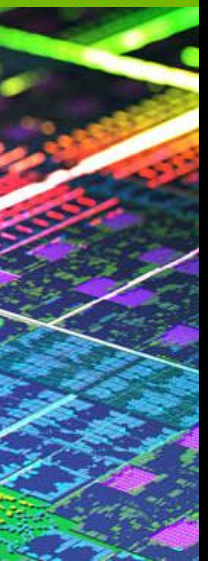
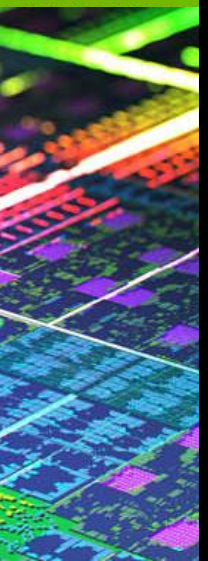
Optimizing Tegra Apps and Games using Unity

Paul “Hodge” Hodgson (Manager, Tegra Developer Technologies)



What's to come?

- Generic issues with Unity based solutions.
- Can be applied to other engines.
- Based on analysis of many Tegra applications.

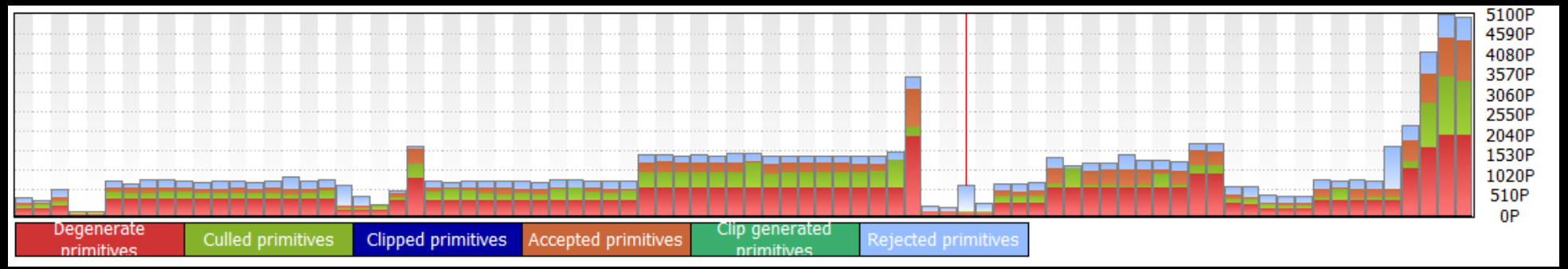


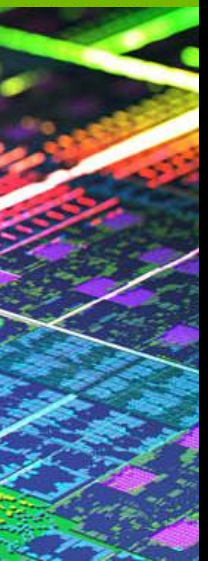
Know how you have spent your budget

- Use available tools both within and external to Unity
- Many possible bottlenecks
  - Vertex
  - Primitive
  - Fragment
  - Bandwidth
  - CPU
- Be aware of cumulative effects
- Spend your optimization budget wisely also

Use optimized triangle lists

- Effectively zero contribution
- Reduces three potential bottlenecks
  - Vertex transform and vertex cache re-use
  - Primitive count
  - Attribute bandwidth
- Important for multi-pass techniques





Use optimized triangle lists

- For imported meshes
  - Player settings->Optimise mesh data
  - Import new asset->Inspector->Optimise mesh
- For dynamic meshes
  - Mesh.SetTriangles(triangles, submesh)
  - Mesh.Optimize()

Only clear what/when you need to

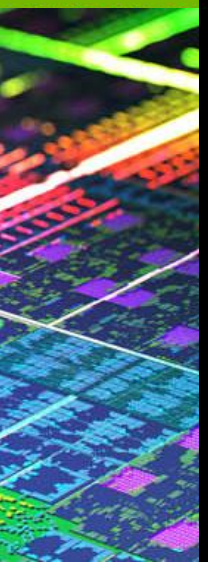
- Zero contribution is common case with HUD/overlays
- Saves bandwidth from clear
- Saves bandwidth from content by removing
  - Depth test
  - Depth write

