Press Release

# CoolMUC-3: New energy-efficient many-core cluster at LRZ

**Garching near Munich, Germany, November 12, 2017. The Leibniz Supercomputing Centre (LRZ) of the Bavarian Academy of Sciences and Humanities puts into operation CoolMUC-3. The HPC cluster is based on Intel's many-core architecture and is particularly characterised by the innovative energy-efficiency technologies it features, e.g. the warm-water cooled Omni-Path switches. The system was developed and delivered by MEGWARE (www.megware.com), a Chemnitz-based HPC solution provider who successfully concluded the European procurement process.**

LRZ's procurement targets for the new cluster system were:

- To deploy state-of-the art high-temperature water-cooling technologies for a system operation that avoids heat transfer to the ambient air of the computer room.
- To supply a system to its users that is suited for processing highly vectorizable and thread-parallel applications, and
- To provide improved scalability across node boundaries for strong scaling.

The system's baseline installation consists of 148 computational many-core Intel "Knight's Landing" nodes (Intel® Xeon Phi™ 7210-F hosts) connected to each other via an Intel Omni-Path high performance network in fat tree topology. The theoretical peak performance is 400 TFlop/s and the LINPACK performance of the complete system is 255 TFlop/s. A standard Intel® Xeon® login node is available for development work and job submission.

"CoolMUC-3 is the result of an established partnership between LRZ and Megware. Similar to the delivery of the first CoolMUC in 2011 we have managed to raise the bar for energy efficiency in HPC once more by developing new, innovative technologies", concludes Axel Auweter, CTO at Megware.

CoolMUC-3 comprises of three warm-water cooled racks, using an inlet temperature of at least 40 °C. A very high fraction of waste heat deposition into water is achieved by deployment of liquid-cooled power supplies, Omni-Path switches and thermal isolation of the racks to suppress radiative losses. In addition, the liquid cooled racks operate entirely without fans. A complementary rack for air-cooled components (e.g. management servers) uses less than 3% of the systems total power budget. With 4.96 GFlops/Watt (according to the strict Green500 level-3 measurement methodology) CooLMUC-3 is one of the most efficient x86 systems worldwide.

"LRZ has a long-standing history in energy-efficient, warm-water cooled HPC systems. In the long run, we want to get rid of inefficient air-cooling completely. With CoolMUC-3 we take an important step into this direction." states Prof. Dr. Dieter Kranzlmüller, Chairman of the Board of Directors at LRZ.

CoolMUC-3 is particularly suitable for parallel applications that minimize memory consumption by hybrid programming, e.g. with MPI and OpenMP and then take advantage of the vector units after optimizing the data location. For codes that require use of the distributed memory paradigm with small message sizes, the integration of the Omni-Path network interface on the chip set of the computational node can bring a significant performance advantage over a PCI-attached network card. The actually observable memory bandwidth of the high bandwidth memory yields approximately 450 GB/s per node.

Being an Intel Parallel Computing Centre (IPCC), LRZ has acquired extensive knowledge in recent years in optimising scientific codes to this new type of architecture and will provide corresponding support to its customers. CoolMUC-3 is accessible for researchers of the Ludwig-Maximilians-Universität Munich (LMU) and the Technical University of Munich (TUM) as well as for researchers from universities across Bavaria.

**Learn more about CoolMUC-3 at SC17: Visit LRZ at booth #875 or our partner Megware at booth #1231.**

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**Photography:**

- CoolMUC-3 system
- CoolMUC-3 node

Please note: Both pictures courtesy of Megware.

**About LRZ**
The Leibniz Supercomputing Centre (Leibniz-Rechenzentrum, short LRZ) is the IT service provider for all Munich universities as well as a growing number of research organisations throughout Bavaria. In addition, LRZ plays an important role as a member of the Gauss Centre for Supercomputing (GCS) delivering top-tier HPC services on the national and European level. LRZ supports groundbreaking research and education throughout a wide range of scientific disciplines by offering highly available, secure and energy-efficient services based on cutting-edge IT technology. It is an institute of the Bavarian Academy of Sciences and Humanities.

**About Megware**
With over 1100 installations to date, MEGWARE Computer Vertrieb und Service GmbH is one of Europe's leading suppliers of high performance computing and IT technology. Being a full-service provider, Megware delivers customer-centric solutions based on latest technologies from major HPC solution providers. Innovative in-house developments for high temperature liquid cooling and energy monitoring complement Megware’s portfolio of highly energy-efficient solutions for industrial and academic HPC customers.