

EASE Activity Report 2009

How to deal with 100mbit/s in your handheld device without burning your fingers?

To receive and render high-definition video can get any computer to go hot. When the computer is hand-held, this must be far more effective both to avoid burning your hands and to save battery.

In coming techniques it is more energy efficient to split the computations on more and slower processor nodes than do all the computations on one fast processor. Thus, the industry is about to introduce multicore processors also in handhelds units.

A challenge for multicore processors is to keep all of them busy. Traditional programming languages are sequential by nature. The leads to that when programs written in traditional languages are mapped to multicore processors, a processor core often has to wait for results calculated in another core. Research on compilers for multicores has been going on since the 1980s and few believe that drastic progress needed for tomorrow's multiprocessor systems are possible.

CAL compiler for multicores

EASE theme B attacks some of the problems with multicore systems by developing techniques for compilation of the programming language CAL. The compiler maps the application to process threads, processor cores and memory adapted to target processors that today might have two or four cores with shared memory, but in a few years probably has much more of both cores and memories.

CAL is an open source based language and tool set [\[opendf.org\]](http://opendf.org) based on data flow graphs, which means that the language does not force

calculations to be done in a particular order, but only describes the actual data and control dependencies that exist between different parts of the program. CAL is therefore more suitable for mapping applications to multi core systems. Thus, the final step in the compilation gets better conditions for distributing the computations between cores and memories.

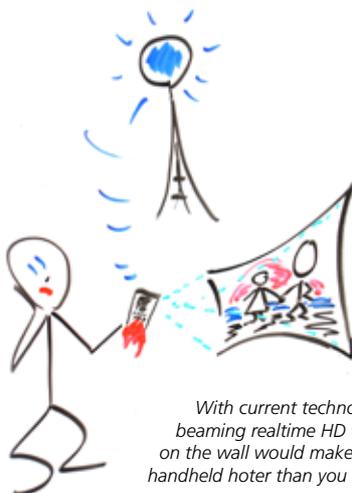
– In 2009, the project has demonstrated new and working mapping techniques. The focus for 2010 is partly to integrate these techniques into the CAL environment and secondly to increase the flexibility in the CAL environment as such. Then we will be able to pilot the findings in an industry environment, says Per Andersson, Post-doc at LTH.



Speculative execution

Another approach to keep processor cores busy is to perform speculative parallel execution, i. e. dynamically generate parallel activities from a serial program. However, if the speculation is wrong the system needs to restore the execution to an earlier state and restart in a safe mode.

– Initial studies during 2009 show promising results for web applications targeted at mobile devices, says Håkan Grahn coordinator EASE theme B.



With current technology, beaming realtime HD video on the wall would make your handheld hotter than you wish.

Heading for excellence

The need for innovation, research, and highly skilled software engineers has never been bigger than today in the software industry. Collaboration between universities and industry is one of the most important success factors for companies to stay competitive in the future. EASE combines industry relevant research and academic excellence. The mutual exchange of people, challenges, ideas and results provides an exciting environment for novel solutions for embedded software applications.

During 2009 much effort has been put into scaling up activities and recruit new employees. Thus, at year-end 2009, thirteen senior researchers and six PhD students are working within EASE. During the year we have also established procedures for frequent interaction between the industry partners and researcher and strengthened the foundation for the exchange that is one of the main objectives of the center. An exchange that is starting to spread research findings in both industry and academia.

This annual report summarises the EASE research 2009. These findings we, where possible, will make available at our public web pages. But the best way to share the results are, of course, to join EASE, and that way participate in formulating the research questions. Therefore, we now intensify our efforts to attract more partners and thus expand.

While 2008 was a year of start-up and designing ways of working and 2009 was a year of scaling up and start to deliver. Focus for 2010 is yet more of delivering, broadening the industry base and to found studies for coming eight years of EASE.



Sten Minör,
EASE Interim
Board chairman



Per Runeson,
Director of Research

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Did you know that EASE researchers...

- are Editor-in-Chiefs for to world leading scientific journals within EASE domains: *Journal of Microprocessors and Microsystems and Information and Software Technology*.
- during 2009 got two top-ten positions in a survey of system and software engineering scholars.
- during 2009 significantly contributed to *A Strategic Research Agenda for the Swedish Software Intensive Industry* [swedsoft.se].

