**USER BENEFITS AT A GLANCE**

- Ideal for both worlds: The DEEP/-ER systems provide superior efficiency and scalability and are thus equally suited for HPC applications from *science and industry*.

- **Heterogeneous runtime characteristics**: The DEEP/-ER systems are especially suited for HPC applications with code parts that differ in their scalability characteristics (i.e. multi-scale and/or multi-physics simulations).

- Efficient system use: Separating the code into highly scalable and low scalable parts and its dynamic distribution to either Cluster or Booster ensures the *system resources are used in an optimal way*.

- **Easy-to-use**: Porting an application to the DEEP/-ER machines is a snap with the DEEP programming model – especially if you are using MPI already. The model is based on standards, protecting your investment in code modernization.

- The DEEP-ER prototype is additionally optimised for I/O intensive applications and exploits new memory technologies like non-volatile and network attached memory.

- The system software provides advanced features for *resiliency*, reducing the overhead of task and process checkpoints by exploiting a multi-level memory hierarchy.

- Open questions? The projects provide support for proven, industry standard HPC programming models like MPI and OpenMP (or OpenMP 4.x). Naturally, the relevant documentation will be made available as well.

**TESTING THE DEEP/-ER SYSTEMS**

The DEEP prototype system is installed at the Jülich Supercomputing Centre. After the official project end, the system is made available to interested external users to get familiar with the architecture and programming models and evaluate their potential. The same will apply for the DEEP-ER prototype.

**You are interested in testing the DEEP/-ER systems?**

**GET IN TOUCH!**

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DeeP/-er Use case
Towards a better understanding of the brain with DEEP
Brain simulation is making giant leaps towards a better understanding of the brain’s inner workings. in DeeP, the swiss federal institute of technology in lausanne (EPFL) has been adapting CoreNeuron – an advanced brain simulation application – to run efficiently on the platform.

Optimising CoreNeuron for manycore architectures
in manycore architectures, efficient threading and vectorisation are no longer optional. to take advantage of them, these changes were necessary:

• an elaborated load balancing strategy at the thread level, taking into account the complexity of simulating different kinds of neurons.

• Data layout changes and refactoring of the compute loops to enable vectorisation.

The result: the effects of the refactoring are already very noticeable. the simulation now achieves a very high level of parallel efficiency and is able to take advantage of using 240+ threads.

Memory layout transformation and vectorisation optimisation lead to enhanced performance even on memory bound kernels.

Going even further with DEEP
Being a highly scalable application, CoreNeuron is already running on some of the most powerful supercomputers on the planet. On the DeeP system, it can leverage one of the highest levels of parallelism very efficiently and explore future heterogeneous system designs. the key to success:

• Decoupling the i/O from the computation.

The result: a speedup of more than one order of magnitude with respect to performing i/O directly from Xeon Phis in some preliminary tests on standard platforms. the design of the OmpSs offload allows direct (Cluster to Booster) and reverse (Booster to Cluster) offloading in the same way, which allows to implement the reverse offload followed in CoreNeuron in a particularly easy way.