



Direct3D Multithreading

Phil Rogers

Senior Software Architect

ATI Research Inc

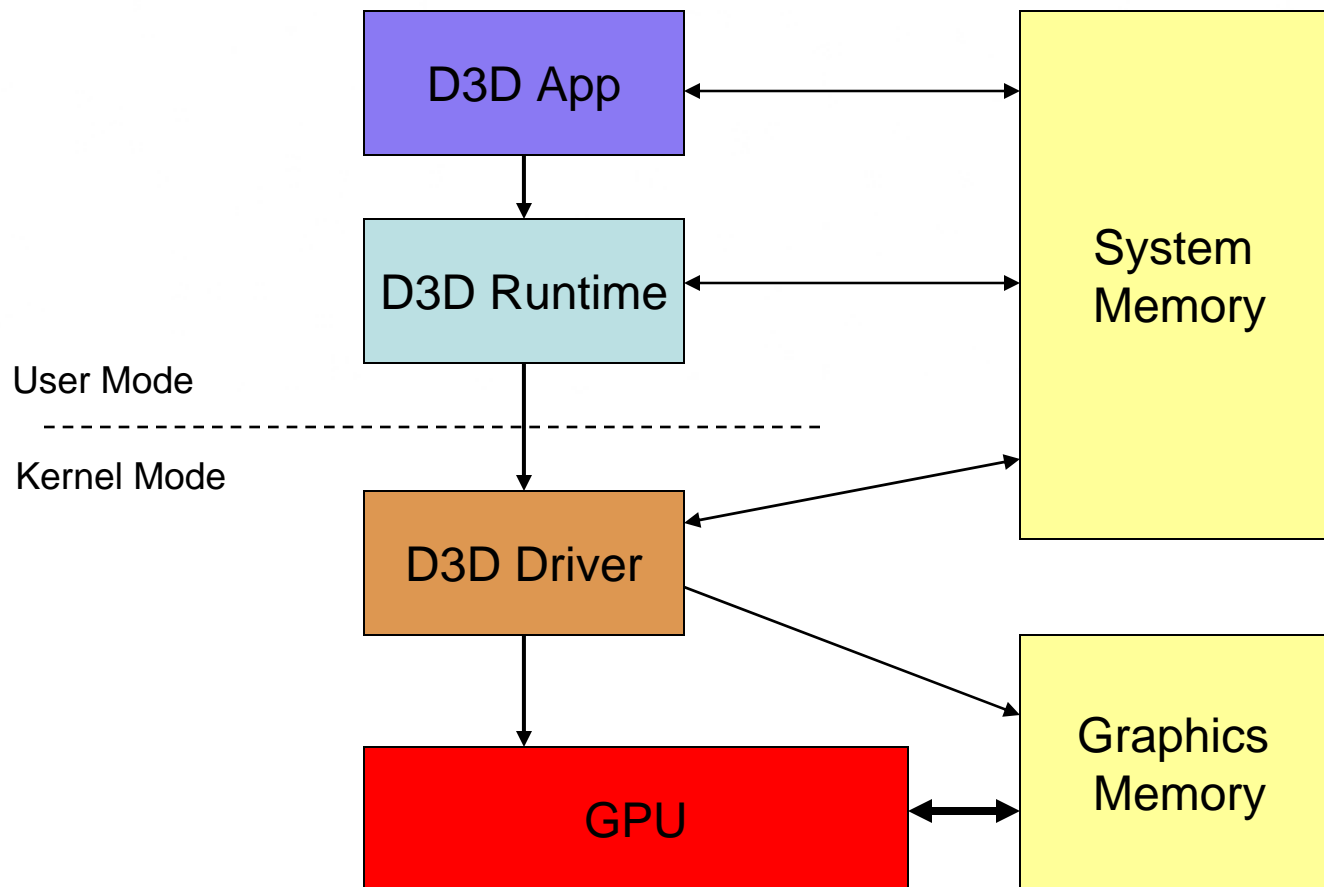


Overview

- Review D3D Application driver stack to hardware
- Where threading makes the most sense
- ATI's D3D Driver multithreading
- Playing nice with the driver stack

