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ESSPER: FPGA Cluster for Research on Reconfigurable HPC with Supercomputer Fugaku

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At RIKEN Center for Computational Science (R-CCS), we have been developing an experimental FPGA Cluster named "ESSPER (Elastic and Scalable System for high-PErformance Reconfigurable computing)," which is a research platform for reconfigurable HPC. ESSPER is composed of sixteen Intel Stratix 10 SX FPGAs which are connected to each other by a dedicated 100Gbps inter-FPGA network. We have developed our own Shell (SoC) and its software APIs for the FPGAs supporting inter-FPGA communication. The FPGA host servers are connected to a 100Gbps Infiniband switch, which allows distant servers to remotely access the FPGAs by using a software bridged Intel's OPAE FPGA driver, called R-OPAE. By 100Gbps Infiniband network and R-OPAE, ESSPER is actually connected to the world's fastest supercomputer, Fugaku, deployed in RIKEN, so that using Fugaku we can program bitstreams onto FPGAs remotely using R-OPAE, and off-load tasks to the FPGAs. In this talk, I introduce our ESSPER's concept, system stack of hardware and software, programming environment, under-development applications as well as our future prospects for reconfigurable HPC.

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