Adding FPGA-based Acceleration to Flash Memory for Real-Time Analytics

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*Increasing Performance by Moving Compute Closer to Data*
FPGA Platforms for Database Acceleration

PCIe attached FPGA acceleration platform

- Target optimized hardware
- Enable massively parallel processing units
- DDR4 for high capacity, HBM for high bandwidth

VCU1525
Virtex Ultrascale+ XCVU9P
4x DDR4 16GB, 2400MT/s, x64 with ECC

VCU1551
Virtex Ultrascale+ XCVU37P
2HBM2 stack, 1024 @ 1.8 Gbps, 8GB
4x DDR4 16GB, 2400MT/s, x64 with ECC

FPGA Acceleration offers 10-50x compute efficiency improvement over CPUs
Xilinx Accelerated Postgres on Amazon F1

- Customers can run existing queries
- Uses 32 SQL PU in a parallel configuration
- Current PU implements scan & aggregate; extensible to hash, sort, or customer specific instructions

Offloads by hooking FPGA scan/aggregate into Postgres query plan

https://aws.amazon.com/marketplace/pp/B07BVSZL51
Bringing compute closer to storage

Integrated compute relieves IO bottlenecks, frees up CPU for higher performance

PCIe attached acceleration

IO becomes the bottleneck for large data

Peer-2-Peer connections

CPU memory does not see SSD to FPGA transfers
Enabling Peer-2-Peer Acceleration with SSD

Query 6 runs 30x faster on FPGA with 32 parallel processing units.

IO bandwidth limits the performance, CPU cycles are also inefficiently utilized.

Xilinx booth demo shows TPCH Query 6 in PostgreSQL using Peer2Peer connection to SSD.

Direct connection between FPGA and SSD relieves IO and CPU cycles.
Objective
• Showcase FPGA P2P capabilities for enabling efficient storage acceleration

Application
• TPCH Query 6 accelerated in Postgres using SDAccel stack and P2P implementation on Xilinx FPGA
• Database benefits by the direct P2P access from the storage to the acceleration kernel within FPGA

Please visit Xilinx Booth to see the demo !!!
Database in an integrated computational storage platform

Xilinx Acceleration Platform

Terabytes of Storage

Processed and filtered in FPGA

For gigabytes of IO transfer & CPU processing

Improve database performance by bringing compute closer to storage!!

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Summary

• Successful demo of a system architecture integrating FPGAs and flash storage with system software stacks

• Xilinx platforms available with SDAccel tools to move data from SSD to FPGA device memory without going to CPU memory space overcoming IO bottlenecks

• Many data analytics and processing blocks available to be implemented on FPGA