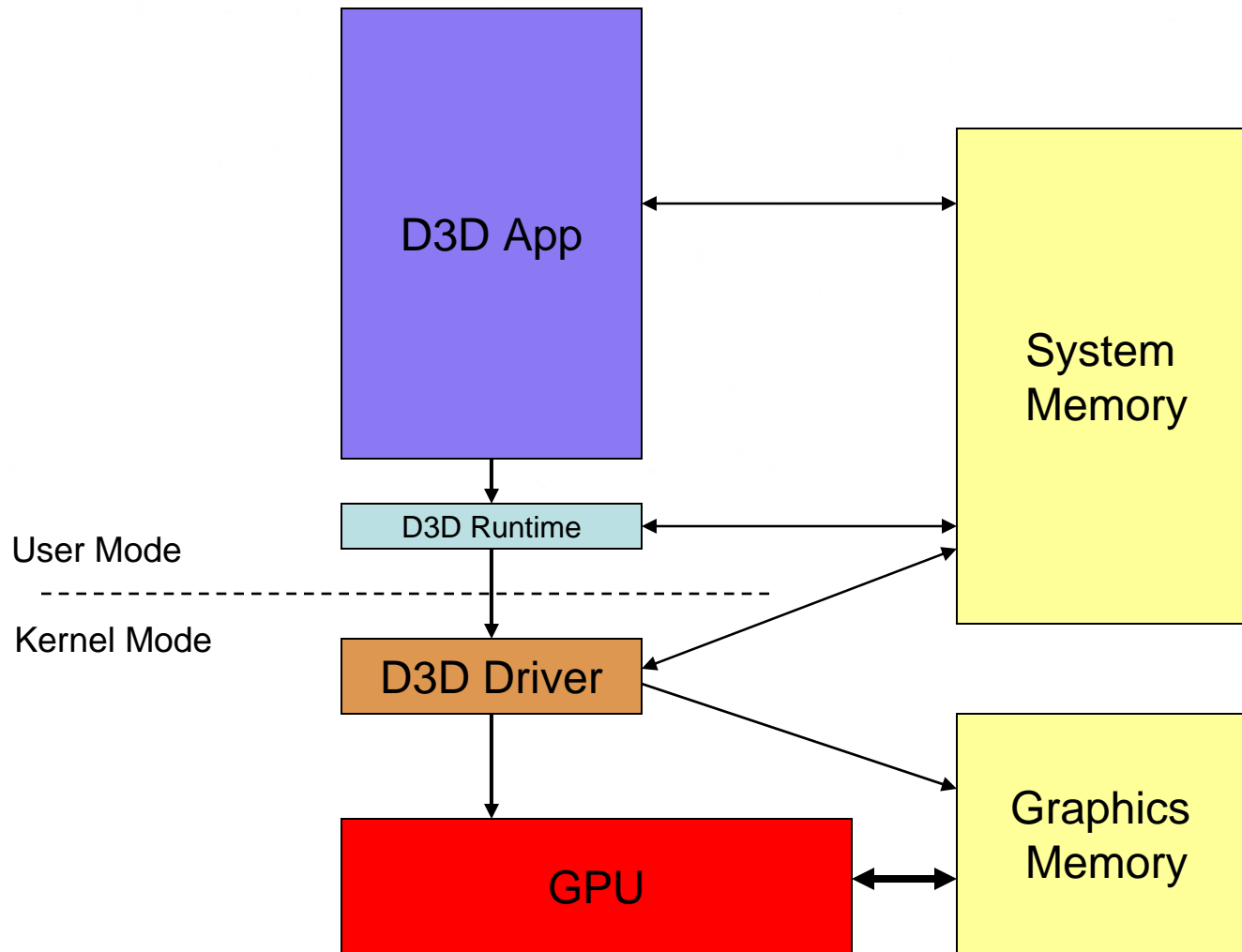


The (Simplified) Direct3D Stack





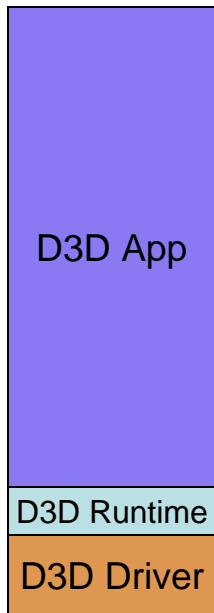
SW Components Sized by CPU Time



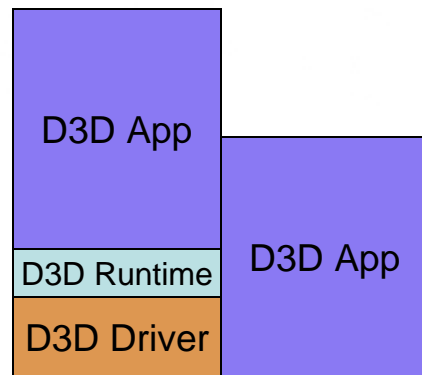


Impact of Threading on CPU Time

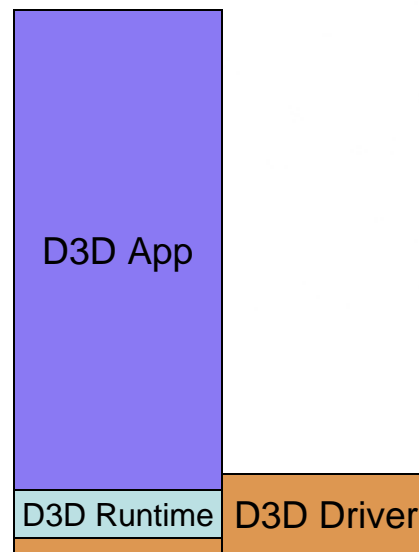
No Threading



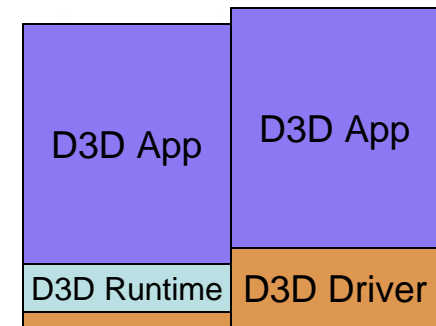
Game Threading



Driver Threading



Game+Driver Threading



- Biggest gain is from threading the application
 - Only the application has domain specific knowledge
- Driver threading helps too
- If we both do it right ... even better!

