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

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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 34 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.

Preliminary electrical measurements are provided and status update of the hardware developments are reported.

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