

Towards Exascale: Foundation of EIC and ECL

Projects

The Jülich Supercomputing Centre at Forschungszentrum Jülich started two new collaborations with renowned companies to force the research and development on Exascale systems. In March 2010, Forschungszentrum Jülich and IBM signed the contract for a joint "Exascale Innovation Center" (EIC), and, at ISC 2010 in Hamburg, Forschungszentrum Jülich, Intel, and ParTec signed a multi-year agreement to create a new ExaCluster Laboratory (ECL), both located on the campus of Forschungszentrum Jülich. These two endeavours reflect the dualistic concept JSC is pursuing since several years now. On the one hand side, the JUGENE supercomputer based on IBM's BlueGene technology targets highest scalability while, on the other hand, the JUROPA/HPC-FF cluster computer-based on Intel's Nehalem processors and ParTec's ParaStation cluster middle-ware aims at more

general purpose applications. Since both architectures provide a large potential for machines beyond the Petaflop range, Jülich's goal is to analyse the prospect to scale these technologies to exascale.

Exascale Innovation Center (EIC)

EIC will develop hardware and software for an exascale supercomputer by the end of this decade. Exascale - which means a thousand times more performance than JUGENE or 1 exaflop/s - is the premier challenge for supercomputing worldwide. With exascale supercomputers it will be possible to perform simulations of unprecedented complexity. However, a great many challenges have to be tackled to achieve this goal. Energy efficiency will be the most prominent challenge to be solved in order to create exascale supercomputers. In a successful collaboration with IBM Germany, the German Research Foundation's (DFG) Collaborative Research Centre for Hadron Physics and JSC developed the supercomputer QPACE, which was declared the world's most energy-efficient supercomputer by the GREEN500 list last November. "With QPACE, we have managed to get a grip on energy consumption," says Prof. Thomas Lippert, director of the Jülich Supercomputing Centre. Further challenges are the development of the chip and processor technology towards the exascale level with respect to hardware and the improvement of algorithms with respect to software in order to run and use a supercomputer of this size. Jülich is contributing its outstanding expertise in the development of algorithms.



Forschungszentrum Jülich and IBM signing the contract for a joint "Exascale Innovation Center". From the left: David Jursik (Vice President worldwide Deep Computing Sales, IBM Systems & Technology Group), Dirk Wittkopp (Vice President and Director IBM Laboratory Böblingen), Prof. Thomas Lippert (Director of Jülich Supercomputing Centre, Forschungszentrum Jülich), Prof. Sebastian Schmidt (Board of Directors of Forschungszentrum Jülich) (Photo: Forschungszentrum Jülich)

According to the schedule, a prototype of the new exascale supercomputer is expected to be available in 2015. Five scientists from the IBM development laboratory in Böblingen and five scientists from Jülich will be collaborating with a team of scientists at the IBM Watson Research Center in Yorktown Heights. The goal is to install an exascale-class system in Jülich by 2019.

ExaCluster Laboratory (ECL)

ECL will explore the key challenges of building computing systems with a thousand times the performance of today's fastest supercomputers. The new lab will initially employ about a dozen researchers and is expected to triple its staff over time.

"The Forschungszentrum Jülich has taken a leading role in driving high-performance computing research in Europe," said Kirk Skaugen, vice president and general manager of Intel's Datacenter Group. "We have chosen to work with Forschungszentrum Jülich and the ParTec Cluster Competence GmbH, because of their strong history of innovation in the area of HPC."

The ExaCluster Laboratory will conduct research into current challenges in systems management software for large

heterogeneous supercomputer systems, with a view to scaling this software to reach exaflop/s performance. This will include research on open exascale runtime system software and software tools. The aim of the work on systems management software is to further improve the scalability of ParTec's ParaStation cluster middle-ware and – at the end – to create an OpenSource software stack capable to manage Exascale systems. Specific problems tackled in the first 3-year period of the Laboratory are – among others – the analysis of the necessary measures to improve system-resiliency or known scalability issues with today's MPI-stacks.

Looking at current processor road-maps it becomes clear that clusters will not be able to cope with proprietary solutions from IBM or Cray in the near future, if they just follow the line of general purpose CPUs. Therefore, the applications of accelerator technologies will be crucial in order to keep clusters competitive in the next years. ECL will investigate innovative technologies to overcome the yet unsolved problem to couple accelerators more tightly to the high-speed interconnects building the spine of today's cluster computers.

Projects

- Norbert Eicker
- Willi Homberg
- Sabine Höfler-Thierfeldt

Jülich
Supercomputing
Centre



At the ISC 2010 in Hamburg, Forschungszentrum Jülich and the companies Intel und ParTec sign the contract for a joint "ExaCluster Laboratory". From the left side: Hugo Falter (ParTec), Prof. Achim Bachem (Board of Directors of Forschungszentrum Jülich), Prof. Thomas Lippert (Director of Jülich Supercomputing Centre, Forschungszentrum Jülich), Kirk Skaugen (Intel Vice President), Raj Hazra (Intel). (Photo: Forschungszentrum Jülich)