Creating an Industry Ecosystem for Handheld Rich Media and Graphics

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Handheld Graphics Revolution

• Mobile Games are beginning to gain market presence
  - BUT there have been many difficulties and obstacles – and many issues remain

• We are just beginning to understand the potential of handheld graphics
  - We can enable new categories of innovative rich media titles and applications

• BUT - it needs to be easier for handheld developers to make money!
  - The industry needs to enable you to innovate – and create applications never seen before

This slideset will explore this handheld graphics revolution ...

- What are the issues holding the revolution back?
- What we can do to make the revolution happen faster?
  - What opportunities it will create?

A call to action for everyone to help build this opportunity together
Pervasive Mobile Computing

- Mobile phones are the largest and fastest growing market - ever
  - The largest ever market opportunity for the graphics industry

- Handsets are becoming personal computing platform - not “just” phones
  - A real computer in your hand – mobility, connectedness and numerous sensors

- Sophisticated media processing will be central to this handheld revolution
  - Just like it has been on the PC
  - Games are one of the first handheld media applications
The State of Mobile Gaming

• Users are placing a premium on compelling games titles
  - Consumers are interested in more than just casual games

• Users pay more for accelerated premium 3D gaming content
  - 50-100% price increase for 3D games over 2D games is common

• Multi-user content encourages higher network usage
  - OTA provisioning 3D applications and levels, real-time multi-player networking

BUT – industry ecosystem issues are holding back the market for advanced media and games developers

Spider-Man 2: The Hero Returns
Sony Pictures

2D

Software 3D

Accelerated 3D

Spider-Man 2 3D: NY Subway
Sony Pictures

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Issue: Platform Fragmentation

- Every handset is unique from the programmer's perspective
  - Differences in operating system functions, Java implementations and media functionality

- Severe platform fragmentation exists today
  - ISVs need to port to and support 100s (even 1000s) of source variants of each title

![Global Handset Sales by Device Type Graph]

- Symbian 7, 8, 9, UIQ, S60
- PocketPC / Windows Mobile / WinCE
- Many Linux variants (and growing)
- Java MIDP-1, MIDP-2, JSR fragmentation
- Palm, RIM

- Numerous RTOS with no consistently defined OS abstraction or media portability – Nucleus, Synergy etc.
**Issue: Need Increased Performance**

- Java is widely available – but doesn’t provide the best media performance
  - Java applications benefit significantly from hardware acceleration

- Native acceleration enables still higher display quality and performance
  - A fact now recognized through benchmarks and real developer experience

"OpenGL ES is the technology of the future for 3D game development. The transition from 2D to 3D can be compared to that of black-and-white TV to color TV." *Gameloft president Michel Guillemot*

<table>
<thead>
<tr>
<th>Device</th>
<th>Java (fps)</th>
<th>OpenGL ES (fps)</th>
<th>Native Advantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nokia N93</td>
<td>18.6</td>
<td>77.8</td>
<td>x4.2</td>
</tr>
<tr>
<td>Sony Ericsson M600</td>
<td>6.0</td>
<td>30.6</td>
<td>x5.1</td>
</tr>
</tbody>
</table>

GLBenchmark – direct port of identical Java benchmark
Khronos Solution: Native Media APIs

- ISV Feedback:
  - 1. Reduce fragmentation!!
    - Consistent APIs on every handset
  - 2. C Programming Environment!
    - Significantly faster performance
    - Familiarity for developers
    - Eases ports from PCs, handhelds and consoles

- OEM Feedback:
  - Game titles failing to meet expectations
    - Price per title is being held artificially low
    - Difficult for ISVs to get return on investment
      - Holding back innovative content development

- "Native Media Acceleration APIs"
  - A cross-platform set of native APIs for media application development

- Fragmentation
- Lack of native performance

- 3D Gaming
- "MAC-like"
- Advanced
- Composited
- Windowed
- User Interfaces

Mobile Platforms
Media APIs Enable Market Growth

- An API is a contract between hardware and software worlds
  - Enabling both - everyone wins

- ISVs see reduced variability across multiple platforms
  - More software can reach market faster at a better level of functionality and quality

- Hardware vendors can accelerate many applications
  - Adding value to their platform
**APIs Enable Mobile Acceleration**

**Faster Performance at Higher Quality**
Hardware delivers at least 10 times the performance of software – even on low-cost systems with low-end CPUs.

