

2. Publishable summary



The HiPEAC network of excellence has been created in the context of the radical paradigm shift towards multi-core computing and the convergence of the commodity market, the supercomputing market, and the embedded market, making the (heterogeneous) multi-core chip the universal computing device of this era. Through the HiPEAC network of excellence, the 12 project partners want

- (i) **To stimulate pan-European collaboration and networking** between the members of the network and beyond. This involves stimulating joint research in various ways, e.g. between member institutions across the different disciplines - computer architects, design tool builders, compiler builders, and system designers; between researchers from academia and industry; and between European and non-European institutions. This collaboration between best-of-breed must lead to more European excellence in the HiPEAC domain.
- (ii) **To coordinate European research in the HiPEAC domain.** Research coordination in HiPEAC is done in nine thematic clusters, each of which deals with a specific part of the HiPEAC research agenda. Clusters are formed by researchers from industry and academia interested in the cluster topic. Clusters continuously update their research agenda and steer European research by deciding on which challenges to tackle, and by coordinating the research efforts of the cluster members.
- (iii) **To stimulate valorisation of research results.** The network stimulates highly visible publications and the commercialisation of research results by existing or newly created companies. The goal is to further increase Europe's worldwide visibility in the HiPEAC domain and to help companies achieve world-leading positions in computing systems and computing products.

The HiPEAC partners are Universiteit Gent (Belgium), RWTH Aachen (Germany), Barcelona Supercomputing Center (Spain), Chalmers University of Technology (Sweden), TU Delft (The Netherlands), University of Edinburgh (UK), FORTH (Greece), INRIA (France), ARM Ltd (UK), IBM (Israel), NXP Semiconductors (The Netherlands), STMicroelectronics (France).

The HiPEAC network is however very ambitious in its goals and wants to extend its operation beyond the partners of the network. Every excellent researcher from academia or industry can join the HiPEAC network as a HiPEAC member. A HiPEAC member has both entitlements and responsibilities. He or she can participate in all public HiPEAC activities, can have access to the resources of the network (collaboration grants, internships, summer school, conference, journal, newsletter, ...). We expect from the members that they start collaboration with other members in the network and that they promote the network. Non-active members automatically lose their membership status. HiPEAC members can link their students, colleagues and collaborators, making them HiPEAC PhD student or HiPEAC affiliated member. HiPEAC extends its links outside Europe too. Non-European researchers can become associated members. Associate members have all the rights of the regular HiPEAC members, but as non-Europeans, they cannot access the financial resources.

The HiPEAC objectives are translated into a joint program of activities consisting of three programs, supplemented by appropriate management processes. The three programs are heavily interdependent and are the basic mechanisms for achieving the main objectives of the network.

2.1. Joint program of activities

- **WP1: Mobility program**

Real collaboration is only possible if people spend a considerable time together working on a common problem. The mobility program supports two different types of mobility:



Large networking events

HiPEAC has four large networking events: the ACACES Summer school, and three Computing Systems Weeks - one in winter, co-located with the yearly HiPEAC conference, one in spring and one in autumn. The latter two are located close to a major HiPEAC company, and consist of cluster meetings and a full day's industrial workshop. The primary goal of the large networking events is to bring the HiPEAC community together under one roof on a regular basis, and thereby create an opportunity to meet and make collaboration plans.

Exchanges

Examples are internships, collaboration grants, and mini-sabbaticals. These exchanges last between a couple of weeks and three months, and result in some concrete research result (joint paper, report, prototype, etc.)

- **WP2: Research program**

This program is aimed at coordinating and carrying out joint research between the different partner and member institutions. Based on the HiPEAC strategic research agenda, nine thematic clusters have been formed, each dealing with a substantial part of the HiPEAC research agenda. Each academic partner in HiPEAC coordinates at least one cluster, and the cluster operation is supported by a dedicated experienced researcher who takes care of the day-to-day (scientific and administrative) management of the cluster. The nine clusters are:

- Multi-core architecture
- Programming models and operating systems
- Adaptive compilation
- Interconnects
- Reconfigurable computing
- Design methodology and tools
- Binary translation and virtualisation
- Simulation platform
- Compilation platform

These nine clusters are supplemented by four task forces that deal with cross-cutting aspects.

- Low power
- Applications
- Reliability and availability
- Education and training

These 13 thematic working groups are where the actual HiPEAC research coordination takes place. They also help in updating the HiPEAC strategic research agenda.

- **WP3: Spreading excellence program**

This program manages all the public communication and integration activities of the network. The most visible activities are the HiPEAC website, the yearly HiPEAC conference attended by more than 200 delegates, the HiPEAC journal, the quarterly HiPEAC info newsletter, the biannual industrial workshops, the HiPEAC roadmap, detailing the HiPEAC strategic research agenda and the yearly International Summer School on Advanced Computer Architecture and Compilation for Embedded Systems (ACACES). Just as important are the activities targeted at the HiPEAC start-ups, the web seminars, the award program to stimulate dissemination of research results in top conferences, and the HiPEAC technical reports.

2.2. Main achievements in the first year

Since the kick-off meeting of the network in Goteborg, the community has grown considerably, and all tasks are up and running. Currently, HiPEAC has 12 partners, 178 members, and 19 associate members. Of the 178 members, 43 are company members. Furthermore, we have 269 HiPEAC PhD students and 153 affiliate members. The current list of members is at <http://www.hipeac.net/dmemberslist>.

