Next Generation of QPACE Operational

The "QCD Parallel Computing Engine" (QPACE) project started in 2007 by the universities of Regensburg and Wuppertal in the framework of the transregional Collaborative Research Centers SFB/TRR 55. Meanwhile several generations of QPACE supercomputers have been put into operation. Most recently, QPACE 3 has been installed at Jülich Supercomputing Centre.

The goal of the QPACE project is on the one hand the development of novel application optimized supercomputer architectures and on the other hand the creation of competitive research infrastructure for simulating the theory for strong interactions, namely quantum chromodynamics, on a lattice. The strategy of the project is to integrate extremely fast processors in a particularly dense way. Unlike previous generations, QPACE 3 was not the result of a joint development project but of an open tendering process, which resulted in a contract awarded to Fujitsu.

QPACE 1 [QPACE1] and QPACE 2 [QPACE2] were based on the IBM PowerXCell 8i and the first generation of Intel Xeon Phi, respectively. For QPACE 3 the second generation Xeon Phi is used (codename Knights Landing). While the selected Xeon Phi 7210 with its 64 cores is not the fastest available processor of its kind, it was expected to be the most power efficient choice. All generations of QPACE had been designed for power efficiency and were ranked top in the Green500 list [green500]. Thanks to strong support from Fujitsu in Augsburg (Germany) it had been possible to have QPACE 3 listed at rank #5 on the November 2016 list.

All these generations do also have in common the use of direct liquid cooling. Initially, this approach was selected to minimize costs by maximizing density. Meanwhile other benefits of liquid cooling have become more important. As direct liquid cooling allows to significantly increase temperature of the liquid that leaves the data centre, full year free cooling becomes an option, which again helps to reduce power consumption. The Fujitsu CS600 servers use technology from the Danish company Asetek to enable outlet liquid temperatures beyond 40°C and mounting of servers both from front and back of the racks. All 352 compute nodes, i.e. almost 1 PFlop/s compute performance, could thus be accommodated in just 4 racks only.

Until summer 2017, the size of the QPACE 3 installation will be significantly increased. In parallel, work on the next generation has started. QPACE 4 is being developed with Cray and will again exploit highly advanced processor technology, but now based on the ARM architecture.

References

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"QPACE 2 and Domain Decomposition on the Intel Xeon Phi". In: PoS LAT2014 (2014), p. 001. arXiv:1502.04025 [hep-lat].

[green500]: https://www.top500.org/green500/

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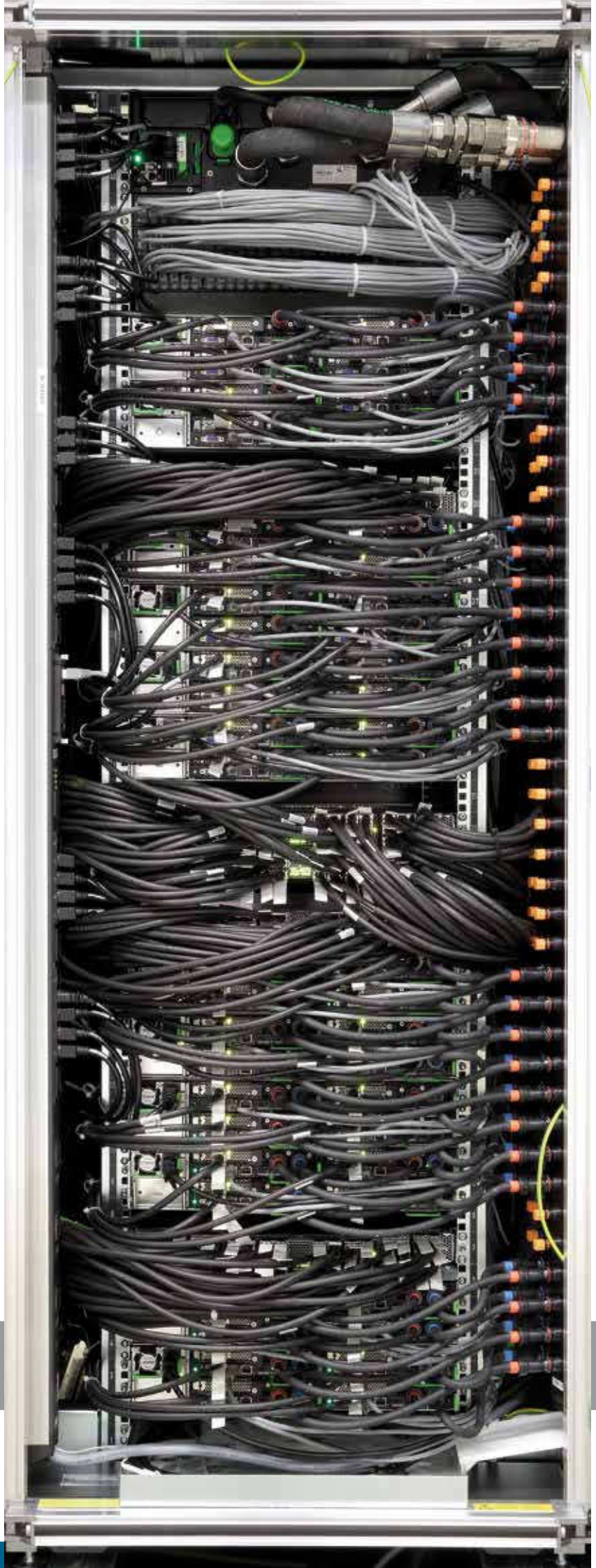

Single QPACE 3 rack with a water manifold at the right side, which is connected to a heat exchanger in the top of the rack.