

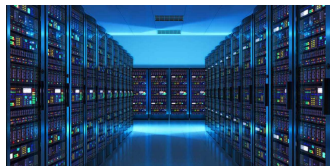
# Research and FPGA Implementation of RDMA NIC Performance Enhancement



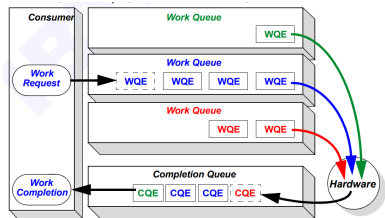
On board test by Alveo U280

## INTRODUCTION

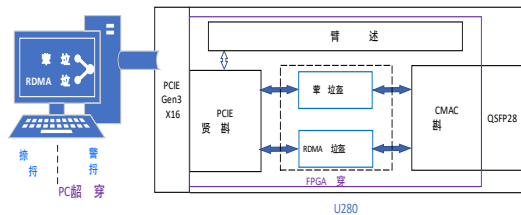
**High-performance computing** requirements for networks lies on high throughput and low latency. The industry generally adopts **RDMA (Remote Direct Memory Access)** to replace the TCP protocol to achieve low latency and reduce the utilization rate of CPU of HPC server. Problems faced by commercial RDMA network cards: 1) adopt a DRAM-free design, and the network throughput decreases significantly when the number of QP connections increases. 2) lack one-to-many efficient and reliable communication support. The point-to-point RDMA RC protocol will introduce huge communication overhead in one-to-many/many-to-many scenarios



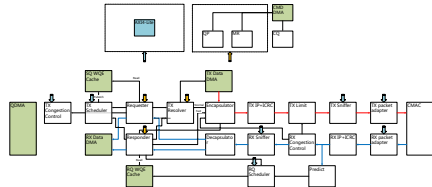
HPC with demand of high throughput and low latency



Data flow in RDMA system



Architecture design on boards



Overview of design in system (WQE, AXI4-Lite, QDMA...)

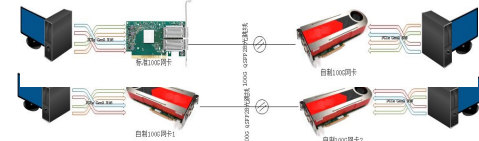
Referring to the AMD OpenNIC Project, PCIe IP adopts **QDMA** and the network port adopts **100G CMAC**

- 1) Complete FPGA **RTL** process development, support standard network card and **RoCE v2 RC** some functions; The driver supports Linux kernel, compatible with **OFED API**, and supports perftest;
- 2) Efficient **WQE** Cache and prefetch mechanism implementation under Memory-free architecture (DRAM-free);
- 3) Based on **QDMA** multi-mode to realize various types of data interaction between the host and the board;
- 4) RDMA one-to-many reliable protocol design and implementation (**WIP**)

CREATIVE DESIGN

RESULT

RDMA **bandwidth test** (ib\_write\_bw) based on system Ubuntu 18.04. **Compatibility test & End-to-end test** with the arrange of devices as figure shows below:



Illustrations of devices for compatibility test (upper and left) and end-to-end test (lower and right) respectively

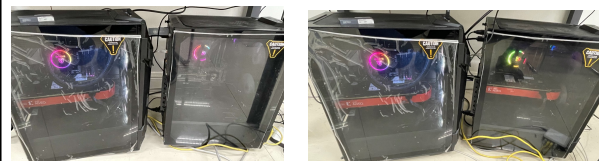


Table of performance in compatibility and end-to-end test (PMTU, Bandwidth Test, CPU Usage, Delay)

	PMTU	带宽测试 (Gbps)	CPU占用 (%)	发送1M数据的时延 (us)
兼容性测试	1024	89.37	6.25	121.89
端到端测试	1024	92.47	6.29	128.63