- **WP1: Mobility program**

After the initial cluster meetings during the kick-off in January in Goteborg, the spring computing systems week was held at BSC in Barcelona in June 2008. The second cluster meeting was held during the computing systems week at Thales in Paris in November 2008. Both events attracted almost 200 people in Barcelona and more than 160 at Thales. The last cluster meeting was co-located with the HiPEAC2009 conference in Paphos. Almost 90 people attended the event.

There has been a call for internships in January 2008. In total we received 22 internship positions, of which 10 were granted. These internships were funded by HiPEAC1. The HiPEAC2 2008 internship budget will be spent in future calls.

There have been two calls for collaboration grants of 3 months: one at the computing systems week in June, in Barcelona, and one at the summer school. In total, we received 35 applications, of which 14 could be granted from the budget.

A general call for mini-sabbaticals was launched in January 2009. Currently we have granted 1 request.

- **WP2: Research program**

All research clusters got their first meeting at the kick-off meeting in Goteborg, and have been meeting 3 times in 2008. Cluster meetings attract at least 30 people up to more than a 100 for the most popular clusters. In total 150-200 people attend the cluster days. In 2008, the clusters have been working on their internal organization: the cluster researchers were hired, cluster members could present their research to each other, the cluster members have been brainstorming about future challenges in the domain of the cluster, clusters have been identifying research topics of special interest to subsets of the cluster members, clusters have stimulated the formation of consortia for future FP7 projects. All clusters have been involved in the organization of an international event (workshop, tutorial, seminar) that is directly linked to the cluster activity.

The clusters are:

1. Multi-core Architecture (Chalmers, Per Stenström)
2. Programming models and operating systems (BSC, Mateo Valero)
3. Adaptive compilation (Edinburgh, Michael O'Boyle)
4. Interconnects (Forth, Manolis Katevenis)
5. Reconfigurable Computing (TU Delft, Georgi Gaydadjiev)
6. Design methodology and tools (RWTH Aachen, Rainer Leupers)
7. Binary translation and virtualization (UGent, Koen De Bosschere)
8. Simulation platform (INRIA, Olivier Temam)
9. Compilation platform (INRIA, Albert Cohen; IBM, Ayal Zaks)

Next to the cluster, there are also four task forces, working on cross-cutting challenges:

1. A task force on *education and training* (FORTH, Manolis Katevenis)
2. A task force on *power* (University of Patras, Stefanos Kaxiras)
3. A task force on reliability and availability (University of Cyprus, Yiannakis Sazeides)
4. A task force on applications (BSC, Nacho Navarro)

Task forces have a similar organization, but they do not have an associated cluster researcher.

- **WP3: Spreading excellence program**

The conference in Paphos attracted 97 papers submissions, of which 27 were accepted. 198 people attended the event, of which 17 from industry..

The ACACES 2008 Summer School was held from July 13 to July 19, 2008. With 376 applications for 200 available seats, the summer school continues to be a very attractive event. 69 PhD students received a HiPEAC grant. 28 people from companies attended. The participant's appreciation was 4.2/5.

The best ranked articles from the Goteborg conference were published in the HiPEAC Journal. The journal received 22 submission, and eventually accepted 15. The total collection of accepted papers will be published in Spring 2009.

The network has collected input for the roadmap for all clusters and task forces and has condensed the input in a first draft of the roadmap.

Four issues of HiPEAC-info, the quarterly HiPEAC newsletter has been produced and mailed to 725 subscribers.

A database with publications by HiPEAC members has been set up and will be made available on the website. A technical report service with automatic time stamping is being set up.

The HiPEAC website www.hipeac.net is fully operational. New services are the reimbursement service, the registration system for meetings, membership management, publication database,...

Two industrial workshops have been organized: in Barcelona, HP hosted the fifth HiPEAC Industrial workshop in June. Thales hosted the sixth industrial workshop in Paris, in November. Both events were attended by about 100 delegates.

In order to promote HiPEAC start ups, Peter Magnusson, founder of Virtutech, was invited at the summer school to present a keynote speech on entrepreneurship. An overview of HiPEAC related

start-up companies was published in the April HiPEAC newsletter. More detailed descriptions of the companies were published in the subsequent newsletters.

The list of award rules and conferences was published on the HiPEAC website and the newsletter. In 2008, ten HiPEAC members got a HiPEAC award for their papers.

- **WP4: Management**

The HiPEAC steering committee meets monthly, either physically or virtually with a conference call. Meeting minutes are produced by the administrative staff.

The reimbursement service for the members is up and running. About 70 reimbursement requests were entered on the website in the first year. The system proves to be lightweight and efficient.

The HiPEAC community welcomed 56 new members, of which 16 from industry. New member companies are Transitive, Absint, Coware, Infineon, Recore Systems and Microtech. 19 new associate members were accepted. New associate member companies are Tensilica, AMD, Xilinx.

The administrative staff of HiPEAC2 were hired. Wouter De Raeve is project management assistant. Klaas Millet is technical staff member. Both are located in Ghent.

2.3. Contact details

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