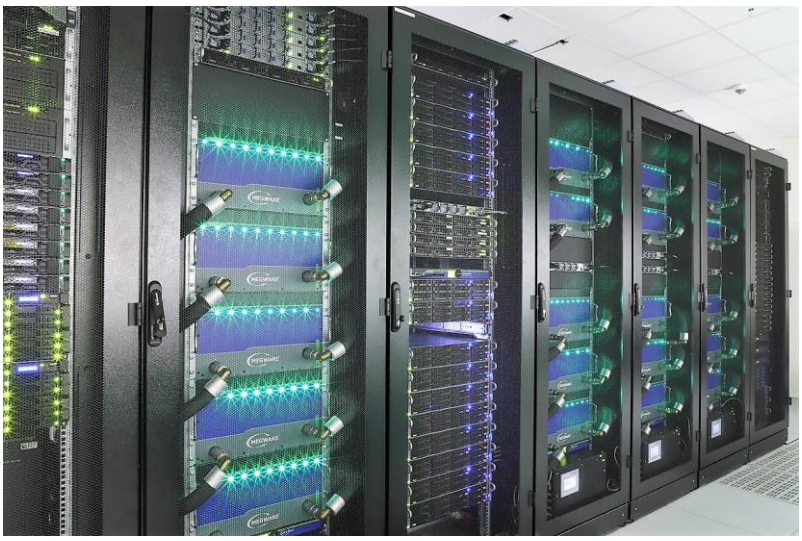
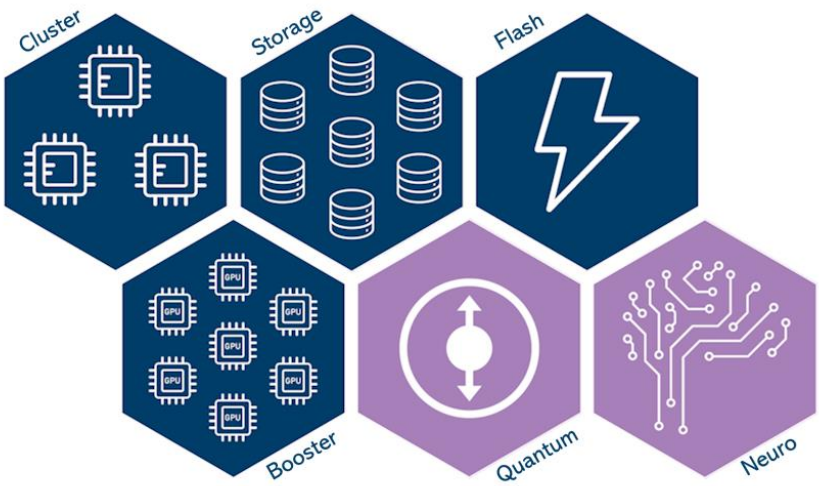
DEEP Projects





