Large Emerging Opportunity for 3D

3D hardware acceleration is about to be everywhere

80's
3D Hardware Acceleration in workstations

90's
3D Hardware Acceleration in everyday PCs

00's
3D Hardware Acceleration in Handhelds

Beach head application is 3D games on cell phones which will drive 3D acceleration hardware into handsets in 2004
Embedded Market has API Problem

*No suitable low-level graphics APIs exist - yet*

- These APIs are the foundation for all advanced graphics applications
- It’s like having Desktop Windows without Direct3D or OpenGL

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![](image)

- No suitable APIs exist at this level
- Low-level Graphics APIs
- High Level Graphics Libraries
- Applications

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- OpenGL is widely available across platforms – but is way too big
- Direct3D - not cross platform – so every platform other than Windows CE has a real problem
Khronos’ Evolving Organization

Khronos 1.0
Original Promoters cooperated under Khronos Participation agreement 1.0 to produce OpenML 1.0 specification

Khronos 2.0
New Khronos Participation Agreement 2.0 Enables multiple working groups

OpenML
Media API for Dynamic Media Authoring. Specification Complete 2001

OpenGL ES
Small footprint OpenGL profiles for Embedded Systems

Deploying and evolving OpenML

25 companies in Khronos today
Aiming for 60 companies by end of first quarter
OpenGL ES Working Group

Teleconferencing Every Two Weeks

- Traffic is growing in intensity on Khronos reflector
- Paid specification editor - funded by Khronos from membership dues
  - David Blythe – 3d4w, ex-SGI

Most Active WG Members so far

3d4W
3Dlabs
ARM
ATI
Ericsson
Hi
Imagination
Motorola
Nokia
Seaweed
Symbian
SGI
TI
Tungsten
Yumetech

More members joining every month: wireless, automotive and avionics segments
OpenGL ES Philosophy

A coherent design framework

• Reduce size by pruning functionality
  - Irrelevant functionality and redundant functionality

• Be strongly requirements-based
  - Define enabling forward-looking functionality – don’t just encapsulate current practice

• Take large-scale profiling decisions – eliminate large functionality blocks
  - Don’t endlessly tweak individual function calls and parameters
  - It often makes little difference to size
  - Increases ISV confusion to have many detailed differences

• Should be implementable on limited platforms – agreed worst case ...
  - Small memory footprint (~30-50 K code space for profile)
  - Limited processing power (20-100 MIPS)

• Enable software and fixed point implementations
  - As well as hardware accelerated implementations with floating point
OpenGL ES Philosophy 2
A coherent design framework

• Profiles are proper subsets of OpenGL 1.3
  - Use the “OpenGL way” unless absolutely need to take a different approach

• Small number of profiles – 2 or 3
  - A large number would cause fragmentation

• Planning on annual specification updates
  - Temporal upgrading of functionality

• Extensions are enabled
  - But should be the exception rather than the rule

• Defining conformance tests as well as API
  - More latitude on certain quality factors – minimum quality defined by conformance tests
Profile Directions – Just Two

*Focus on hand-held and safety-critical markets*

- **Primary Profile**
  - Minimum footprint full function 3D with texture-mapping
  - Good gaming platform
  - Implementable on cell phones

- **Safety Critical Profile**
  - Absolute minimum 3D to ease safety certifications
  - Anti-aliased 2D
Aggressive Timelines for OpenGL ES

Embedded industry won’t wait

- First ad hoc working group meetings at Siggraph
- Working for ratifiable spec in 1Q03
How Khronos Membership Works

Promoters establish and participate in working groups for spec generation, marketing, reference implementations, conformance tests, etc.

Specification work undertaken in Working Group. Generates specs are passed back to the Promoters for final ratification.

Contributors participate in working groups and have full voting rights within those groups.

Application developers may use drivers implementing Khronos standards with no license or royalties.

Adopters may sign a royalty free license to implement Khronos-based specifications.
OpenML Status

Regenerating Momentum

• Spec complete at Siggraph 2001

• Next step is produce cross-platform SDK
  - Including DDI definitions to enable straightforward support of new devices

• SGI has completed a lot of the work for a cross-platform SDK
  - Using dmSDK

• No one company had enough dedicated resource to drive the SDK
  - Hence the effort stalled

• Khronos has hired a paid contractor to complete the SDK
  - Fabrice Jaubert – ex Discreet

• OpenML Working Group meetings to start again in December
  - Directing the engineering resource

• Aiming for first SDK deliverables at NAB 2003