**POWER EFFICIENCY**

<table>
<thead>
<tr>
<th>Processor</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARM9</td>
<td>0.36</td>
</tr>
<tr>
<td>32-Bit RISC at 400MHz</td>
<td>0.14</td>
</tr>
<tr>
<td>DSP at 175MHz</td>
<td>1.85</td>
</tr>
<tr>
<td>APA 512 MiMagic 6</td>
<td>17.8</td>
</tr>
</tbody>
</table>

**Less Power**
Hardware accelerators exploit parallelism in a media pipeline to give a ×10 increase in power efficiency over software.

**State of the art user interfaces**
Smaller screens need more advanced graphics processing per pixel.
Khronos - Open Media Standards

Open Membership
Any company is welcome
Funded by membership dues - $5K / year

Open Standards
Publicly available on web-site
Royalty-free

Open Standards for Media Authoring and Acceleration

Khronos typically develops “Foundation-Level” APIs
High-performance “Close-to-the-metal” access to hardware acceleration
Good foundation for higher-level engines and middleware
Khronos Dynamic Media Ecosystem

- Cross-platform graphics authoring/acceleration Ecosystem
- 2D/3D
  - Vector 2D
- Streaming Media
- Enhanced Audio
- "DirectX-like" set of native APIs
  - Includes mixed media acceleration and OS portability APIs
- Dynamic Media Authoring Standards
- 3D Authoring
  - Cross-platform 2D/3D
- Safety Critical 2D/3D
- Embedded Media Acceleration APIs
  - OpenKODE

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OpenKODE

It's like DirectX™ for mobile phones!
Except it's an open standard, cross-platform, royalty-free and streamlined for handheld devices

OpenKODE is a set of C-native APIs for handheld games and media applications

2D, 3D, video and audio media types are all seamlessly accelerated by OpenKODE

OpenKODE minimizes source changes when porting games and applications from phone to phone

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Native Fragmentation

Software Platform (e.g. Brew, Symbian UIQ, S60, WIPI)

Native Applications

- User Interface
- 3D Game Engines
- Flash/SVG Players
- TV/Video/Audio Players

Media Accelerator Silicon
GPU / DSPs / CPUs

Kernel Operating System
(e.g. Rex, Symbian OS, Windows Mobile, Linux, Nucleus, Synergy)

CPU

Different OS APIs on every handset

Proprietary media APIs, single-threaded, not tested for mixed-media operation

Java Applications

Java JVM

JAR File

Carrier OTA Provisioning

No Native OTA Deployment

Handheld devices increasingly need advanced graphics and media acceleration for user interfaces, 3D gaming, Flash, TV...

Severe API fragmentation to access OS resources and media acceleration = HUNDREDS of source variants per game
The OpenKODE Solution

System Abstraction (OpenKODE Core)

Media Accelerator Silicon
GPU / DSPs / CPUs

Kernel Operating System
(e.g. Rex, Symbian OS, Windows Mobile, Linux, Nucleus, Synergy)

Software Platform (e.g. Brew, Symbian UIQ, S60, WIPI)

User Interface
3D Game Engines
Flash/SVG Players
TV/Video/Audio Players

Native Applications

Java JVM

Java Applications

Bindings

Trans-API communication (EGL)

Selected Khronos media APIs for state-of-the-art media acceleration

Trans-API data and event coordination – WITH full trans-API Conformance Tests (EGL)

System Abstraction APIs for portable access to operating system resources, input devices and displays (OpenKODE Core)

A coherent, cross-platform API set for NATIVE portable media applications
OpenKODE Participation

• 40 companies participating in OpenKODE working group
  - Core participants include ARM, Ericsson, Freescale, Ideaworks 3D, Intel, Nokia, NVIDIA, Samsung, SUN, Symbian, Tao, TI

• Working for industry adoption on many platforms
  - Symbian, WIPI, Linux, Windows, Brew
  - Any platform can use royalty-free, open-standard, vendor-neutral, media acceleration API layer
  - Incorporates significant design expertise from leading industry media companies
OpenKODE provides foundation-level acceleration for advanced user interfaces and media applications that mix multiple media types

A conformant OpenKODE must pass all individual conformance tests PLUS trans-API tests to ensure APIs can communicate and operate concurrently

Selected Media APIs PLUS any EGL needed for those APIs to communicate

Operating System Abstraction APIs to reduce source fragmentation
Leveraging and Accelerating Java

Existing provisioning, billing and security systems can be used to OTA provision native OpenKODE applications.