The DEEP-SEA Project – Concept and Achievements

EuroHPC Summit Week, Antwerp, March 18-21, 2024

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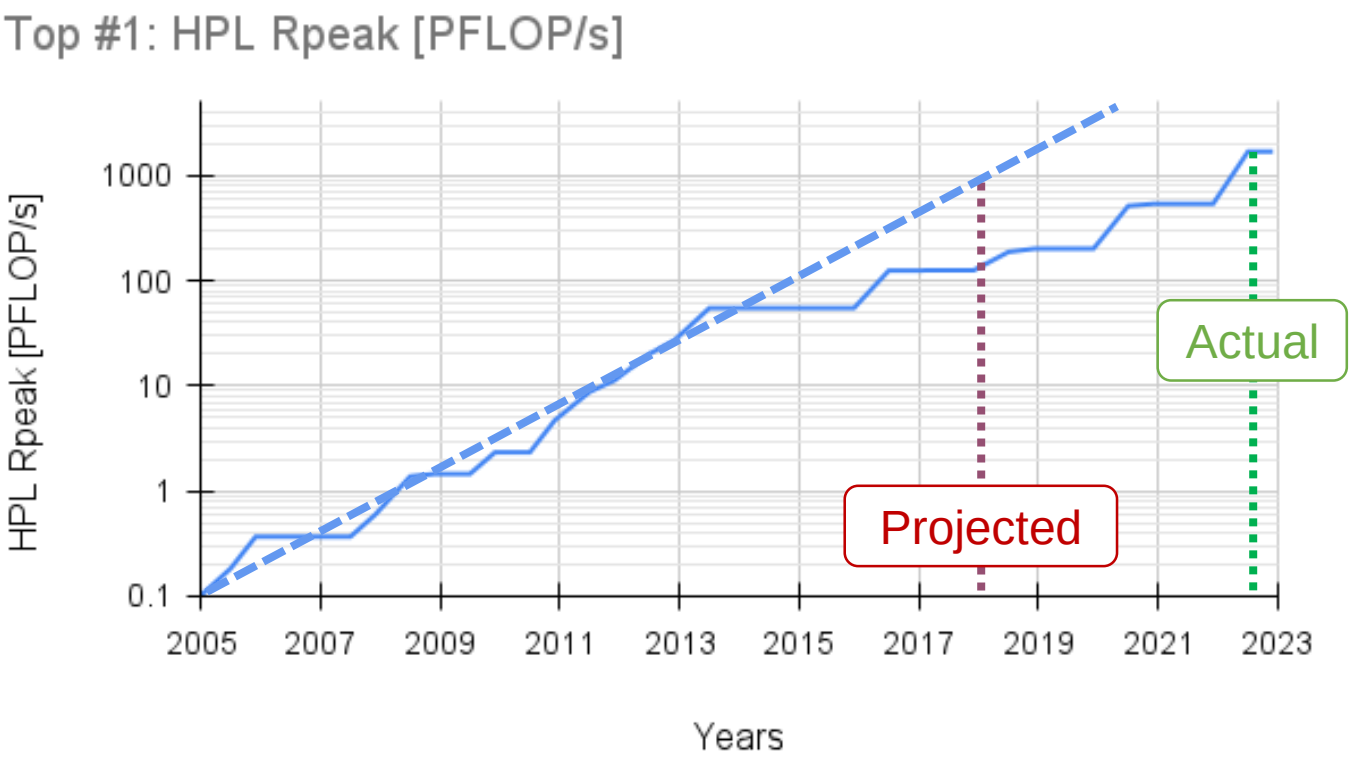
SEA Projects