Master Thesis Projects

- Strömförsörjande media i PalCom performed at LTH
- Fjärrstyrning av hemmanätverk från mobil enhet med DLNA och Linux performed at ST Ericsson
- Strömbesparingar på mobila plattformar i Linux performed at ST Ericsson
- Designing a flexible compilation framework for CAL performed at LTH
- Distributed and automatized prioritisation performed at Flygprestanda AB
- Expressing quality requirements in Junit tests performed at LTH
- Managing product variants in a component-based system performed at Sony Ericsson
- Test application development using a remote-controlled platform interface performed at Ericsson AB
- Test Processes for a Scrum Team performed at Sony Ericsson
- Test Case Selection for Regression Test in a Black Box Test System performed at Sony Ericsson
- Kvik programvarutestning performed at Testway AB
- Portning av GCC till DSP performed at ST Ericsson
- Prestandatesta hårdvarustöd för Java Virtual Machines performed at ST Ericsson
- OpenMPBench - An Open-Source Benchmark for Multiprocessor Based Embedded Systems performed at BTH
- Comparison of Shared memory based parallel programming models performed at BTH
- Performance Evaluation of Windows Communication Foundation's Interoperability performed at BTH
- Performance Tradeoffs in Software Transactional Memory performed at BTH
- Performance Prediction of Parallel Programs in Linux Environment using VPPB performed at BTH
- Machine learning algorithms executed on GPU performed at BTH
- Exploratory Testing in Industrial Practice performed at BTH
- Evaluating the impact of Test Driven Development on Open Source Projects performed at BTH
- Fault Tolerance in Mobile Agents: State-of-the-Art and Challenges performed at BTH
- A Software V&V Management Framework for the Space Industry performed at RUAG
- A Factorial Experiment on the Scalability of Search-Based Software Testing performed at BTH
- Minimizing Defects Originating from Elicitation, Analysis and Negotiation Phase in Bespoke Requirements Engineering performed at Qjube
- An Experiment on the Suitability of RAM for Test Case Design performed at Qingdao Gaoxiao
- Concurrent Software Testing: A Systematic Review and an Evaluation of Static Analysis Tools performed at BTH

Published 2009

Theme A - User Experience-Driven System Configuration

Thomas Pederson: **Towards general-purpose end-user interfaces for using and configuring and programming assemblies of devices and services**, Technical report.

David Svensson Fors: **Assemblies of Pervasive Services**, PhD Thesis, February 19 ISSN/ISBN: 1404-1219

Theme B - Flexible Execution of Software in Parallel Embedded Systems

Christophe Wolinski, Krzysztof Kuchcinski, Kevin Martin, Erwan Raffin, Francois Charot: **How constraints programming can help you in the generation of optimized application specific reconfigurable processor extensions**, The Intl. Conference on Engineering of Reconfigurable Systems and Algorithms, 2009-07-13/2009-07-16, Las Vegas, USA, (INVITED PAPER).

Kevin Martin, Christophe Wolinski, Krzysztof Kuchcinski, Antoine Floch, Francois Charot: **Constraint-driven identification of application specific instructions in the DURASE system**, SAMOS IX: International Workshop on Systems, Architectures, Modeling and Simulation, 2009-07-20/2009-07-23, Samos, Greece.

Kevin Martin, Christophe Wolinski, Krzysztof Kuchcinski, Antoine Floch, Francois Charot: **Constraint-driven instructions selection and application scheduling in the DURASE system**, The 20th IEEE International Conference on Application-specific Systems, Architectures and Processors, 2009-07-07/2009-07-09, Boston, USA.

Christophe Wolinski, Krzysztof Kuchcinski and Erwan Raffin, Professor Francois Charot: **Architecture-driven Synthesis of Reconfigurable Cells**, The Euromicro Conference on Digital System Design (DSD), 2009-08-27/2009-08-29, Patras, Greece.

Christophe Wolinski, Krzysztof Kuchcinski and Erwan Raffin: **Automatic design of application-specific reconfigurable processor extensions with UPaK synthesis kernel**, ACM Transactions on Design Automation of Electronic Systems (TODAES), Volume 15, Issue 1, 2009.

