

Blurring the Boundary between CPU and GPU

Optional subheading

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SAME VIRTUAL ADDRESS EVERYWHERE

Same virtual address on GPU and CPU aka CL fine grain:

- Use memory from C malloc() or C++ new operator
- Access mapped file directly from GPU
- Migrate, range of virtual address, to GPU memory

In short, you can access any of existing data structure (tree, list, ...) from the GPU transparently with no changes on how you allocate those structures.

HOW TO USE

Allocate your objects:

```
struct mystruct *foo = malloc(sizeof(*foo) * nelems);
```

Migrate your object memory to GPU memory:

```
ptrs[0] = &foo[0]; sizes[0] = sizeof(*foo)*nelems; ...  
clEnqueueSVMmigrateMem(queue, 1, ptrs, sizes, ...);
```

Pass object pointer as a kernel argument:

```
clSetKernelArgSVMPointer(kernel, 0, foo);
```

HOW IT WORKS

All done in the linux kernel and kernel device driver.

Works with any compiler (without any changes to the compiler).

BEHIND THE SCENE

On PCIE address back by GPU memory look like swap

GPU support page fault like CPU

GPU can access any main memory

Mirror CPU page table into GPU page table

OpenCL inside Mesa 3D

SOME DEFINITIONS

Gallium3D is a driver framework to ease developing rendering and media APIs (OpenGL, VDPAU, OpenCL, ...)

NIR is an driver IR inside Mesa to ease developing backend compilers by sharing common optimization and lowering passes, supported by most drivers inside Mesa

GOAL

Main Goal: make it easy to write an OpenCL driver

We have Open Source OpenGL(ES) drivers for most hardware inside Mesa supporting Compute Shaders

Based on this work, adding support for OpenCL should be trivial

EXISTING COMPONENTS

- Gallium3D
- clover: OpenCL Frontend of Gallium3D
- clang: OpenCL C(++) Frontend
- SPIRV-LLVM-Translator: LLVM to SPIR-V converter
- vtn: SPIR-V to NIR converter (for Vk/GL4.6)
- libclc: OpenCL C builtin library written in OpenCL C
- existing OpenGL driver wth compute shader support

CONCLUSION

Most parts already there, little work left for a fully working OpenCL driver

TAKEAWAYS

Patches submitted for initial support, including support for the Nouveau driver (Open-Source driver for Nvidia GPUs)

First working OpenCL kernel running on freedreno after one day of work by reusing existing infrastructure based on this work

SyCL can be used on top of clover as well