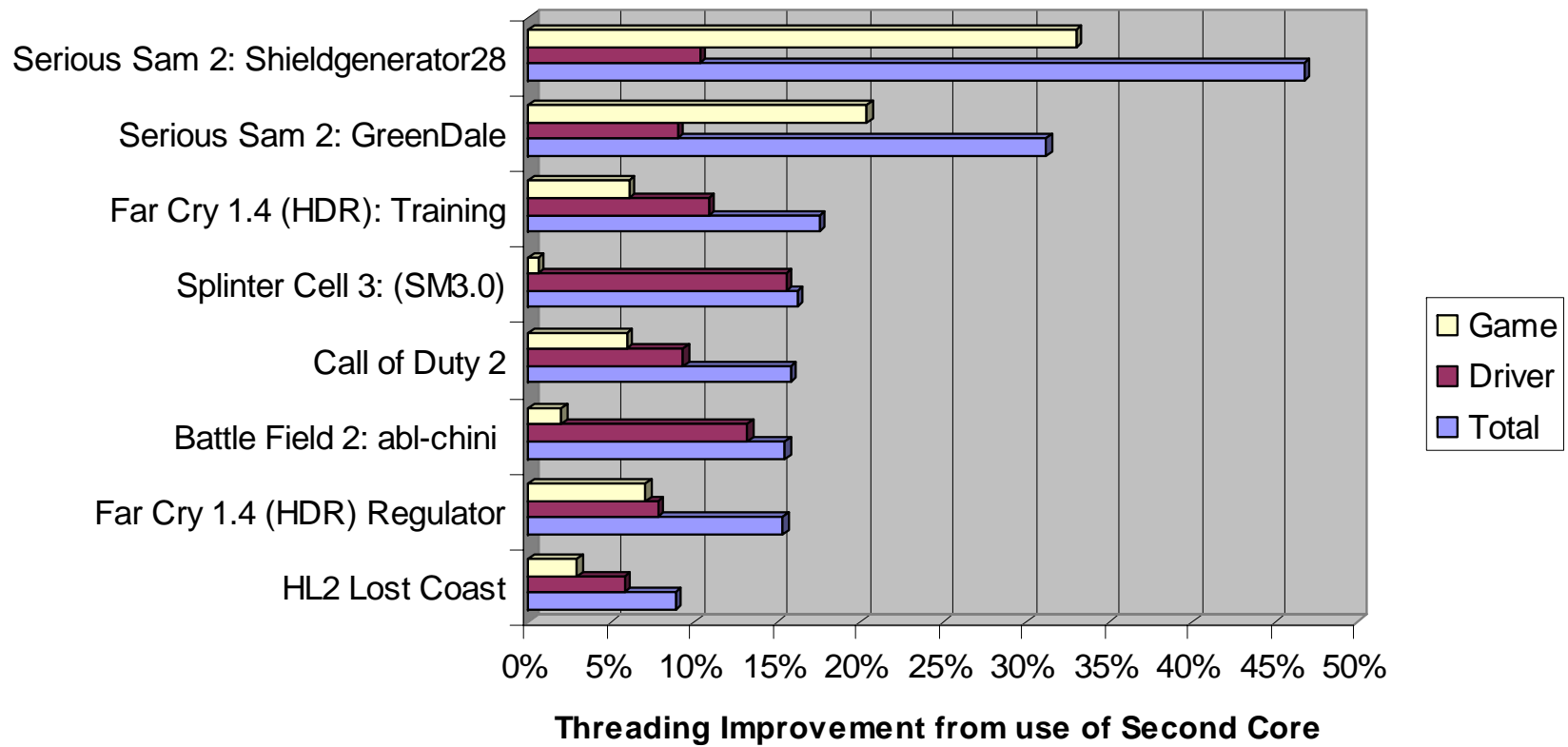


D3D Driver Multithreading

- We run most of the D3D driver work in a single worker thread
 - Allows driver to run in parallel with the application
 - Low overhead in most cases to start and sync the worker thread
- Driver does not set thread affinity
 - Allow the OS to balance threads across cores (it does a good job!)
 - Minimize possibility of interference with application
- Driver may well add additional optimizations in the future
 - Look to improve overall system performance
 - Do no harm!



Threading Performance Gains





How to play nice with MT drivers

- Minimize use of System Memory Vertex Buffers
 - Never use `DrawPrimitiveUP` or `DrawIndexedPrimitiveUP`
 - Avoid placing Vertex Buffers in `D3DPOOL_SYSTEMMEM`
 - Minimize use of `D3DUSAGE_DYNAMIC`
 - Create `D3DUSAGE_DYNAMIC` VBs with `D3DUSAGE_WRITEONLY`
 - Lock with `D3DLOCK_DISCARD` or `D3DLOCK_NOOVERWRITE`
- Group all resource updates (Texture and Vertex) together once per frame
 - Beginning or end is fine, just don't scatter them among drawing calls
- Avoid sparse usage of System Memory Vertex Buffers
 - Causes wasteful copies
- Do not use `d3d state blocks`
 - Never a good idea anyway ☺
- Avoid query deletions during drawing
- Eliminate all spin loops
 - Sometimes we see these in "frame ahead" limiters or waiting on queries