DEEP-SEA
IO-SEA
RED-SEA

DEEP-SEA Addresses Key Exascale Challenges

The road to Exascale was longer than expected

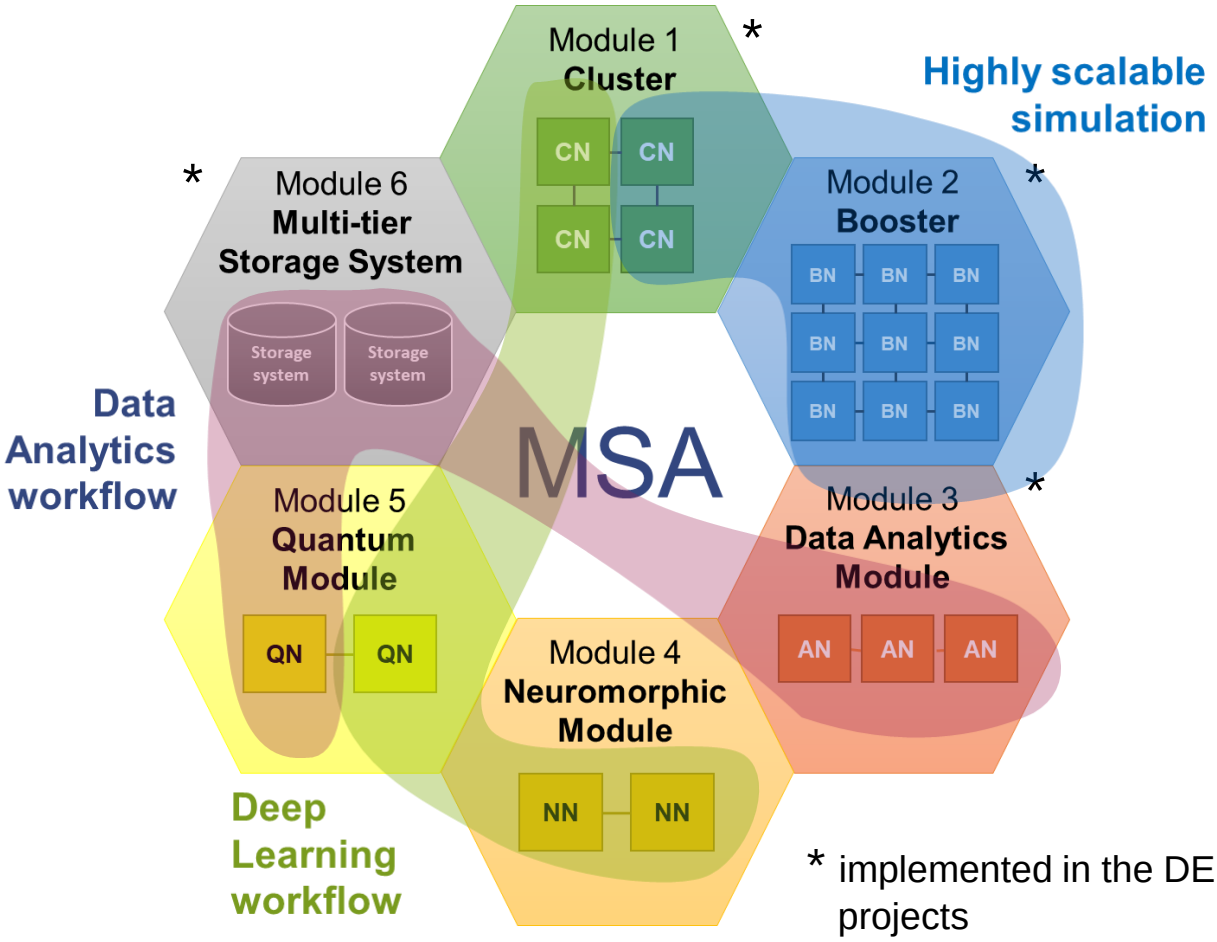


Principal Challenges

- Extreme application parallelism
  - Up to billions of individual execution threads — DEEP-SEA
- Truly scalable supercomputers
  - Interconnects must handle huge numbers of endpoints with highest performance & reliability
- Energy efficiency
  - Use of accelerators and beneficial scale for all applications — DEEP-SEA
  - Energy-oriented scheduling & management — DEEP-SEA
- Memory and storage
  - Growing performance gap between compute and memory & I/O throughput — DEEP-SEA
- Support of workload diversity
  - Wide variety of HPC, AI and data analytics workloads — DEEP-SEA

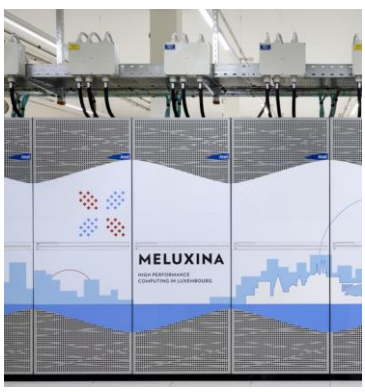
DEEP-SEA Addresses Key Exascale Challenges

