Towards Open Source 3D Acceleration For Nvidia Cards

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Introduction

- Dependence on proprietary drivers
  - Future window systems will be layered upon OpenGL
  - 3D applications
  - 3D heavily used in games
- Proprietary Nvidia drivers
  - No luck on non-x86 hardware
  - Inability to fix bugs
  - Long time support ?

Nvidia : the hardware

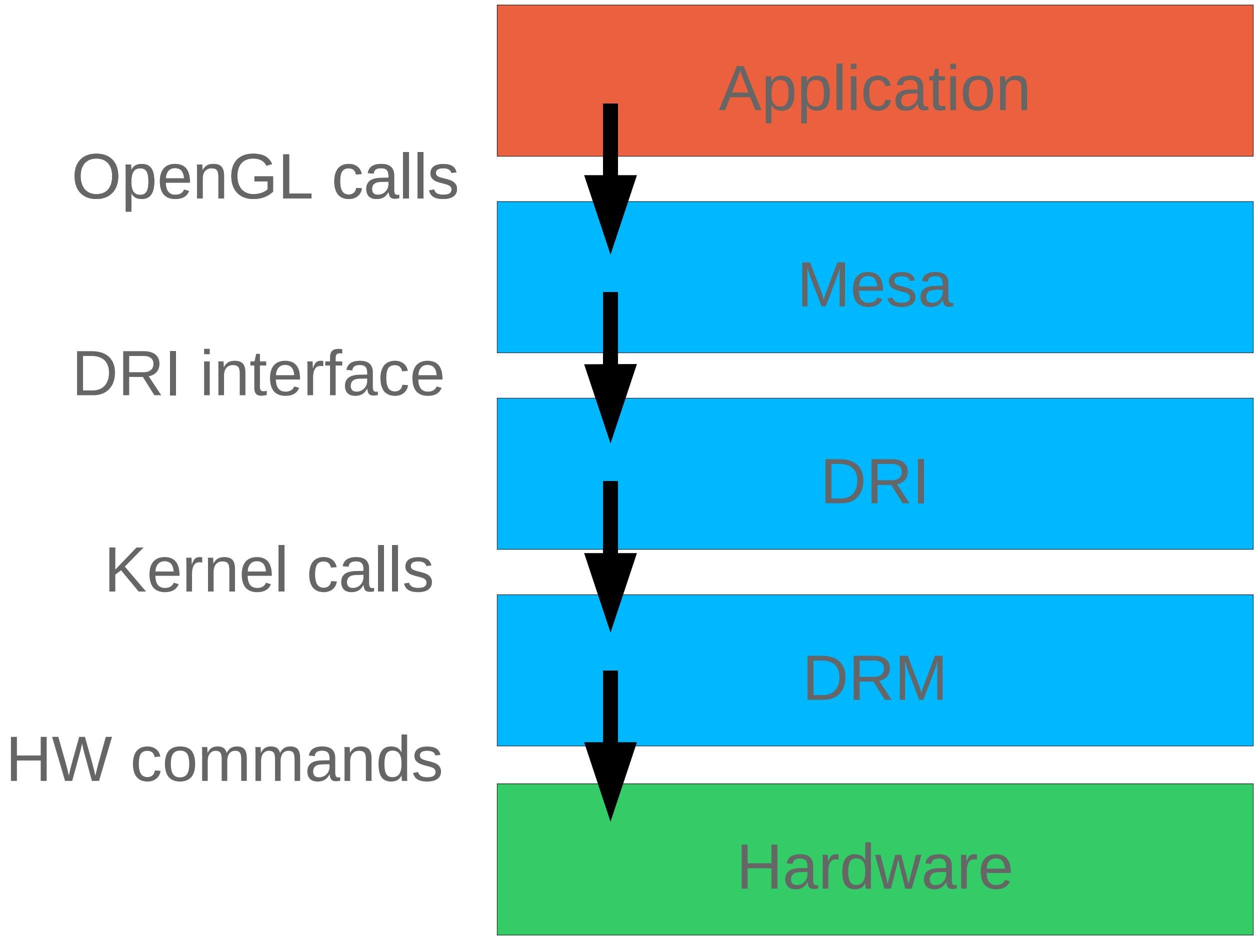
- GeForce 6x00 (NV40)
  - Multiple hardware contexts (since NV3 !)
    - In the form of multiple command fifos
    - At least 8 contexts
  - OpenGL 2.0 hardware
    - Powerful
    - Complex
  - No documentation available
    - Source code used to be available (up to NV5)
    - The “nv” DDX (all cards)
    - The Utah GLX driver (up to NV18)
    - The BeOS 3D driver (up to NV18)

The DRI/DRM model

- DRM module protects access to the card
  - In-kernel
  - Low footprint
  - Has to check each command for security
    - Can be costly
    - State tracking to avoid useless calls
    - Complex implementation
- DRI module makes most of the work
  - User space
  - Plugs into Mesa
  - Builds command packets
  - Makes kernel calls to submit commands to the DRM

