AMD **Accelerated** Parallel Processing TECHNOLOGY

SAMPLE

BufferBandwidth

1 Overview

1.1 Location

`$(AMDAPPSDKSAMPLESROOT)\samples\opencl\cl\app`

1.2 How to Run

See the *Getting Started* guide for how to build samples. You first must compile the sample.

Use the command line to change to the directory where the executable is located. The pre-compiled sample executable is at `$(AMDAPPSDKSAMPLESROOT)\samples\opencl\bin\x86\` for 32-bit builds, and `$(AMDAPPSDKSAMPLESROOT)\samples\opencl\bin\x86_64\` for 64-bit builds.

Type the following command(s).

`BufferBandwidth`
This runs the program with the default options: `-t 0 -d 0 -nwk 1 -nl 20 -nr 1 -nk 20 -nb 33554432` (32MB) `-nw 7 -s 2 -if 0 -of 1 -cf 5 -cf 2`.

1. `BufferBandwidth -h`
   This prints the help file.

1.3 Command Line Options

Table 1 lists, and briefly describes, the command line options.

Table 1 Command Line Options

Short Form	Description
`-t <n>`	Test type: 0 clEnqueue[Map,Unmap] 1 clEnqueue[Read,Write] 2 clEnqueueCopy 3 clEnqueue[Read,Write], prepinned
`-d <n>`	Number of GPU devices.
`-pcie or -dma`	Measure PCIe/interconnect bandwidth.
`-nwk <n>`	Number of CPU threads (max: 32; for Linux: 1).
`-nl <n>`	Number of timing loops.
`-nr <n>`	Repeat each timing <n> times.
`-nk <n>`	Number of loops in the kernel.
`-nb <n>`	Buffer size in bytes (min: 2048 * CPUthreads).
`-nw <n>`	Number of wave fronts per SIMD (default: 7).
`-l`	Print complete timing log.
`-s <n>`	Skip first <n> timings for average (default: 2).

Short Form	Description
-[if,of,cf] <n>	Input, output, copy flags (ok to use multiple): 0 CL_MEM_READ_ONLY 1 CL_MEM_WRITE_ONLY 2 CL_MEM_READ_WRITE 3 CL_MEM_USE_HOST_PTR 4 CL_MEM_COPY_HOST_PTR 5 CL_MEM_ALLOC_HOST_PTR 6 CL_MEM_USE_PERSISTENT_MEM_AMD
-m	Always map as MAP_READ | MAP_WRITE.
-db	Disable host memory bandwidth baseline.
-h	Print all options and their meanings.

2 Introduction

This sample measures a complete round trip loop of data transfer steps to, and from, an OpenCL device. It also assesses the bandwidth characteristics of a given system, including GPU memory and interconnect (for example: PCIe) bandwidth, achievable in OpenCL.

This sample can run the following tests:

- Create a simple baseline for host memory read and write performance. This can be used to ensure sanity of device buffer access performance numbers created by the other tests.
- Benchmark a round-trip chain of synchronous, serialized transfer steps between the host and the device.
- The sample can create a log over many iterations to locate one-time effects or variations over time.

The following transfer paths can be tested via command line option:

clEnqueueMap/UnmapBuffer
clEnqueueRead/WriteBuffer
clEnqueueCopyBuffer
clEnqueueRead/WriteBuffer, prepinned

This sample allows selection of any of the various CL buffer creation attributes for the source and destination buffers of the transfer chain.

3 Implementation Details

The bandwidth reported by -pcie or -dma is obtained by measuring the clEnqueueRead/Write performance on a prepinned buffer. This typically corresponds to the maximum interconnect rate achievable at application level for the explicit copy path (usually by DMA engine).

Details on the various buffer types and recommended transfer paths are provided in Chapter 4 of the *AMD APP OpenCL Programming Guide*.

All transfer steps are executed synchronously to ensure accurate bandwidth measurement. The application code should not follow this model, but submit as many commands to a CL queue as possible before forcing the queue to drain.

The `-l` option can be used to identify some of the one-time costs that exist for a given transfer chain. For instance, during the first one or two iterations, the GPU and CPU achieve maximum clock rates. Also, buffers are allocated and transported to their final location. These costs show up as increased execution times for the first few OpenCL calls.

4 Notes and Caveats

- Do not run graphics applications while benchmarking compute or transfer operations.
- The read and write GPU kernels are written for clarity, and should achieve around 85% of HW peak with the right number of threads.
- The data verification used is basic.
- The smallest supported buffer size in this sample is 2048 bytes, corresponding to a single work-group of 128 work-items. Buffer sizes supplied by `-nb` are adjusted to a multiple of a block size that is know to perform well across all measurement stages.

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