

# Apple OpenGL and Quartz Extreme



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### Apple OpenGL Update

- Mac OS X "Jaguar" Release
- Quartz Extreme
- Demo
- Jaguar Open GL



#### Mac OS X "Jaguar"

- Mac OS X version 10.2
- Available August 24th
- Announced last week at MacWorld NY
- 3rd major update to Mac OS X in 18 months
- Lots of new graphics features



Aqua

Frameworks

Graphics

Darwin



# Frameworks Quartz OpenGL QuickTime Darwin



Quartz OpenGL QuickTime

Quartz Compositor



Window System as a Digital Image Compositor



#### Compositing Digital Images

Thomas Porter Tom Duff !

Computer Graphics Project Lucasfilm Ltd.

#### ABSTRACT

Most computer graphics pictures have been computed all once, so that the rendering program takes care of all computations relating to the overlap of objects. There are several applications, however, where elements must be rendered separately, relying an compositing techniques for the anti-alicaed accumulation of the full image. This paper presents the case for four-channel pictures, demonstrating that a matte component can be computed similarly to the color channels. The paper discusses guidelines for the peneration of elements and the arithmetic for their arbitrary compositing.

CR Categories and Subject Descriptors: 13.3 [Computer Graphles]: Picture/Image Generations — Display algorithms; 13.4 [Computer Graphles]: Graphics Utilities — Software support; 14.1 [Image Processing]: Digitization — Sampling.

General Terms: Algorithms

Additional Key Words and Phrases: compositing, matte channel, matte algebra, visible surface algorithms, graphics systems

#### I. Introduction

Increasingly, we find that a complex three dimeas acene cannot be fully rendered by a single program, wealth of literature on rendering polygons and cu surfaces, handling the special cases of fractals and spl and quadrics and triangles, implementing refinement texture mapping and bump mapping, noting speed-up the basis of coherence or depth complexity in the se suggests that multiple programs are necessary.

In factal reliance on a single program for rendering entire scene is a poor strategy for minimizing the cost small modeling errors. Experience has taught us to be down large bodies of source code into separate modules order to save compilation time. An error in one rout forces only the recompilation of its module and the retiredy quick reloading of the entire program. Similar small errors in coloration or design in one object show not force the "recompilation" of an entire image.

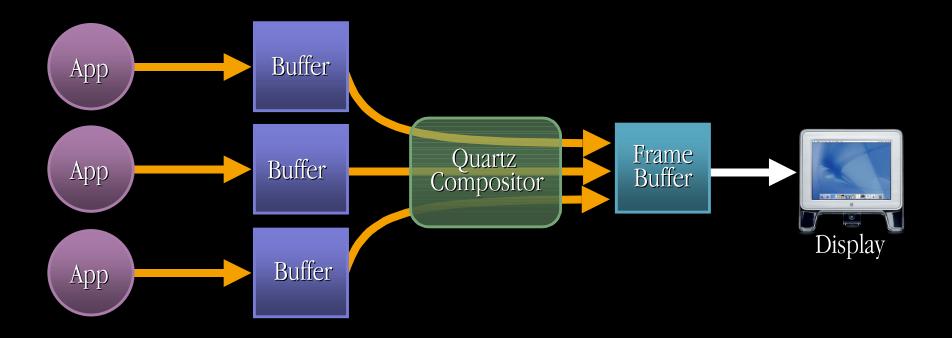
Separating the image into elements which can be independently rendered saves enormous time. Each element has an associated matte, coverage information which designates the

#### Quartz Compositor

- Double buffered windows
- Per-pixel alpha channel
- Per-window fade control
- Per-window transform and warp
- Integrates 2D, 3D, and Video