The DRI/DRM model

- DRM-managed command submission

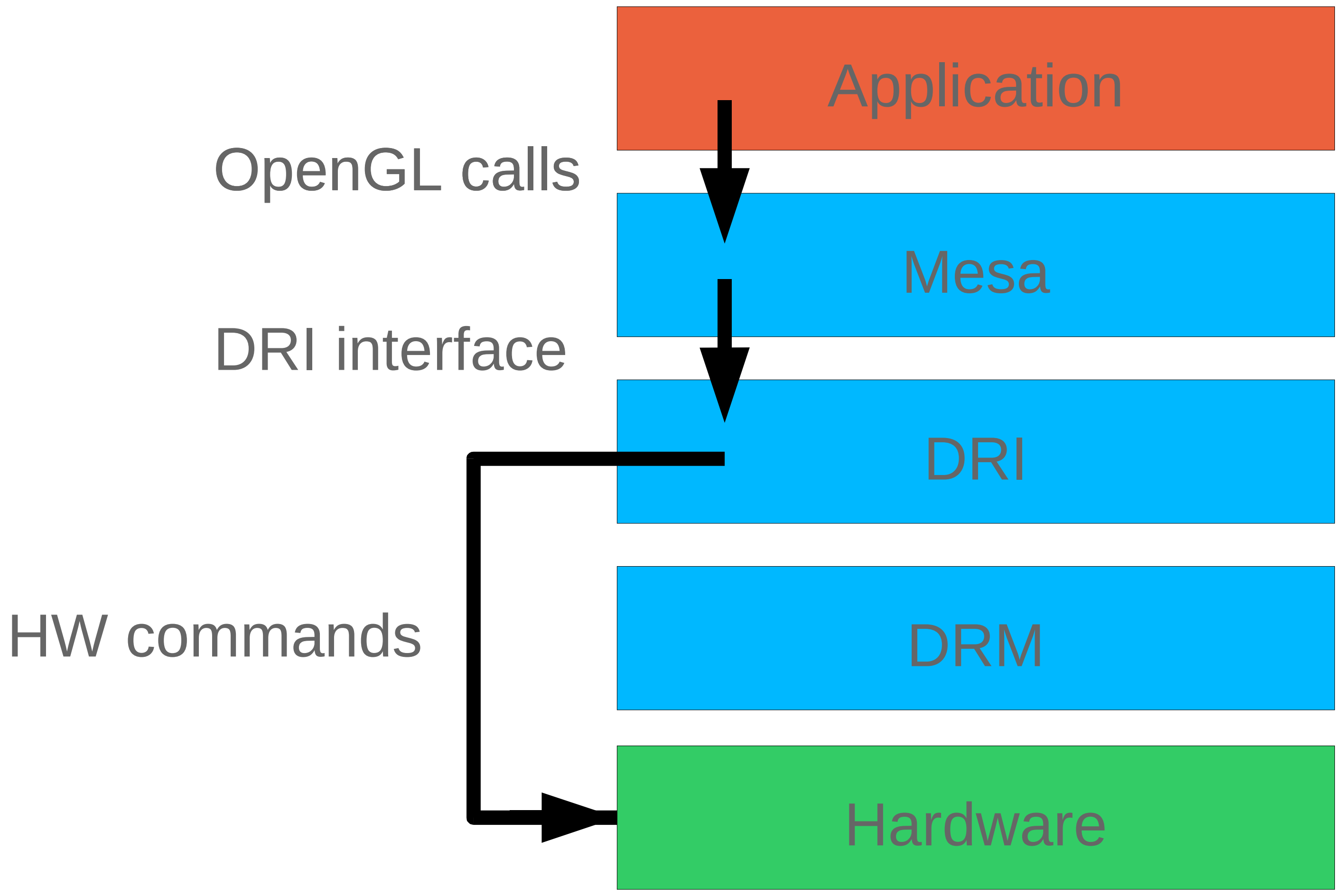


Relaxing the DRI/DRM model

- Nvidia hardware has multiple fifos
  - DRM maps one fifo per client (RW)
  - DRI client then has exclusive use of its fifo
    - Can fill it as it likes
    - Full OpenGL primitive submission in user-space
    - No need for context switches
    - No need for (some of the) mutex locks
    - Of course, other things still need to be checked (DMA accesses)
    - DRM update not always needed for new functionality

Relaxing the DRI/DRM model

- Full user-space command submission



DRM at work

- The DRM initalizes and setups the registers
- Initialize the multiple rendering contexts
- Setups a fifo when requested by a DRI client and maps the fifo to the client
- That's about it (lazy guy)

