AMD

PCIE® 4 PERFORMANCE

SIGGRAPH 2019

PCIe® gen 4 spec

- Double the bandwidth provided by PCIE gen 3
- 16 GT/s in both direction (read and write)
- Encoding is 128b/130b => every 128 bits are encoded in 130bits.
- 16*128/130 = 15.75Gb/s => 1968MB/s for 1 lane
- PCIE 4 16x=>31.51GB/s in one direction

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Hardware supporting PCIe® gen4

- CPU
  - Ryzen™ 3000 series

- GPU
  - AMD Radeon™ RX 5700 XT
  - AMD Radeon™ RX 5700 XT
  - AMD Radeon™ Instinct MI60
  - AMD Radeon™ Instinct MI50

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How to get best performance - OGL

- Using persistent buffer storage as source/destination

  glBufferStorage(UNPACK_BUFFER, size, NULL, GL_MAP_WRITE_BIT | GL_MAP_PERSISTENT_BIT);
  glMapBufferRange(UNPACK_BUFFER, 0, size, GL_MAP_WRITE_BIT | GL_MAP_PERSISTENT_BIT)

  glBufferStorage(PACK_BUFFER, size, NULL, GL_MAP_READ_BIT | GL_MAP_PERSISTENT_BIT);
  glMapBufferRange(PACK_BUFFER, 0, size, GL_MAP_READ_BIT | GL_MAP_PERSISTENT_BIT)

- Then transfer to/from your texture using

  glTexSubImage2D
  glReadPixels

- For buffer to buffer use GL_COPY_READ_BUFFER/GL_COPY_WRITE_BUFFER for binding and transfer with glCopyBufferSubData

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How to get best performance - OCL

- OpenCL provides a mechanism to “pre-pinned” a buffer and thus achieve the best transfer rate on the PCIe® bus

1. pinnedBuffer = clCreateBuffer(CL_MEM_ALLOC_HOST_PTR or CL_MEM_USE_HOST_PTR)
2. deviceBuffer = clCreateBuffer()
3. void *pinnedMemory = clEnqueueMapBuffer(pinnedBuffer) //pinning cost is incurred here
4. clEnqueueRead/WriteBuffer(deviceBuffer, pinnedMemory)
5. clEnqueueUnmapMemObject(pinnedBuffer, pinnedMemory)

- Typically an application will perform step 1, 2 ,3 and 5 once. While the mapped pinned buffer can be uploaded several times from the CPU and thus different data can be uploaded while repeating step 4

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How to get best performance - Vulkan

- Vulkan enforces the use of a staging buffer. Use the following memory properties when calling vkAllocateMemory for your staging buffer.
- CPU-to-GPU - Upload

  VK_MEMORY_PROPERTY_HOST_VISIBLE_BIT |
  VK_MEMORY_PROPERTY_HOST_COHERENT_BIT
- GPU-to-CPU - Download

  VK_MEMORY_PROPERTY_HOST_VISIBLE_BIT |
  VK_MEMORY_PROPERTY_HOST_COHERENT_BIT |
  VK_MEMORY_PROPERTY_HOST_CACHED_BIT

- Then start your transfer using vkCmdCopyBuffer

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Performance results

- System spec
  - Ryzen 5 3600
  - 16GB
  - RX 5700
  - Driver Adrenalin 19.7.2

	1KB	4KB	8KB	16KB	256KB	1MB	4MB	16MB
Read	0.7 GB/s	1.7 GB/s	2.9 GB/s	5.5 GB/s	21 GB/s	27 GB/s	28 GB/s	28.3 GB/s
Write	0.7 GB/s	1.8 GB/s	3 GB/s	3.3 GB/s	20 GB/s	26 GB/s	28 GB/s	28.3 GB/s

*Based on AMD internal testing (19/07/2019) using non-blocking mechanism. Results may vary

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ISV partnership – BlackMagic Design

- BlackMagic Design Resolve was already optimized for PCIe® transfer using OpenCL™
- We get the benefit from PCIe® gen4 for free without modification of the software
- While working on 8K frame we need to do a lot of heavy transfers
- A raw 8K frame at 32bits per channel ~ 500MB
  - @30FPS, we need a stable 15GBS/s
  - @60FPS, we need a stable 30GB/s

- For more info see the BlackMagic pod in our booth

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PCIe® gen 4 scenario

- Video at very high quality and resolution. 8k is already there, 16k is coming in a few years
- Oil and Gas terrain visualization
- Screen captures at high resolution
- Reduce latency for mGPU VR.
- name your use case for data transfer ☺️

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