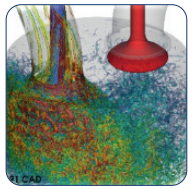
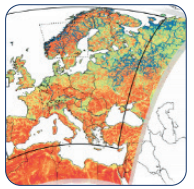
CO-DESIGN APPLICATIONS

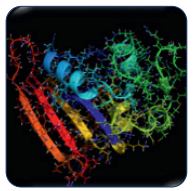
Ambitious European HPC applications from seven fields of science & engineering drive the co-design process and are used to evaluate the software elements developed in DEEP-SEA.
The diversity of these applications ensures that the DEEP-SEA software stack will excel in effectiveness, usability, performance and stability across real-world usage domains, and bring significant benefits to users and operators of European Supercomputing Centres.



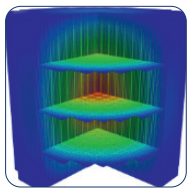
Computational Fluid Dynamics



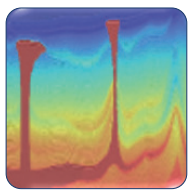
Earth System Modelling



Molecular Dynamics

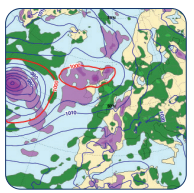


Neutron Monte Carlo Transport



Seismic Imaging

Space Weather



Weather Forecast

IN A NUTSHELL

BUDGET:
- Overall budget € 15 Mio., EU funding € 7.5 Mio.

PROJECT TERM:
- April 2021 – March 2024

CONSORTIUM:
- Coordinator: Forschungszentrum Jülich
- 14 Partners
- 8 European countries

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DEEP-SEA

SOFTWARE FOR EXASCALE ARCHITECTURES

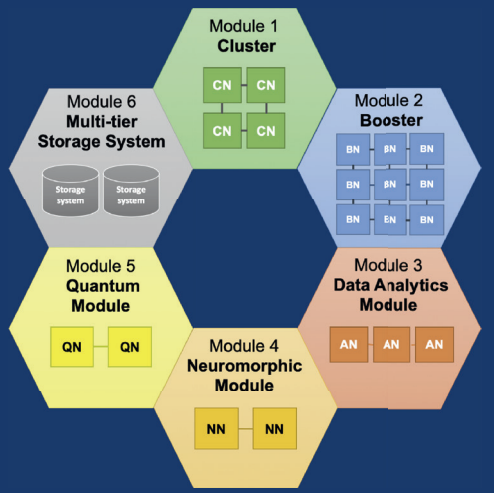
DEEP Projects

MODULAR SUPER-COMPUTING ARCHITECTURE

The Modular Supercomputing Architecture (MSA) is a blueprint for heterogeneous HPC systems supporting the highest efficiency and scalability. The MSA developed throughout the DEEP projects integrates different compute modules with specific performance characteristics for different workloads, and it provides substantial benefits for heterogeneous applications and workflows.

To cope with the high computing and memory heterogeneity of modern HPC architectures and the MSA in particular, an adapted and optimised software stack is needed.
Each part of a code can be executed on the most suitable platform, improving both time to solution and energy efficiency. Extracting the maximum performance from the diverse pool of compute resources requires the applications to be adapted.

The innovative DEEP-SEA SW stack enables applications to effectively harness modularity. It supports memory hierarchies and a wide range of accelerators. DEEP-SEA builds on the results of the DEEP project series and is linked to the partner project RED-SEA to cover HPC interconnect topics, and also to IO-SEA to address system-level I/O and storage management.



SOFTWARE FOR HETEROGENEOUS SYSTEMS

Systems and applications are rapidly getting more complex. To make the best use of the available resources, these must be dynamically assigned according to the needs of the application. Furthermore, programming models and tools must enable efficient sharing and exploitation of the heterogeneous computing and data processing capabilities.

- At the **node-level,** the European Processor Initiative (EPI) will integrate general-purpose CPUs and accelerators and combine them with DRAM and HBM memories. Consequently, DEEP-SEA implements support for data placement policies for deep memory hierarchies, improving application performance on future EPI-based platforms.

- At the **system-level**, the MSA efficiently integrates CPUs, storage systems and accelerators. The DEEP-SEA software stack enables dynamic resource allocation, application malleability, programming composability, and includes tools for mapping applications to the MSA. The result is a software environment enabling applications to run on the best suited hardware, in a scalable, and energy efficient manner.

- At the **organisation-level**, DEEP-SEA works closely with the EU-funded projects IO-SEA and RED-SEA. Both have their own specific focus, but share the same goal of European exascale architecture: IO-SEA provides a novel data management and storage platform for Exascale computing, while RED-SEA enhances the European interconnect technology BXI and its related low-level software.

ENERGY EFFICIENCY

Supercomputing is extremely energy-consuming. Today, this is one of the factors limiting the use of more capable systems. Achieving highest energy efficiency is crucial for the road to Exascale.

In the near future, this goal can only be reached with heterogeneous architectures combining general-purpose processors with different types of compute and data processing accelerators and matching memory technologies.

Harnessing complexity by dynamic resource allocation results in a software environment that enables applications to run on the best-suited hardware, in a scalable, and energy-efficient manner.

> *Energy efficiency is crucial for the road to Exascale.*

FUNDING

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