.cs.st-andrews.ac.uk/refactoring.html

[17] Performance Enhancement Infrastructure (PEI)
    http://www.paraphrase-ict.eu/Deliverables/deliverable-3.2/deliverable-3.2-prototype/view

[18] FastFlow website
    http://calvados.di.unipi.it/dokuwiki/doku.php?id=ffnamespace:about
[19] ParaPhrase website
http://paraphrase-ict.eu
3. Future community building activities

As laid out in D7.1, our target group is individuals and institutions which have already identified performance as an issue with their own application. This group is most likely actively seeking alternatives to their current development approaches and technologies. Given convincing arguments regarding the suitability of ParaPhrase technology for their particular application type, this group is willing to invest effort in switching to another programming model, provided that adequate training made available to them. The best way to convince our target group is to show-case the benefits of ParaPhrase technology. In most cases user will be looking not only to raw execution performance, but also to usability of the technology, and the portability of performance to new architectures.

We have specifically planned the following community building activities.

Events

- HPC User Forum, October 28-29, 2014, Stuttgart, Germany
  Hosted and co-organized by HLRS

- Programmability: Programming Models for Large Scale Heterogeneous Systems, Workshop at HiPEAC 2015, January 19 - 21, 2015, Amsterdam, Netherlands
  Organizer: HLRS in collaboration with FP7 project POLCA

- Software Technology Forum, February 6, Budapest, Hungary
  Organizers: ELTE

Materials production

- UNIPI aims to publish a on FastFlow parallel programming techniques before the end of the project

- consolidate available materials and offer them on the project website

- finalize new FastFlow tutorials on recent developments

- finalize training material for the Refactoring tools and the Performance Enhancement Infrastructure