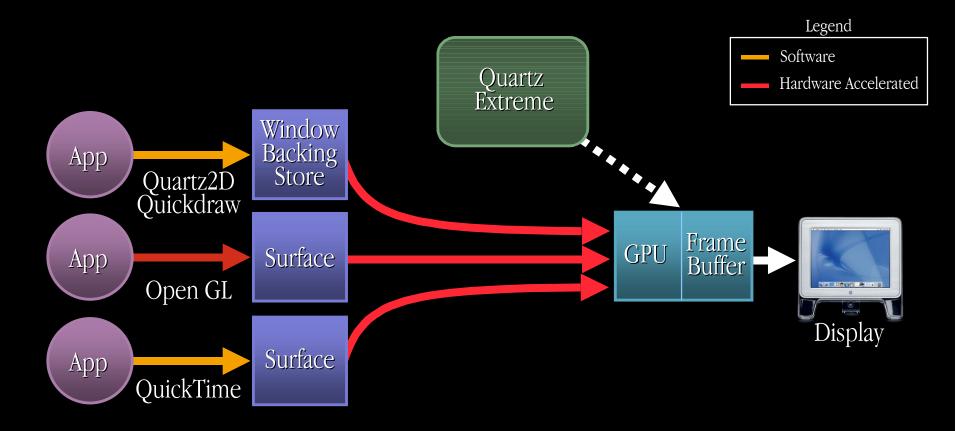


#### Quartz Compositor





#### Quartz Extreme



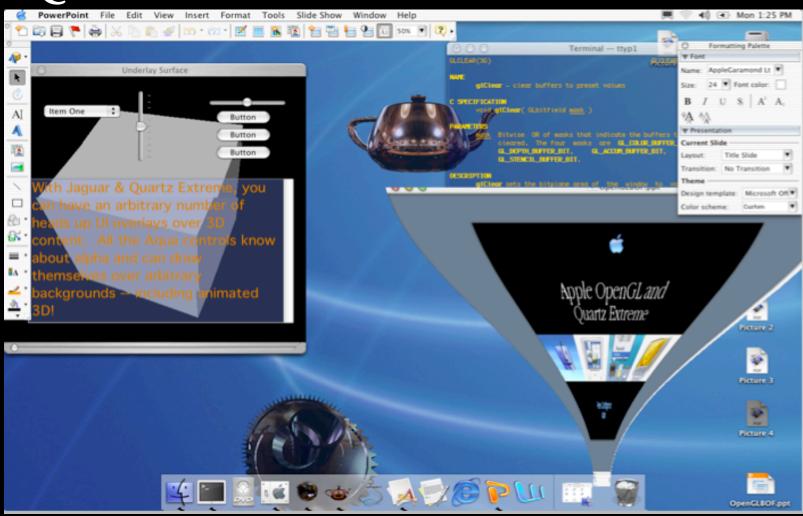




## DEMO: Quartz Extreme



#### Quartz Extreme Screenshot





## Just another OpenGL application

- Quartz Extreme uses OpenGL like any other application
- The desktop is a 3D scene
- Everything is a textured polygon
- Compositing via blending and multitexture



#### GPU Requirements

- 16MB of video memory required (32 recommended)
- AGP 2X required (4x recommended)
- Direct support for Quartz data formats via DMA
   –ARGB8888, ARGB1555, A8, 2vuy, yuvs
- Non-power of two textures
- Multitexture



#### Mac OS X OpenGL

- State of the art architecture
  - Resource virtualization
    - Textures, surfaces, gpu contexts
  - Data flow optimizations
- Apple co-develops drivers
  - Work closely with vendors
  - Maintain consistence across product line
  - Consistent and stable drivers



#### New in Jaguar OpenGL

- System Integration
- Texture upload performance
- Programmable Shaders
- Lots of extensions
- Amazing new Tools



#### System Integration

- Quartz2D on a texture
  - High quality 2D antialiased content on ARGB texutures
- Video on a texture
  - Non power of 2 textures
  - -YUV texture formats
- Window Compositor integration
  - Arbitrary number of alpha blended overlays
  - "Heads up" UI for 3d apps



#### Texture Upload Performance

- Direct DMA from native texture formats
- No per pixel CPU involvment
- Flexible synchronization model