DRI at work

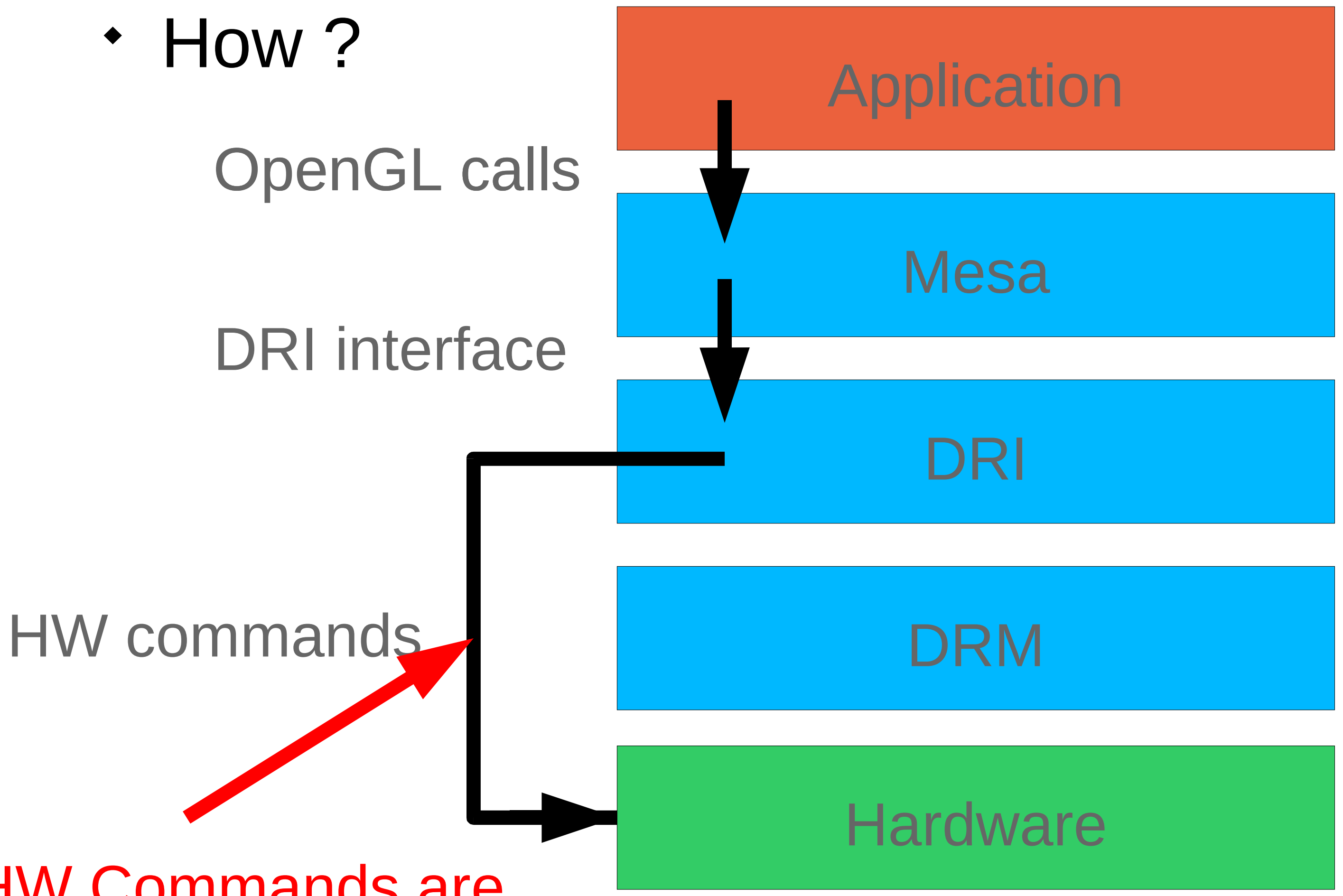
- The DRI initializes, maps the fifo from the DRM
- Primitive submission can then work without the DRM's help
- Full fifo control happens in user space
  - No complicated code for context switching and tracking
  - No need for a kernel call
- Emitting primitives
  - DRI emits primitives to the fifo
  - DRI flushes the fifo

DDX at work

- Functionality needs to be added to the DDX
    - Back/depth buffers
    - Swapbuffers
    - Cliprects
    - ...
- On top of the EXA patch
- DDX is hardcoded to use context 0
    - Always reserve this context

Reverse engineering

- Need to figure out functionality for NV20 and later cards
  - How ?



HW Commands are here !

Reverse engineering

- Solution
  - Create an OpenGL process
  - Find the fifo among the mappings
  - Dump the fifo & registers contents
  - Do something with the graphics pipeline
    - glClear()
    - glVertex()
    - ...
  - Compare the fifo & registers with the previous state
  - Deduce functionality

Reverse engineering applied

- Working with vertices
  - Vertex submission
    - Send 1 vertex
    - Send 2 vertices
    - ...
    - Send X vertices
    - Compare the results
    - Deduce how to submit vertices
  - Vertex description
    - Send color vertices
    - Send color+lighting vertices
    - Send textured vertices
    - ...
    - Compare

Show me the code !

- (Not yet working) code : http://nouveau.sf.net
- Assumes NV40

Conclusions

- Lots of work left
  - Adapt the DRM to do client-exclusive mappings
  - Contexts >0 need initialization code
  - Add back/depth buffers
    - Needs a memory manager
  - Textures (needs some DMA support)
    - Textures compete with pixmaps for video ram
    - Once again, memory manager
  - NV40 is being looked at
    - Explore other chips
    - Keep a unified driver
  - Reverse engineering works
    - But not all HW information can be found that way

Thanks !