European HPC Project DEEP-EST Successfully Completed

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JÜLICH and MUNICH, Germany, April 15, 2021 — The project “DEEP Extreme Scale Technologies”, funded by the European Union, has come to a successful conclusion. DEEP-EST started in 2017 to develop a modular architecture for High-Performance Computing (HPC). Leveraging a co-design approach with real-life applications, the DEEP-EST project paved the way for future exascale systems that will bring supercomputing to a new level.

One major goal in HPC is to build exascale systems – systems that are capable of calculating 10^{18} FLOPS (Floating Point Operations per Second). In Europe, different research projects work on this challenge, with different approaches and different focal points. DEEP (Dynamical Exascale Entry Platform) projects, a series on EU funded research projects on future supercomputing, are part of this community. On March 31, 2021, the latest DEEP project was completed successfully: DEEP-EST.

DEEP-EST (EST: Extreme Scale Technologies) started to develop the prototype of a modular architecture for future exascale HPC systems. This system-level concept dynamically adapts to the needs of different types of applications. Not all workloads in today’s supercomputing are the same: Many combine data analytics, sheer number-crunching, machine learning and more. It is hard to optimise system usage, energy efficiency, and execution performance with a single architecture. A modular system enables running workloads on the hardware that’s best suited for the specific case, adapting the system to the needs of next generation of applications.

Modular Supercomputing Architecture

The Modular Supercomputing Architecture (MSA) developed in DEEP-EST comprises three different compute modules interconnected by a high-performance fabric:

1. Cluster Module (CM): The Cluster Module is a general-purpose cluster with 50 nodes, using dual Intel Xeon Scalable processors with high single-thread performance and warm water cooling.
2. Extreme Scale Booster (ESB): The Extreme Scale Booster provides 75 nodes, each equipped with a single Intel Xeon Scalable processor and one NVIDIA Tesla V100 GPGPU.
3. Data Analytics Module (DAM): The 16 Data Analytics Modules are each equipped with dual Intel Xeon Scalable processors, one NVIDIA Tesla V100 GPGPU, and one Intel Stratix 10 FPGA per node.

The DEEP-EST prototype follows a modular design that adapts dynamically to the requirements of different workloads.

All modules are connected with a high-performance network. Besides standard Infiniband for CM and Ethernet for DAM, the project leverages a new low latency fabric developed by DEEP-EST partner Extoll. The Fabri3 network provides six 100Gbit/s links per node and enables 3D grids and tori to be configured.

Realistic Co-Design Approach

On the software side, the focus was on ease of programming, resource management and job scheduling. The DEEP-EST software stack allows defining optimal resource allocations for each combination of workloads, supports adaptive scheduling and, enables dynamical reservation of the resources. To prove this concept with real-world codes, a co-design approach was chosen. Six different application teams from European partners ported their codes to the DEEP-EST system to support development and validate the technologies. Additionally, an Early Access Programme (EAP) enabled academic users from outside the project to intensively test the new architecture with their applications.

DEEP-EST was completed successfully on March 31, 2021. The hardware prototype is located at the Jülich Supercomputing Centre and will be used for further projects. The DEEP series of projects goes on with DEEP-SEA (Software for Exascale Architectures): DEEP-SEA aims to deliver the programming environment for future European exascale systems. The new project started on April 1, 2021 with a planned term of 3 years.

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Project Partners:

- Jülich Supercomputing Centre at Forschungszentrum Jülich (Germany): www.fz-juelich.de/jsc
- ASTRON (Netherlands): www.astron.nl
- Barcelona Supercomputing Center (Spain): www.bsc.es
- CERN (Switzerland):home.cern
- EPCC – The University of Edinburgh (United Kingdom):www.epcc.ed.ac.uk
- Extoll GmbH (Germany):www.extoll.de
- Fraunhofer ITWM (Germany): www.itwm.fraunhofer.de
- Intel Deutschland GmbH (Germany): www.intel.de
- KU Leuven (Belgium): www.kuleuven.be
- Leibniz Supercomputing Centre at the Bavarian Academy of Sciences and Humanities (Germany): www.lrz.de
- MEGWARE GmbH (Germany): www.megware.com
- National Center for Supercomputing ApplicationsNCSA (Bulgaria): www.scc.acad.bg
- Norwegian University of Life Sciences NMBU (Norway): www.nmbu.no
- ParTec GmbH (Germany): www.par-tec.com
- University of Heidelberg (Germany): www.uni-heidelberg.de
- University of Iceland (Iceland): www.hi.is

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