Jan Kasper Martinsen, Håkan Grahn: **Thread-Level Speculation for Web Applications**, Proc. of the Second Swedish Workshop on Multi-Core Computing, pages 80-88, November 2009, Uppsala, Sweden.

Theme C - Efficient Software Development

Alma Orucevic-Alagic, Martin Höst: **Analysis of Software Transition from Proprietary to Open Source**, Submitted to OSS 2010 - International Conference on Open Source Systems.

Sebastian Barney: **Perspectives on Software and their Priorities: Balancing Conflicting Stakeholder Views**, Lic.Thesis Licentiate Dissertation Series No. 2009:07, ISBN 978-91-7295-164-8

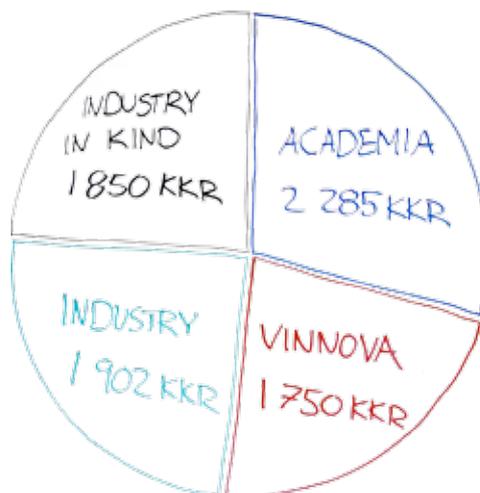
Sebastian Barney, Claes Wohlin: **Alignment of Software Product Quality Goals in Two Outsourcing Relationships**, submitted to International Conference on Evaluation & Assessment in Software Engineering (EASE) 2010.

Martin Höst, Alma Orucevic-Alagic: **A Systematic Review of Research on Open Source Software in Commercial Software Product Development**, submitted to International Conference on Evaluation & Assessment in Software Engineering (EASE) 2010.

Theme D - Aligning Requirements and Verification

Giedre Sabaliauskaite, Per Runeson: **Early Indicators of Software Quality – how far can we go?**, Proceedings 3rd International Workshop on Software Quality and Maintainability, March 24, 2009, Kaiserslautern, Germany.

EASE Funding 2009



Industry: Sony Ericsson, Ericsson, ST Ericsson, ABB, Axis Communications Softhouse Consulting.
Academia: Lund University/LTH, Blekinge Institute of Technology.

Communicated

- **EASE Kick-off workshop** (2009-02-23 -- 24)
- **Open Source-presentation** by Alma Orucevic-Alagic at LTH (2009-05-28)
- **EASE exhibition material** released (2009-09-01)
- **EASE presentation folder** released (2009-09-01)
- Håkan Grahn, BTH, was part of the organization committee for **Multicore Day**, held at SICS where folders about EASE was distributed. (2009-09-04)
- **EASE presented at Embedded Systems Conference Scandinavia** (2009-09-10)
- Five EASE initiatives was presented at **LU-CAS day** at LTH (2009-09-23)
- Per Runeson was speaker at **SQS conference** in Stockholm (2009-09-25)
- **EASE-web site** migrated to new platform (2009-10-01)
- Görel Hedin, Björn Regnell and Per Runeson gave talks at the **Øredev conference** (2009-11-04--06)

Time to secure the alignment between requirements and tests

To ensure that software becomes what you intend, the alignment of requirements engineering and testing are of paramount importance. We need to check that all requirements are realized and up to quality, but also make sure that we do just enough. There is much research in the two fields of testing and requirements engineering, but very little in the boundaries in-between concerning the coordination of the areas. This is especially important in large, complex systems developed in distributed organizations utilizing cutting edge technology. EASE takes an holistic approach to this issue. The first step was to study industry practice, conducting large and in-depth empirical evaluations in industry in collaboration with some of the most successful companies in the world. Starting with current practice enables not only real challenges to be identified, but also the possibility to learn what works, and paving the way for a real technology and knowledge exchange between researchers and industry practitioners.

