apeNET+: a 3D toroidal network enabling petaFLOPS scale Lattice QCD simulations on commodity clusters

Content:
apeNET is a seven-years old project aimed at the acceleration of numerical simulations, mainly Lattice QCD, on commodity clusters of O(1000) nodes using a custom-designed 3D toroidal interconnect.
In this paper we report on apeNET+, the new generation of our network adapters supporting wire speeds up to 30 Gbit/s per link, PCIe x8 gen 2, improved hardware RDMA support and enhanced communication primitives.
The project target is the development of a low latency, high bandwidth direct network, i.e. without external switching hardware, matching the wire performance of the commercial counter-parts and improving on the price/performance ratio when the cluster size increases.
apeNET is a network of point-to-point links with a 3D toroidal topology, where each processing node is directly connected to its first neighbours by six bi-directional full duplex links. We adopted a packet-based communication protocol with wormhole dimension-ordered routing and virtual channels. The network interface provides hardware support for the RDMA programming model.
A Linux kernel driver, a set of low-level RDMA APIs and a OpenMPI library driver are available, enabling painless porting of standard applications.
A detailed performance analysis on a real application, namely Lattice Quantum Chromo Dynamics (LCQD), is provided, in comparison with results obtained with InfiniBand.
Finally, we give an insight on future work and developments.

Primary authors: Dr. VICINI, Piero (INFN - National Institute of Nuclear Physics) ; Dr. LONARDO, Alessandro (INFN - National Institute of Nuclear Physics) ; Dr. ROSSETTI, Davide (INFN - National Institute of Nuclear Physics) ; Dr. AMMENDOLA, Roberto (INFN - National Institute of Nuclear Physics)

Co-authors: Dr. BIAGIONI, Andrea (INFN - National Institute of Nuclear Physics) ; Dr. FREZZA, Ottorino (INFN - National Institute of Nuclear Physics) ; Dr. LO CICERO, Francesca (INFN - National Institute of Nuclear Physics) ; Dr. SIMULA, Francesco (Dep. of Physics,
Sapienza, Univ. of Roma and INFN - National Institute of Nuclear Physics) ; Dr. TOSORATTO, Laura (INFN - National Institute of Nuclear Physics) ; Dr. PAOLUCCI, Pier Stanislao (INFN - National Institute of Nuclear Physics)

**Presenter** : Dr. VICINI, Piero (INFN - National Institute of Nuclear Physics)

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