OBJECTIVES & BENEFITS

OBJECTIVES DEEP-EST PROJECT:

- Build a fully working, **energy efficient prototype** of the Modular Supercomputing Architecture (MSA).
- Extend a proven **resource management** and **scheduling system** to fully support the MSA.
- Enhance and optimise the **programming environment** based on **MPI** and **OpenMP,** and add support for **data analytics** and **machine learning** frameworks.
- **Validate** the full **hardware (HW) / software (SW) stack** with relevant HPC and HPDA applications clearly demonstrating the MSA benefits.
- **Accelerate** and **support take-up** and further development of **key European technologies** in e.g. network fabrics, system integration and system software.

BENEFITS OF MSA AND THE DEEP-EST SYSTEM:

- **Mix & Match:** heterogeneous applications/workflows run on exactly matching compute and data resources.
- **Highest flexibility:** each user selects the combination of resources best suited for its code.
- **Significant reductions** in time and energy to solution.
- Improvements in **system throughput** for heterogeneous workload mixes.

IN SHORT: The MSA is an ideal fit for advanced supercomputing centres.

IN A NUTSHELL

BUDGET:

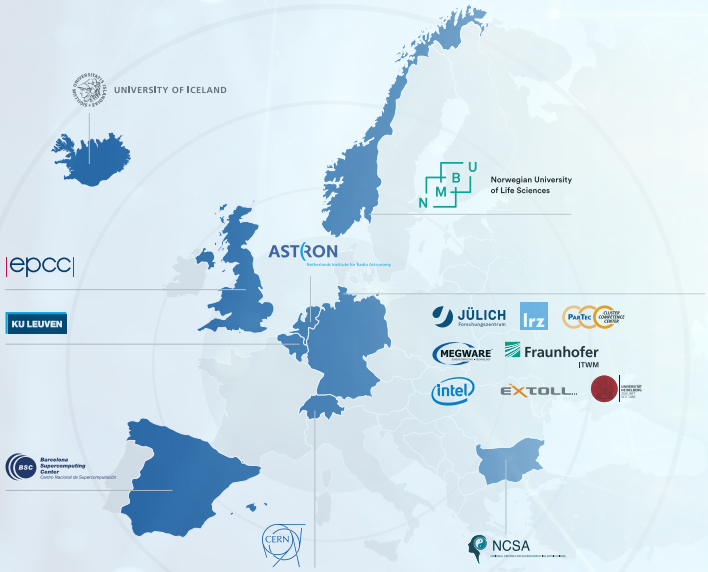
- € 15 Mio. European Union funding

PROJECT TERM:

- July 2017 – June 2020

CONSORTIUM:

- Coordinator: Jülich Supercomputing Centre
- 16 Partners
- 8 European countries



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DEEP

Extreme Scale Technologies

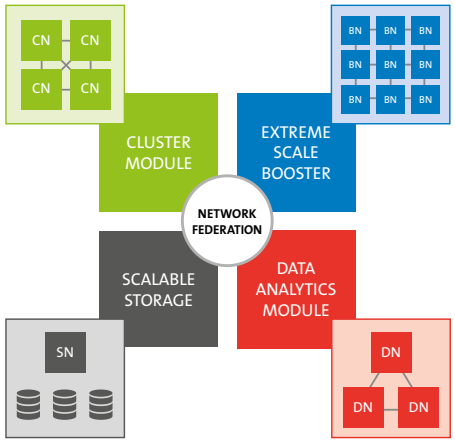
TOWARDS A MODULAR SUPERCOMPUTING ARCHITECTURE

THE MODULAR SUPER-COMPUTER ARCHITECTURE

The Modular Supercomputer Architecture (MSA) is a blueprint for heterogeneous HPC systems supporting the divergent computation and data processing requirements of high performance compute and data analytics with highest efficiency and scalability. The DEEP-EST prototype integrates three compute modules with different performance characteristics:

- **Cluster Module (CM):** reliable performance for all codes, including complex and irregular data structures and control structures.
- **Extreme Scale Booster (ESD):** highest delivered performance for regular and vectorizable codes, plus high energy efficiency.
- **Data Analytics Module (DAM):** highest performance for data analytics and machine learning codes.

The modules are connected to each other via a **Network Federation (NF)** solution. **Network Attached Memory (NAM)** and **Global Collective Engine (GCE)** nodes offer fast globally accessible memory and acceleration of MPI collectives. Finally, storage is provided by the **Scalable Storage Service Module (SSSM).**



SOFTWARE ENVIRONMENT

DEEP-EST provides an **integrated programming environment,** using standards such as MPI, OpenMP and Tensorflow or similar frameworks for machine learning and data analytics. In the DEEP-EST project, R&D activities focus on:

- **SLURM resource manager/scheduler:** Extensions will help to determine the optimal resource allocation for each workload.
- **Adaptive scheduling and dynamic resource reservation:** Aggregation will be used to achieve efficient use of the overall system.
- **I/O and resiliency techniques:** Proven developments of the DEEP-ER project will be adapted to the MSA.
- **Scalability projections** to pre-Exascale performance levels will be provided.

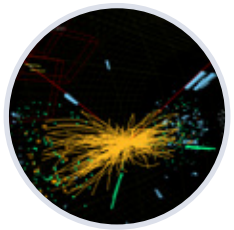
ENERGY EFFICIENCY

The project addresses **energy efficiency** on multiple layers of the HPC system:

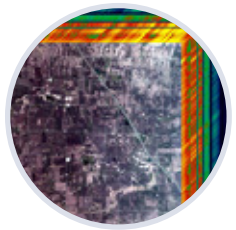
- **Highly efficient code execution:** application requirements are matched with available system resources.
- **Optimal system throughput** leads to reduced time and energy to solution.
- **Efficient system operation** achieved by leading-edge hardware and use of direct warm-water cooling is combined with a **sophisticated monitoring system.**

CO-DESIGN APPLICATIONS

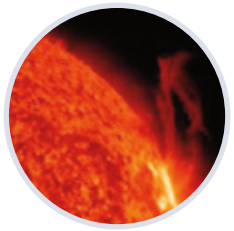
Six ambitious HPC and HPDA applications drive the co-design process and will be used to evaluate the HW and SW technologies developed in DEEP-EST. The application variety will exploit the system flexibility, each one utilizing different module combinations and show that the Modular Supercomputer Architecture is beneficial for a wide range of users. The dynamic scheduling and resource management extensions will ensure highest throughput of applications.



High Energy Physics



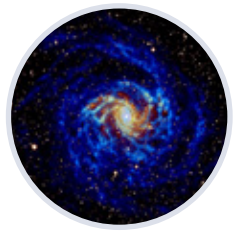
Earth Science



Space Weather

Molecular Dynamics

Neuroscience



Radio Astronomy