Graphics Pipeline Study With MESA On Ubuntu

* Team members:

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* Hardware requirement:

Graphic card installed that supports 3D acceleration, graphics driver supports DX11 (Windows) or OpenGL 4.0 (Linux, Mac)

* Introduction:

Inspired by: <https://fgiesen.wordpress.com/2011/07/01/a-trip-through-the-graphics-pipeline-2011-part-1/>, we would work on inspecting graphics chain on operating system, from high-level graphics application, down to the graphical driver in the operating system kernel. Mesa + Linux (<https://en.wikipedia.org/wiki/Free_and_open-source_graphics_device_driver>) gives feasibility for it. While through studying the code in different levels of graphics chain, we could log the graphics system calls (OpenGL API, EGL API…), analyze the calls, profile for OpenGL calls, and customize the components in chain to yield a graphical output from different levels.

* Approach

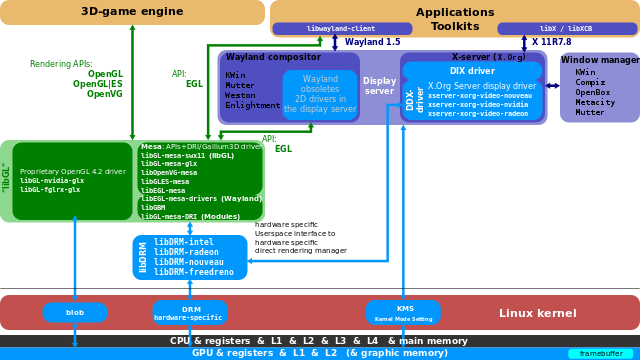


Figure1: The graphics stack on Linux

The inspection would be along the following paths:

* + OpenGL Application->libGL + MESA driver->libDRAM
  + EGL application(2D GUI)-> libGL + MESA driver->libDRAM
  + (Optional) 3D-game engine-> libGL + MESA driver->libDRAM

One challenge is that a significant portion of extra work results from supporting heterogeneous environments: if an OpenGL application is ported from windows to Ubuntu Linux running on VMware, or to Ubuntu Linux running on a bare metal, the differences between the Mesa drivers increases the likelihood of bugs, requiring more caution overall. We plan to tackle this through small but rapid incremental steps which would allow us to consistently make progress without introducing errors. Additionally, the build environment for this would be complex, and would require some effort to setup.

* Experiment

The original Mesa driver will be modified in order to generate trace log information for the usage of OpenGL and EGL from graphical application, and yields graphical output, for example to add a water mark on the display for every graphical application that uses Mesa driver, to profile hardware, and graphical driver information, to compare performance of mesa driver + Ubuntu with performance of other platforms.

* Milestones
  + Port OpenGL demo code from Windows to Ubuntu (VMware version)
  + Upgrade Ubuntu (VMware guest) graphics driver with latest Mesa solution
  + Add FPS(frame per second) report
  + Add logging functionality to OpenGL APIs
  + Initiate EGL demo code
  + Add logging functionality to EGL APIs
  + Set up Ubuntu environment on a bare metal with latest Mesa solution
  + Log function calls to libDRM (hardware specific interface in user space)