

# bwUniCluster: Baden-Württemberg's University Cluster

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“bwUniCluster” is a tier-3 High Performance Computing cluster co-financed by Baden-Württemberg's Ministry of Science, Research and the Arts, and the shareholders: Universities of Freiburg, Tübingen, Ulm, Heidelberg, Hohenheim, Konstanz, Mannheim, Stuttgart, the KIT and the HAW Baden-Württemberg e.V. (an association of universities of applied sciences in Baden-Württemberg). Together with the bwForClusters JUSTUS, MLS&WISO, NEMO and BinAC it constitutes the multi-cluster entry level of Baden-Württemberg's High Performance Computing (bwHPC).

## 1 Introduction

Baden-Württemberg's current initiative on high-performance computing (HPC), officially labelled **bwHPC** [1], has been evolving the traditional HPC entry level, i.e., tier 3, to a federated, heterogeneous HPC cluster infrastructure (cf. figure 1) and state-wide HPC support base. The

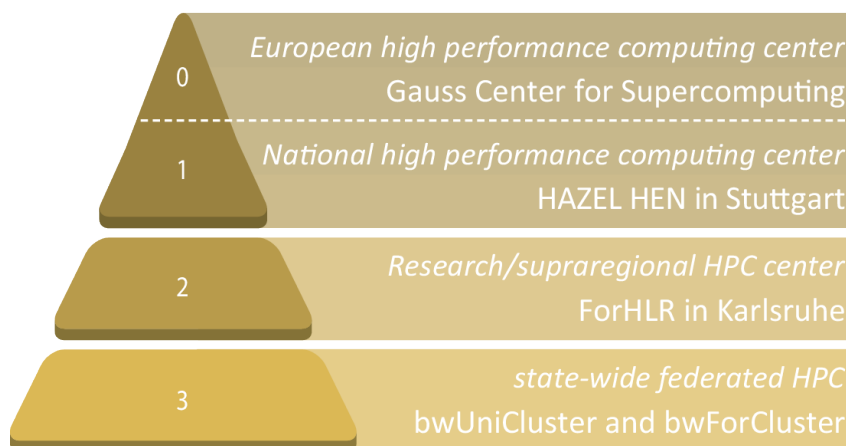


Figure 1: HPC performance pyramid in the state of Baden-Württemberg, Germany: from top (tier 0) to bottom (tier 3) with decreasing scalability and performance level.

initiative bwHPC, recommended for funding by the German Research Foundation (DFG) and considered a model concept for Germany, covers the promotion of HPC with different performance classes and competence centers at all levels.

The bwUniCluster system constitutes within bwHPC one of the five clusters of the HPC entry level. Complementary to the four HPC research clusters (bwForClusters), which are tailored to the needs of specific scientific communities, bwUniCluster provides the resources of Baden-Württemberg's universities for general purpose computing covering teaching and all science communities without a dedicated bwForCluster.

bwUniCluster has been co-financed by Baden-Württemberg's Ministry of Science, Research and the Arts, and university shareholders<sup>1</sup>, hence the derived name "bwUniCluster" from *Baden-Wuerttemberg's univeral* or university *cluster*.

bwUniCluster is located at the Karlsruhe Institute of Technology and has been operating since January 2014. In March 2017, bwUniCluster will be expanded by a second partition, more than doubling the initial computing capacity.

## 2 Hardware architecture

The first partition consists of 532 compute nodes with two 8-core Intel Xeon E5-2670 ("Sandy Bridge") processors and 64 gigabytes of main memory each, plus eight compute nodes with four 8-core Intel Xeon E5-4640 processors and 1 Terabyte of main memory each [2]. The second partition will consist of 352 compute nodes with two 14-core Intel Xeon E5-2660v4 ("Broadwell") processors and 128 gigabytes of main memory each. Together with the second partition total peak performance for the system will be 440 TeraFLOPS as well as providing in total 86 Terabyte of main memory.

On bwUniCluster two parallel file systems based on Lustre are used for globally (i.e., on all nodes) accessible user data. Both file systems differ in usability lifetime, redundancy and total capacity. While \$HOME is permanent and under backup, its 469 Terabyte is not primarily for computing activities. Globally available data scratch is provided by the workspace file system with a total capacity of 938 Terabyte. However workspaces have a limited lifetime and no redundancy.

For providing an extremely fast and high data throughput network with very low latency all nodes are connected to a central InfiniBand fabric at 56 GBit/s per node (4x FDR).

## 3 Support

User support for bwUniCluster is provided mainly by members of the project bwHPC-C5 [3] including:

- maintaining a comprehensive HPC software stack (currently with over 200 software modules) extensible upon user requests,
- HPC teaching courses,
- second level support for any HPC related issues and high-level support teams (aka bwHPC tiger teams), and
- elaborated online best practice and user guides [4].

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<sup>1</sup>Universities of Freiburg, Tübingen, Ulm, Heidelberg, Hohenheim, Konstanz, Mannheim, Stuttgart, the KIT and the HAW Baden-Württemberg e.V. (an association of universities of applied sciences in Baden-Württemberg)

## 4 Access & Registration

The use of bwUniCluster is free of charge for all academic members of the shareholders<sup>1</sup>. After issued a bwUniCluster entitlement by the home organisation one can register online for the service, while access to the cluster can be established via SSH. Further details are covered in the Best Practices Wiki [5].

## 5 Citation

As every funded work, the use of bwUniCluster system has to be cited in any work related publication as follows:

“The authors acknowledge support by the state of Baden-Württemberg through bwHPC.”

## References

- [1] Hartenstein, H., T. Walter, and P. Castellaz. “Aktuelle Umsetzungskonzepte der Universitäten des Landes Baden-Württemberg für Hochleistungsrechnen und datenintensive Dienste.” *Praxis der Informationsverarbeitung und Kommunikation*, Band 36, Heft 2 (2013): 99-108. <http://dx.doi.org/10.1515/pik-2013-0007>
- [2] Scheller, U.: “KIT betreibt zentralen Hochleistungsrechner der Landesuniversitäten”. *SCC-News*, 01-2014, pp 6–7.
- [3] <http://www.bwhpc-c5.de>
- [4] <http://www.bwhpc.de/wiki>
- [5] [http://www.bwhpc.de/wiki/index.php/bwUniCluster\\_User\\_Access](http://www.bwhpc.de/wiki/index.php/bwUniCluster_User_Access)