So far, EASE Theme D has conducted 22 in-depth interviews with 5 companies to elicit challenges, state-of-practice, and good ideas. The results so far have been a gold mine of possibilities pointing to ideas for industry relevant research into how to handle the challenges with realistic technology. This is made possible through the joint competencies between researchers from LTH and BTH, combining their knowledge and experiences to support the development of new methods, models, technologies and processes.

– EASE plans research in the area for at least another 8 years. Therefore it is crucial to develop cooperation within companies, between companies and the involved research groups., says Björn Regnell, coordinator of EASE Theme D. The first scientific publication is about to be published and a suite of research paper is in the pipeline.



The understanding of the field deepens within the participating companies as long as the research progresses. Another important gain is the synergies among the EASE research groups.

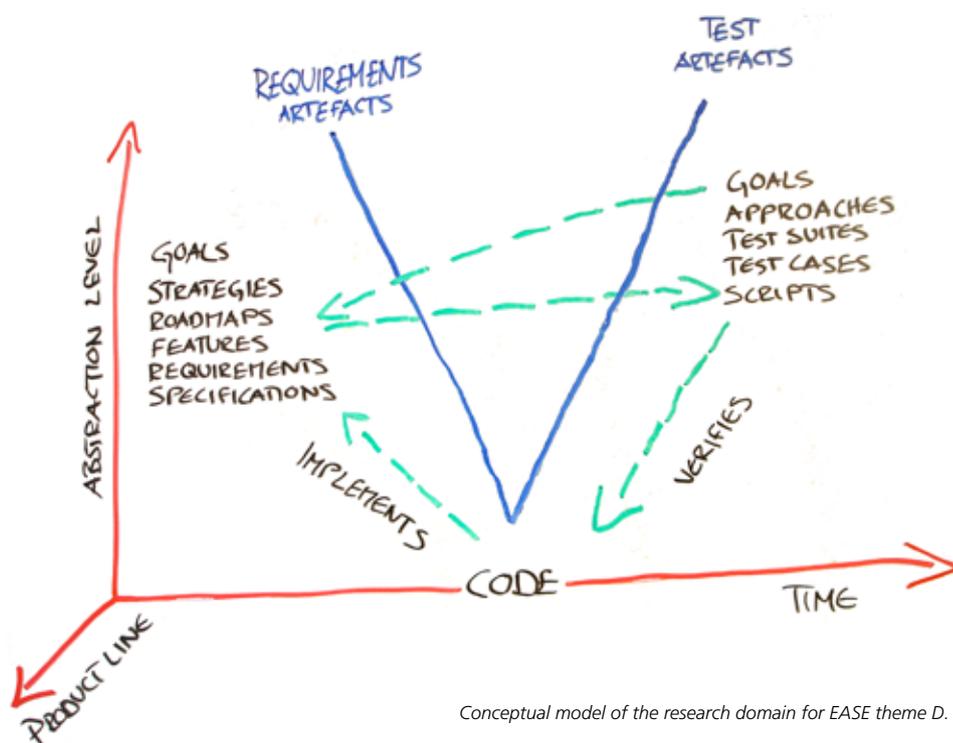
EASE now has both organizational and financial muscles to work in long terms. EASE brings together world-leading software companies in a joint effort for at least a decade. This funding covers research for at least two generations of PhD students.

The first results

The first report in the area is based on the rich case study findings of one of the studied companies and identifies challenges for requirement-verification alignment in that particular company. It answers questions regarding what hinders and supports a successful coordination

between requirements and tests processes and artifacts. The study has created a clear structure for the various problem areas and has provided a validated basis for future studies in other cases. A baseline with deep problem understanding is important to have before new technology and advanced solutions are developed, to make sure that technology and solutions are relevant for current and future practice.

In autumn 2009, early findings were presented for practitioners and researchers who are close to the study. During spring it will be presented to other EASE member companies. The study will also be presented in a wider community through academic publications and other dissemination efforts.



Conceptual model of the research domain for EASE theme D.