Native applications will need certification – as Brew does today.

CHAPI (Content Handler API) - Java standard to register handlers for media types. A native API enables mixing Java and native applications and services.
OpenKODE Milestones

• Aiming for OpenKODE 1.0 release at 3GSM 2007
  - Keeping things as simple possible for first release while delivering significant benefit

• Will include full conformance tests
  - Written by Futuremark
**Expected OpenKODE Roll-Out**

- Simple build out of existing OpenGL ES adoption
  - Expecting rapid industry momentum

- OpenKODE 1.0 allows media API selection
  - To enable widespread early adoption

- OpenKODE does NOT preclude other media APIs
  - OEMs can pace their own transition from proprietary APIs
  - E.g. can ship alongside DirectShow

OpenKODE System Abstraction APIs have no silicon dependency and take <50KB. Provides enhanced 2D/3D mixed mode operation.

Full DirectX functional equivalence. Robust trans-API functionality and testing.

OpenGL ES is everywhere today.
OpenKODE: Acceleration Foundation

- Advanced UI – OpenVG
  - OpenGL ES for special effects

- Accelerated Java Applications
  - OpenGL ES – 184/239, OpenVG - 287

- Augmented Reality – OpenMAX AL
  - Video processed & rotoscoped with OpenGL ES 3D

- Advanced Navigation - OpenVG
  - 3D terrain/satellite data using OpenGL ES

- Video Telephony – OpenMAX AL
  - OpenGL ES lip-synch 3D avatar

- PVR Application – OpenMAX AL
  - OpenVG-based UI and subtitles

- Music Visualizer - OpenSL ES
  - OpenGL ES 3D synchronized to music beat

- 3D Game – OpenGL ES
  - OpenSL ES positional audio & OpenVG HUD/menus

- 3D TV Channel Selector – OpenMAX AL
  - OpenGL ES 3D multi-channel visualization

OpenKODE creates the opportunity to create new applications and user interfaces that use multiple media types.
Innovative Mixed Media Applications

- Breakthrough mobile games and applications will not treat mobile devices as small consoles or PCs
- They will take advantage of the unique capabilities of mobile devices:
  - **Use of handset sensors**
    - Cameras for video and images, sound
  - **Mobility**
    - With GPS location awareness
  - **Connectedness**
    - Unique information flow and social interactions
- An advanced media stack enables innovative applications that mix many kinds of media acceleration

A GPS phone processes OpenMAX video to recognize buildings and landmarks
OpenKODE Native Ecosystem

Carriers

- Compelling media applications increase revenue through existing provisioning, billing, DRM certification infrastructure
- Native OTA provisioning uses existing certification, security, billing, lifecycle management infrastructure

Open standards to simply specify a native, cross-platform media API stack

OpenKODE

Proven media stack architecture based on multi-vendor open-standards - reduces risk

Cross-platform native APIs reduce source fragmentation and increase performance

Handset OEMs

Native, cross-platform media API stack

Content Providers
Industry Call to Action

• We need a forward-looking, multi-threaded media stack architecture
  - That is an open, royalty-free standard to encourage industry innovation
• Foundation for new-generation interfaces and mixed-media applications
  - Driving new market and revenue opportunities
• OpenKODE is a open-standard, multi-vendor native media-stack
  - Helping to solve industry fragmentation and performance issues

• If you are an handset OEM.. Embed an OpenKODE 1.0 media stack!
• If you are a carrier.. Specify OpenKODE 1.0 for your native games!
• If you are a developer.. Demand OpenKODE 1.0 for development!

OpenKODE is a significant opportunity for the handheld industry to help evolve handheld devices into the most pervasive media-capable computing devices the world has yet seen

Slides and Khronos membership details at www.khronos.org