Composability of heterogeneous resources



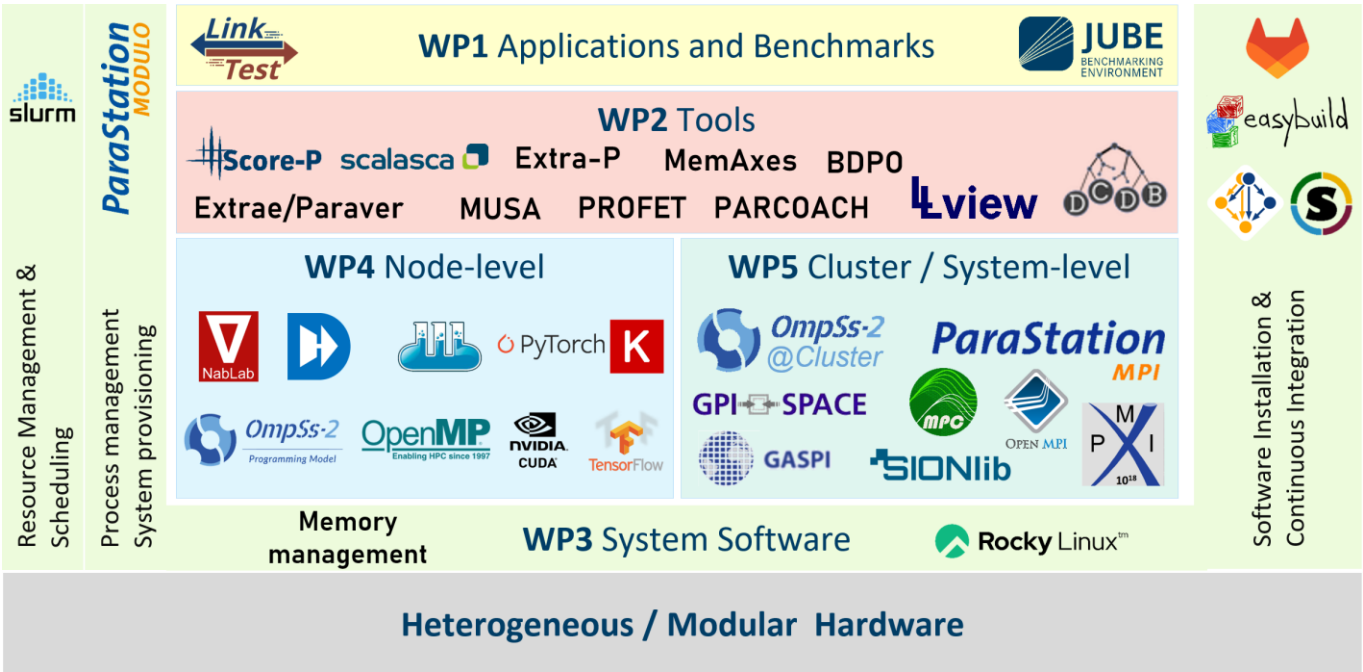
* implemented in the DEEP projects

- Cost-effective scaling
- Effective resource-sharing
- Supports HPC / ML / AI / Big Data workloads



DEEP-SEA Addresses Key Exascale Challenges

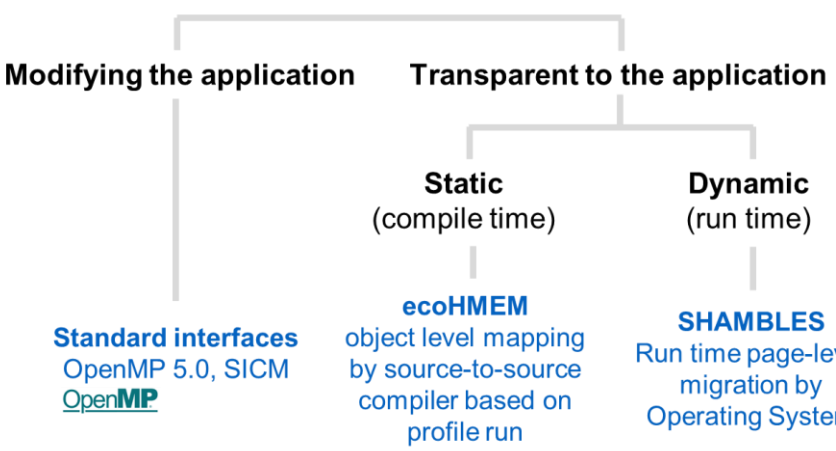
Comprehensive, Integrated, Exascale-Ready

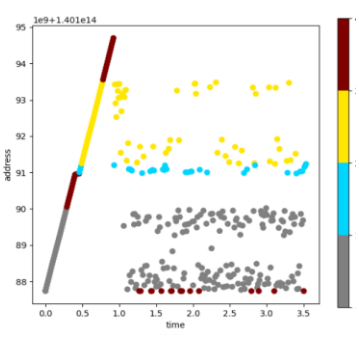


Public release at https://gitlab.jsc.fz-juelich.de/deep-sea/easybuild-repository-public-release

Heterogeneous Memory Support

- Combine fast (HBM) with conventional (DDR) memory
- DEEP-SEA tools support
  - Restructuring of applications (OpenMP)
  - Tool-guided optimization of applications (ecoHMEM)
  - Automatic use by unmodified code





SHAMBLES scatter plot example for sparse kernel

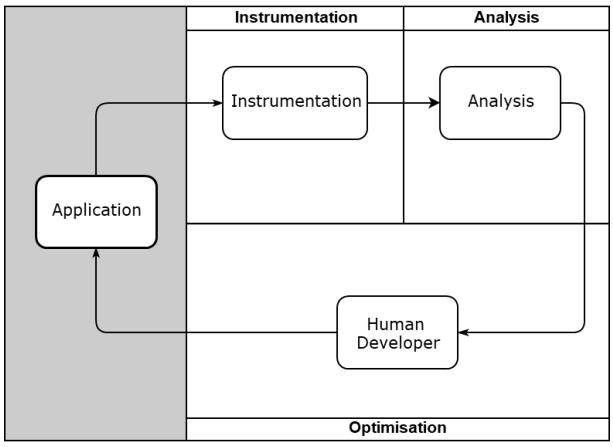
DEEP-SEA Addresses Key Exascale Challenges

Optimisation Cycles Guiding HPC SW Developers

- Many SW tools available to HPC SW developers for analysis and optimisation – in DEEP-SEA, these:

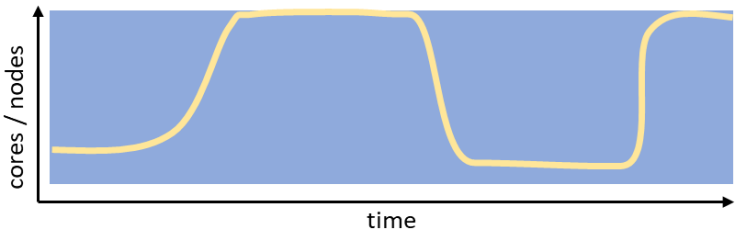
Score-P scalasca Extra-P MemAxes BDPO
Extrae/Paraver MUSA PROFET PARCOACH 4view DCDB