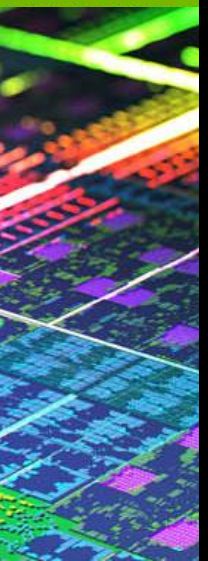
Fragment Operation Functions	
# glClear Calls	2

Only clear what/when you need to

- For each camera
  - Camera->Inspector->Clear flags
- For each subshader

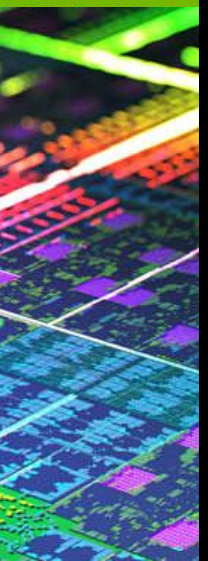
```
Shader “DepthIgnore Example" {
        SubShader {
                Pass {
                        ZWrite off
                        ZTest Always
                        // Rest of shader
                }
        }
}
```





Use appropriate texture settings

- Near zero contribution depending on assets
- DXT
  - Compressed RGBA
  - GA compress normal maps
    - **UnpackNormal (tex2D (_BumpMap, IN.uv_BumpMap))**
- Mipmap
- Anisotropy
- Filter mode

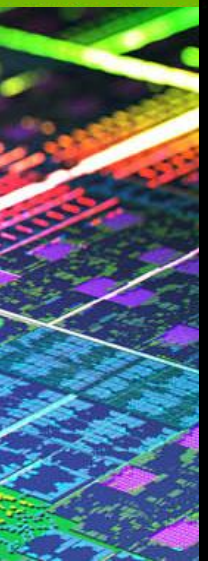


Use appropriate texture settings

- Select texture->Inspector
  - Filter mode
  - Format
  - Aniso level
- File->Build settings->Android->Texture compression

Match shader cost to results

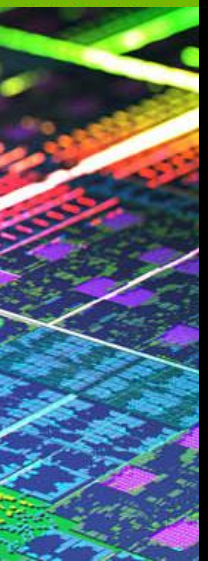
- Avoid uber-shaders
- Use GLSL ‘lowp’ precision where possible
  - Cg type ‘fixed’
- Move constant or near constant results to vertex shader



```
Fragment Shader Performance info:
    ALU/Tex Ratio = 32/9 = 3.555556
    Cycles = 35
```

Render order optimizations

- Zero contribution
- Divide geometry appropriately
- Render largest occluders first
- Ensure skybox is rendered after all other opaque objects



```
Shader “LargestOccluder Example" {
        SubShader {
                Tags {"Queue" = " Geometry-1 " }
                Pass {
                        // Rest of shader
                }
        }
}
```

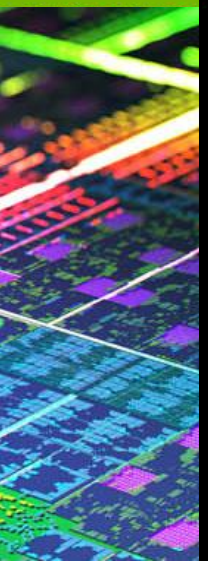
Render order optimizations

- Consider depth pre-pass
  - Normally at (shadeCost*fragments)
  - Opaque at (0.5*fragments)+(shadeCost*visibleFragments)
  - Discards at (minDiscard*fragments)+(shadeCost*visibleFragments)

```
Fragment Shader Performance info:
    ALU/Tex Ratio = 32/9 = 3.555556
    Cycles = 35
```

Render order optimizations

```
Shader “DepthPrepass Example" {
        SubShader {
                // Pass to render to the depth buffer only
                Pass {
                        ColorMask 0
                        // Rest of pre-pass shader
                }
                // Pass to shade only the finally visible opaque fragments
                Pass {
                        ZWrite off
                        ZTest Equal
                        // Rest of shader
                }
        }
}
```



Questions?

- Paul “Hodge” Hodgson

- NVIDIA Developer Zone
  - http://developer.nvidia.com/develop4tegra

- Next up in this room:
  - Stephen Jones with “Performance and Debugging Tools for High-performance Android Applications”