Utilization of modern semiconductors
~GPU, SSD, NVRAM, FPGA, ...~

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The PG-Strom Project
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Target of today’s discussion

HW Class for Computing
- GPU
- FPGA

HW Class for Storage
- SSD
- NVRAM
Characteristics of computing HW

CPU
- Functional cores, but relatively small number (~20)
- Capability of operating system, storage and network
- Relatively large memory (more than 100GB is usual)

GPU
- Simple cores, but relatively large number (~3000)
- Advantaged on massive numerical operations.
- Programmable, and short time to build and reload (~2sec)
- Relatively small memory (~12GB; GTX TITAN X)

FPGA
- Flexible logic defined by HDL
- Advantaged on known, specific and pre-defined function?
- Programmable, but takes long time to rewrite (~30min)
Characteristics of storage HW

**Magnetic Drives**
- You know well

**SSD**
- 200K-400K IOPS, 2.4GB/s throughput
- Interface via filesystem (NVMe also)
- Widely accepted in the market
- No penalty on random access

**NVRAM**
- RAM speed access
- Interface via memory map
- Not yet commodity in x86_64 server
- No penalty on random access
http://opennvm.github.io/nvm-primitives-documents/

What is the project status?
Interesting Technologies (2/2)

ioMemory (Fusion-IO) <-> GPU Direct Memory Access

ioMemory <-> GPU

![Diagram showing ioMemory <-> GPU Direct Memory Access](source_image)

SOURCE: RDMA GPU Direct for ioMemory, Robert Wipfel, David Atkisson, Vince Brisebois
GPU Technology Conference: S4265
Ideas towards PostgreSQL adoption

**HW class for computing**
- Off-loads of CPU intensive workloads
  - Join, Sort, Aggregate on CustomScan node?
- Procedural Language support
  - pl/CUDA, pl/FPGA?

**HW class for storage**
- No random access penalty
  - suitable parallel scan, but planner may needs to pay attention
- Higher read throughput for OLAP workloads
  - I/O density of single query execution is concern
- Small latency for transaction logs
  - NVRAM on transaction log buffer, or atomic write to SSD

**Proprietary Tools**
- CUDA, ioMemory SDK, vendor specific drivers, ...etc
My Vision (1/2)

- SCM
- CRM
- ERP

OLTP database

ETL

OLAP database

Master / Fact Tables

OLAP Cubes

+OLAP

SCM
- CRM
- ERP
- BI

OLTP +OLAP
Cost: Server=$20K, SSD=$10K, GPU=$5K, NVRAM=$5K?

Total: $40K + “value of PostgreSQL”
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