idc15

Imagination Developers Connection

Great Looking Graphics on modern PowerVR GPUs

Rys Sommefeldt

Introduction

Who am I

Optional secondary message

- **Engineering Manager for Business Development, PowerVR Graphics**

- **Run two engineering teams:**
  - Competitive and Performance Analysis
  - Demo Engineering

- **Might sound disconnected but there's a lot of inherent overlap**

- **Also the guy behind Beyond3D for the last 8 or so years**

What do I do

- **Competitive and Performance Analysis**
  - Figure out everyone's architectural and software strengths and weaknesses
  - Including our own stuff
  - Feed that into research, architecture, hardware, software, sales, marketing
  - Crucially, also feed it into the demo team!

What do I do

- **Demo Engineering**
  - 1 artist, 4 engineers (and growing, if you're looking for a job!)
  - Used to just be API-focused demos: New API feature? New demo
    - Small demos, single engineer, no dedicated artist = boring and low overall quality
  - Now art-driven, with whole team working on some productions
  - Focused on showing off the core benefits of our technology and our customers' implementations, rather than API features

PowerVR vs the graphics API

- **Traditional graphics APIs don't really map well to modern GPUs**
- **Counter intuitive since they're clearly capable of driving GPUs well**
- **Lots of hardware ability, efficiency and features left behind the API curtain**
- **Especially poor map to modern tile-based architectures**
- **Constant push-pull between API, driver and how the hardware works**
- **Bleeds little bits of performance, expression and efficiency away at each step**
- **Recent API churn is most welcome!**
  - Difficult for you guys to adapt at first, but…
  - Tilers are now first-class citizens (and tilers are everywhere in mobile remember)
  - Hardware semantics now better expressed by the new APIs

Brief recap of TBDR

- **Overview during keynote earlier**

- **Needed again?**

- **Show of hands!**

Brief recap of Rogue

- **Overview during keynote earlier**
- **Needed again?**
- **Show of hands!**

Mobile GPU performance levels

- **Over 100 GFLOPS of FP32 programmable compute in some phones**
- **Over 250 GFLOPS of FP32 programmable compute in some tablets**
- **More if you count our FP16 rate (1.5-2x more perf depending on the IP core)**
  - High-rate FP16 very common now:
    - GCN, BDW, Tegra X1, Mali, Adreno
  - mediump is your best friend
- **Rogue matches compute with achievable high basic fillrate and texturing**
- **The basics of high efficient performance done right**
  - Predictable compute (scalar SIMD with few hidden performance cliffs)
  - Predictable texture performance
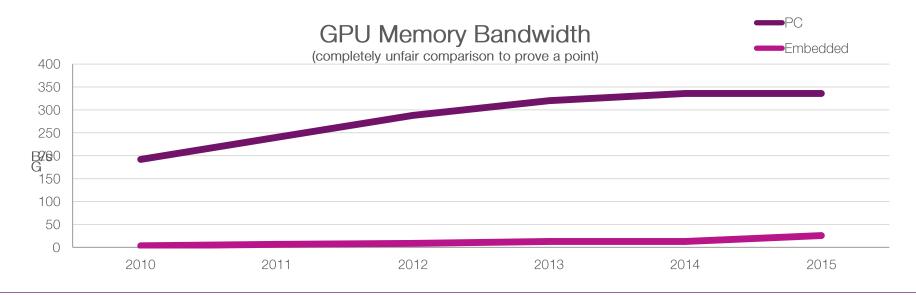 - Predictable pixel export performance

Bandwidth

- **The one thing that hasn't really scaled with everything else**
- **12-24GB/sec available in high-end devices today**
- **Will take the embedded low-end a long time to catch up**

GPU Memory Bandwidth
(completely unfair comparison to prove a point)

Legend: PC, Embedded

Y-axis (GB/s): 0, 50, 100, 150, 200, 250, 300, 350, 400

X-axis: 2010, 2011, 2012, 2013, 2014, 2015

Imagination

Performance summary

- **At the high-end at least, adding it all up:**
  - ~250 GFLOPS FP32
  - ~24GB/sec bandwidth
  - ~8 Gpixels/sec
  - ~8 G/texels/sec
- **Sounds familiar, right?**
- **And even more programmable in many cases**

The future

- **Will take a few years for the low-end smartphone to catch up to that level**
- **Still, high-end today is still *huge* volume**
  - Every 2-3 weeks the industry ships more 100+ GFLOPS devices than Sony have sold PS4s since launch
- **Worth targeting now**

What can you do with it?

- **100s of instructions per pixel**
- **10s of samples per pixel**
- **Matching fillrate**
- **So, things like:**
  - Physically based shading with correct materials
  - Complex deferred shading
  - 4K textures with aniso
  - HDR
  - Lots of post-processing
  - Big triangle budgets

PowerVR Library

- **Boring name. Deal with it.**
- **Goal was to show off high-end texture detail, plus texture compression**
  - While still fitting on 1GB memory devices
- **As many unique texture samples as my artist and engineering could provide: 20 2Kx2K texture maps**
- **Also threw in:**
  - Physically based shading with HDR
  - 4xMSAA
  - 16xAF
  - Correct specular reflections
  - 250K+ triangles
  - Post processing: saturation, dynamic exposure and HDR tone mapping

Bonus surprise!

- **That demo was rendered using Vulkan**
- **New Khronos graphics API**
  - Ground up redesign
  - Graphics and compute both as first class citizens
  - Explicit, direct and predictable command submission to the GPU
  - Closer to the architecture of modern GPUs
    - TBDR is modelled well!
    - Explicit load-store
    - Explicit pass control
    - Programmable blending
    - Explicit memory management

Vulkan Library

- **1 demo engineer**
- **2 months on and off**
- **Worked closely with our driver team on the proof-of-concept Vulkan driver**
- **Ported at the same time the API was being designed by Khronos**
  - Originally an OpenGL ES 3.0 demo

Vulkan

- **Please visit Khronos on Thursday to get a deep dive and great first exposure to the new API**

- **https://www.khronos.org/news/events/gdc-2015**

- **We'll release the Vulkan code for the demo in the near future**

Bonus surprise 2!

- **Preview of our latest demo**
  - Deferred shading
    - 128-bit physically-based GBuffer
  - Dynamic lights
  - Multiple specular probes treated as lights
  - Soft particles
  - PLS
  - Lens flare
  - Colour correction

Complete a survey to enter our prize draw

Winners will be announced on the March 3rd, booth #1142.

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