In progress - Sample of ongoing initiatives when entering 2010

The work on extending the existing CAL front-end for robustness and flexibility continues. This work is carried out together with Ericsson and people from the ACTORS project. (theme B)

A study on evaluation of JavaScript program (web application) behaviour was initiated 2009 Q4. We suspect that existing JavaScript benchmark suites do not match the behaviour of large real-world JavaScript applications and aim to investigate this. (theme B)

A study where the main objective is to implement initial support for thread-level speculation in Mozilla's SpiderMonkey JavaScript engine was initiated 2009 Q4. SpiderMonkey is used in the Firefox web browser. (theme B)

A study on quality aspects together with Sony Ericsson is initiated, based on previously conducted research in another project. Early discussions with EASE industry partners on how to research priority and management of software qualities are initiated. (theme C)

Further research on transformation from proprietary to open source based on a case study on Symbian and Android. A case study resembling that of Ingres' transformation is currently ongoing with Android, and discussion are held concerning a similar study on Symbian. (theme C)

A framework for deciding when to use agile practices is under development, which is intended to be useful for organizations of all sizes, levels of outsourcing, etc. (theme C)

A systematic mapping study and review regarding agile methods in a global context are currently being documented to better understand how agile methods can be applied in a distributed setting. (theme C)

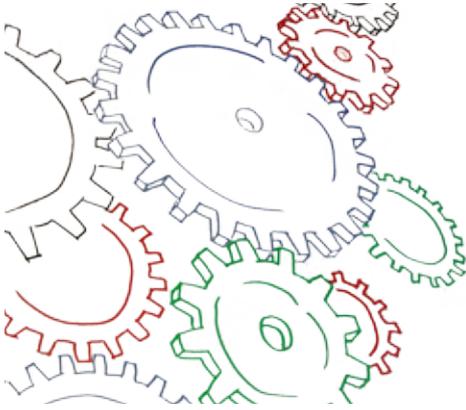
Research on trust in global software engineering is conducted. A paper will be submitted to a conference in January. (theme C)

The main part of the work within Theme D is devoted to the ongoing interview study on challenges and opportunities in requirements-verification-alignment. (theme D)

Redefinition of research direction to fit changing needs and resources availability (theme A).

Challenging Open Source

The times when the open source arena was primarily viewed as a playground reserved solely for programming geeks and nerds has been a thing of the past for quite some time now. Especially so since the industry has recognized the potential of open source software and taken an active role in it. Much research has



been focused on the analysis of pros and cons of different aspects of open source software. Open source business models have emerged, and many companies, especially the software oriented ones, have found involvement in the open source to be crucial in their market positioning.

During the year, a systematic review of existing research on commercial aspects of open source was completed. The goal was not to propose a new method or framework for dealing with commercial aspects of the open source, but rather to assess and categorize the research on commercial aspects of open source published thus far.

An aspect of open source that caught the attention of EASE, especially since the systematic review identified that no research was conducted in this area, on how the source code quality characteristics change as the code is released from proprietary to the open source arena.

This research will bring more clarity and understanding to the release process and the most important factors surrounding it.

Since EASE is a long-term project, it can provide researches with insights on how software evolves in open source environment over a period of several years.

– A finished case study on the transition of the database management system Ingres to open source shows that the static code quality metrics improved, says Alma Orucevic-Alagic, PhD student in EASE theme C.



A long-term study that will follow the whereabouts of the mobile operating system Android is now started. This study will investigate several aspects; the Android community, project structure, and evolution of software code quality and architecture.

People

Researchers

Boris Magnusson, Prof.
Coordinator theme A
Thomas Pederson, Dr.
to 2009-04-30 theme A
Håkan Grahn, Prof.
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Prof. Per Stenström, Chalmers Univer-
sity of Technology, Göteborg

This is EASE

EASE aims to be a world class applied software research facility for embedded software applications. The objective is to ensure that industrial partners have a competitive advantage with respect to competency and innovation of novel solutions and effective engineering of embedded software applications with physical and logical mobility.

The centre impacts on the innovation system through provisioning of competency, via a continuous exchange loop between industry and academia, involving research challenges, industry personnel, researchers, students and research results. These range from technical solutions that can be used in products to improved work procedures for the development.

Research themes

- A** User Experience-Driven System Configuration
- B** Flexible Execution of Software in Parallel Embedded Systems
- C** Efficient Software Development
- D** Aligning Requirements and Verification



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