- Optimisation cycles capture tool workflows for specific purposes
- They guide SW developers and make it easier to achieve specific goals
  - Like improving load balance or reducing energy to solution

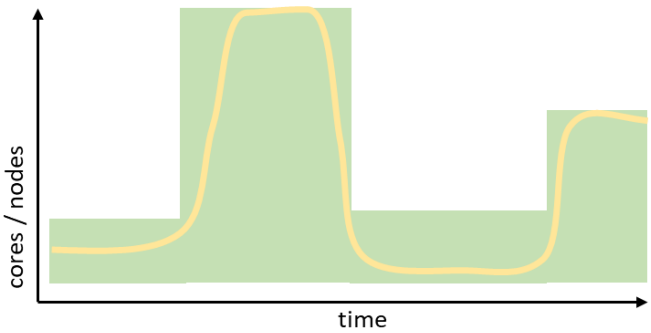


Malleability and Dynamic Resource Allocation

- Use of resources varies over time (yellow curve)
- Constant allocation of resources (blue)

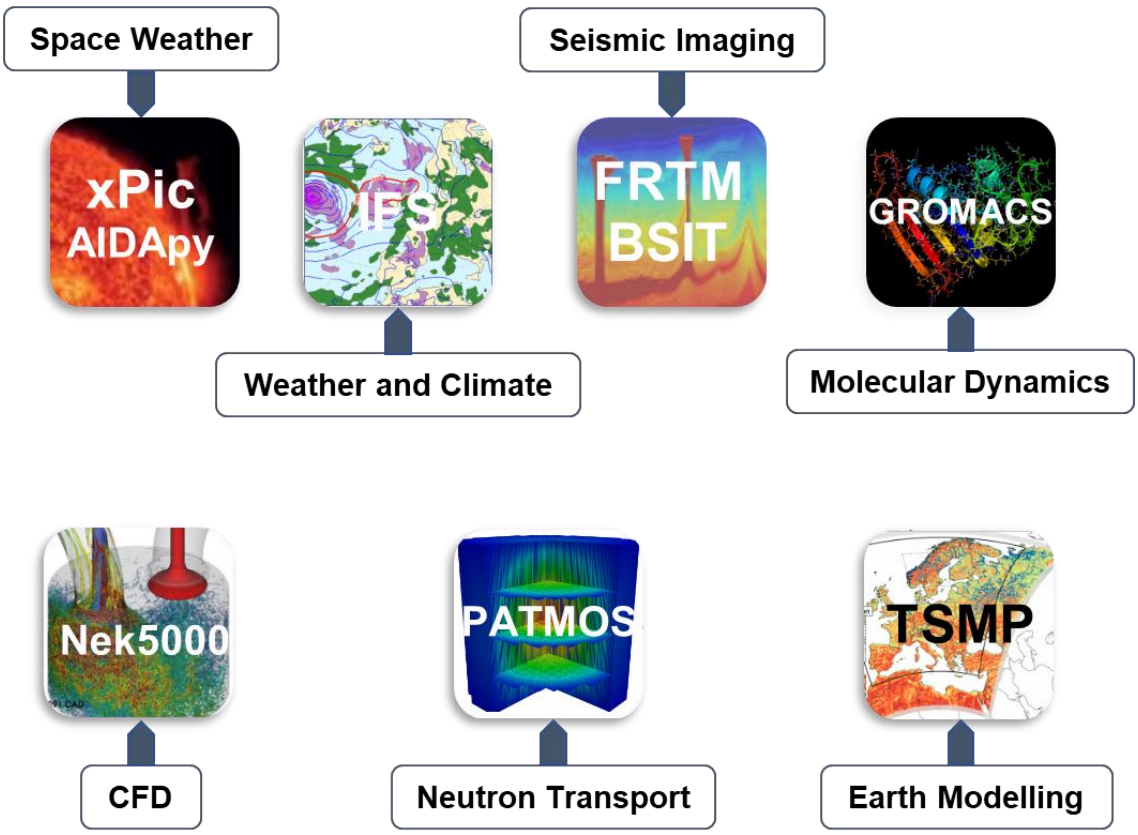


- Improved dynamic allocation of resources (green)
- Malleable applications can request or shed resources
- MPI & Slurm prototype for enabling application-driven malleability



DEEP-SEA Addresses Key Exascale Challenges

Important Real-World Co-Design Applications



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