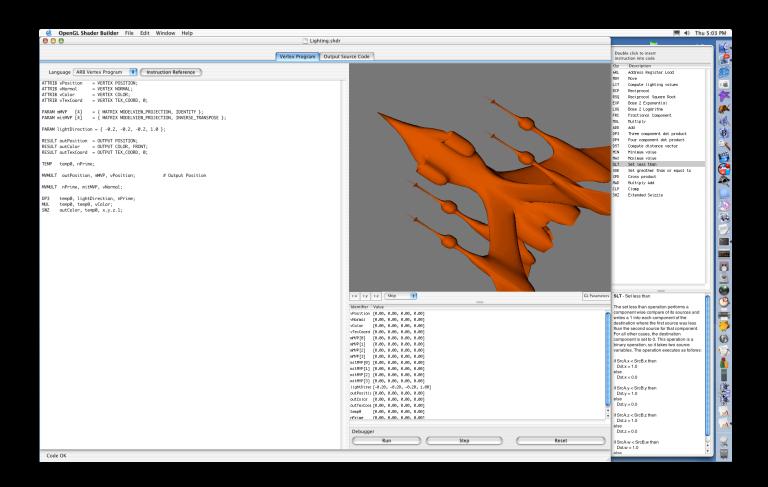


#### Programmable Shaders

- Vertex Shading based on:
  - –GL\_ARB\_vertex\_program
- Pixel and Texture shading based on vendorspecific extensions:
  - -GL\_NV\_texture\_shader[123]
  - -GL\_NV\_register\_combiners[12]
  - -GL\_ATIX\_fragment\_program



#### OpenGL Shader Builder





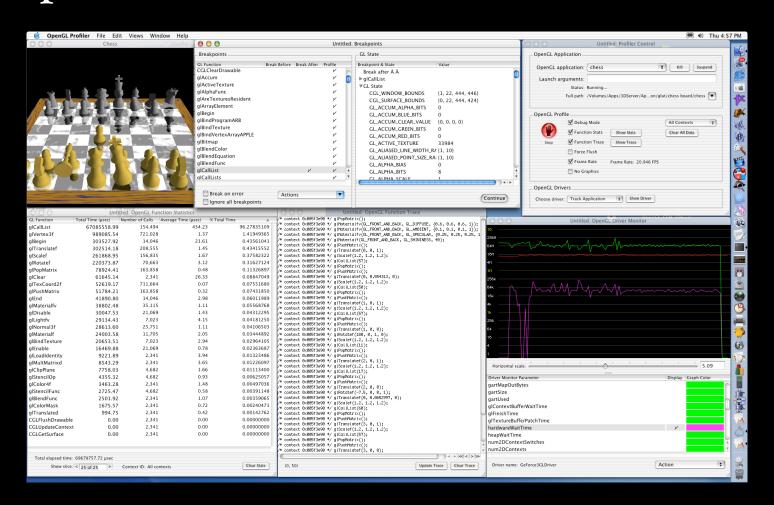
#### New Extensions in Jaguar

```
GL_APPLE_texture_range
GL_APPLE_fence(e)
GL_APPLE_vertex_array_range
GL_APPLE_vertex_array_object
GL_ARB_imaging
GL_ARB_imaging
GL_ARB_multisample
GL_ARB_point_parameters
GL_ARB_pipeline_program
GL_ARB_pipeline_program
GL_ARB_texture_mirrored_repeat
GL_EXT_secondary_color
GL_EXT_secondary_color
GL_EXT_draw_range_elements
GL_EXT_draw_range_elements
GL_EXT_stencil_wrap
GL_EXT_blend_func_separate
```

GL\_SGIX\_depth\_texture
GL\_SGIX\_shadow
GL\_ATI\_texture\_mirror\_once
GL\_ATIX\_fragment\_program
GL\_ATI\_blend\_equation\_separate
GL\_ATI\_blend\_weighted\_minmax
GL\_NV\_blend\_square
GL\_NV\_fog\_distance
GL\_NV\_multisample\_filter\_hint
GL\_NV\_point\_sprite
GL\_NV\_texture\_shader
GL\_NV\_texture\_shader2
GL\_NV\_texture\_shader3
GL\_NV\_depth\_clamp



#### OpenGL Profiler





#### Mac OS X "Jaguar"

- Available August 24th.
- First OpenGL-based windowing system
- Lots of headroom for future innovation
- OpenGL is a key technology for Apple



#### For more info:

- www.apple.com/developer
- Apple developer conference sessions available on DVD or online.
- Become an online ADC member -- it's free!





## Think different.

