

Abstracts of Esd Workshop Presentations at the European HPC Summit Week, 12th of May 2016, Prague

Data Direct Networks

Jean-Thomas Acquaviva

Title: "Paving the way for Exascale: Lessons learnt from I/O accelerators"

"Based on the recent experience of the design and implementation of the Infinite Memory Engine I/O accelerator this talk will focus on some of key learnings about I/O at the Extreme scale. One of the key learning is to address the I/O problem in an holistic way, encompassing not only write dominated check-point restart but the whole diversity of workloads. The second lesson is that non-volatile memory era should not be taken as a challenge but more as an opportunity to redesign the software stack with technological versatility and scalability in mind. This talk will present what we hope to be a contribution to the community to meet the Exascale I/O requirements"

University of Innsbruck, Austria

Thomas Fahringer

Title: Extreme Scale Demonstrators: A software centric approach

The EsD concept is important to enhance European made HPC solutions by combining individual software and hardware technologies created by funded EU projects but also by all other projects originating from Europe with the goal to build more powerful solutions.

There are many HPC solutions that have been developed outside of EU funding. It is crucial to involve these solutions to the EsD program in order to maximize European impact in high performance computing both within and outside of the EU.

That majority of HPC groups and companies in Europe focus on software solutions. In order to reflect the strong history and position of European HPC software, the funding scheme for EsD should thus enable a reasonable number of projects to integrate and assess the best European HPW SW solutions on top of existing HPC HW. Individual projects could focus on important HPC aspects such as programming paradigms, IO, optimization for multiple objectives such as performance and energy, reliability, etc. Evaluation and demonstration should be done based on existing HPC hardware which may include (but not limited to) research HW created as part of previous or running European projects and HW readily available at various data centres.

Application groups should join these EsD projects for systematic testing of the proposed HPC software/hardware systems. Applications should not be built from scratch but rather be restructured to provide a variety of test cases from small to large both in size and input data that stress various nonfunctional behavior (e.g. performance, energy, scaling, IO behavior, reliability, etc.) depending on the focus of the EsD.

Universitat Politècnica de València (UPV)

Jose Flich

Title: Deeply heterogeneous HPC systems with QoS guarantees for Europe

Abstract: The aim of this talk is to show our view for future European HPC infrastructures. We tackle and combine together the typical concepts of HPC systems (raw throughput, peak performance, energy efficiency) together with new design axes that will need to be covered by future HPC systems. This means QoS guarantees to target new incoming applications for HPC domain and the capacity computing approach (where many unrelated applications or instances are run concurrently). We address these design goals with the extreme use of heterogeneous systems combining and tailoring them for the effective achievement of HPC results without sacrificing application requirements. In the talk we will identify the open issues and challenges inherent in these emerging perspectives on HPC.

Diagen Biotech

Muhammed Akif AĞCA

Title: Memory Centric Analytics

Data analytic solutions are usually disk-oriented. Therefore, they are not fast enough to solve analytic problems in real-time or in reasonable time periods. Therefore, new analytic solutions are opting for memory-centric architectures to query big data interactively. Using a balanced RAM and disc architecture and using specific purpose hardware like FPGAs, Flash Disks, nvRAMs, GPUs for specific purposes. MEMCA Project provides time-efficient solutions for visual analytics on big data, distributed systems, HPC and extreme scale applications with novel system architectures.

We collaborate with academia and industry to research and develop products. Developing healthcare analytical solutions together with DiaGen Biotechnology company. Working on data center solutions and cooling systems together with Canovate Group. Doing R&D collaboration with IBM Research Zurich Lab. We look for HORIZON 2020 project partners for the topics. We have a few suggestions for SRA, most important one; real time systems and mission criticalness should be emphasized more detailed and IoT platforms should be considered more deeply for novel HPC, exascale system architectures.

ECOSCALE – Synelixis Solutions Ltd

Prof. Ioannis Papaefstathiou

Title: Energy-efficient Heterogeneous Computing at Exascale

ECOSCALE implements a scalable programming environment and architecture, aiming to substantially reduce energy consumption as well as data traffic and latency. ECOSCALE introduces a novel heterogeneous energy-efficient hierarchical architecture, as well as a hybrid many-core+OpenCL programming environment and runtime system. The ECOSCALE approach is hierarchical and is expected to scale well by partitioning the physical system into multiple independent Workers (i.e. compute nodes). Workers are interconnected in a tree-like fashion and define a contiguous global address space that can be viewed either as a set of partitions in a Partitioned Global Address Space (PGAS), or as a set of nodes hierarchically interconnected via an MPI protocol.

To further increase energy efficiency, as well as to provide resilience, the Workers employ reconfigurable accelerators mapped into the virtual address space utilizing a dual stage System Memory Management Unit with coherent memory access. The architecture supports shared partitioned reconfigurable resources accessed by any Worker in a PGAS partition, as well as automated hardware synthesis of these resources from an OpenCL-based programming model.

So the end ECOSCALE heterogeneous platform will be a good candidate for an EsD project which will mainly work across two different axes: 1) allow the end platform to be efficiently incorporated with existing (at that time) large scale HPC system(s) 2) integrate on the top of the end platform novel HPC low-level software (e.g. for monitoring, debugging, performance analysis, security, QoS etc) and HPC applications.

POP – Centre of Excellence

Prof. Jesus Labarta

Title: Providing insight on application and system behavior

The POP CoE can provide to future EsDs two classes of experiences and advanced technologies that we think are at the core of achieving productivity and efficiency in the design and usage of very large scale systems. The two directions are performance tools with detailed insight and prediction capabilities on one side and programming models and best practices on how to use them on the other.

At the performance analysis level, the project uses technologies developed by the partners with extremely powerful analytics capabilities. This allows us to understand the actual behavior of applications and systems, its deep internal causes and the best ways to address bottlenecks. The tools provide useful information for application developers and users but also for system designers and integrators.

At the programming model level we provide the OmpSs programming model as a stable infrastructure behaving as a forerunner for OpenMP and providing advanced implementation of dynamic resource and locality management runtime policies as well as an environment where to develop and integrate other proposals. Additional work on interoperability with other models is also ongoing and can provide the features needed to address the exascale challenges

Finally, the global experience gathered from the analysis of many applications and the active involvement of the members of the project in programming model standardization (OpenMP, MPI) bodies provide a very valuable addition contribution by the POP CoE.

ExaNoDe – FETHPC

Denis Dutoit

Title : ExaNoDe core technologies towards Extreme-Scale Demonstrators

ExaNoDe project investigates, develops, integrates and validates core technologies aiming a highly efficient, highly integrated, heterogeneous compute node.

Even if ExaNoDe is already built on multiple European initiatives, the project can't reach alone a pilot-level compute node prototype. That's why the EsD concept, based on the combination of isolated R&D outcomes from different projects, is essential. Starting from ExaNoDe core technologies, this talk will present a case study of a potential EsD for a fully integrated pilot-level compute node and will provide some recommendations for EsD roll-out.

EPCC, The University of Edinburgh

Mark Parsons

Title: Thoughts on the ESD Concept

'The Extreme Scale Demonstrator approach offers the opportunity to develop some significant Tier 0 systems in Europe. The balance between timing, costs, development and service is complex. This talk will pose some questions related to these topics based on what size of system the proposed funding would buy today.'

E4 Computer Engineering Spa

Piero Altoè

Title: A journey to the Energy Efficient HPC

The talk has 3 main focuses: a short introduction to the company and which capability of R&D and design of HPC solutions. What is the 3IP-PCP project and which challenges we had to solve Suggestion on EsD project, and which role E4 can have?