

GameDevelopers
Conference

MARCH 20-24
SAN JOSE, CALIFORNIA

WHAT'S NEXT
.....GDC:06

www.gdconf.com

GAME DEVELOPERS CHOICE AWARDS

INDEPENDENT GAMES FESTIVAL

GDC MOBILE

SERIOUS GAMES SUMMIT

GAME CONNECTION



Creating the Embedded Media Processing Ecosystem

Neil Trevett

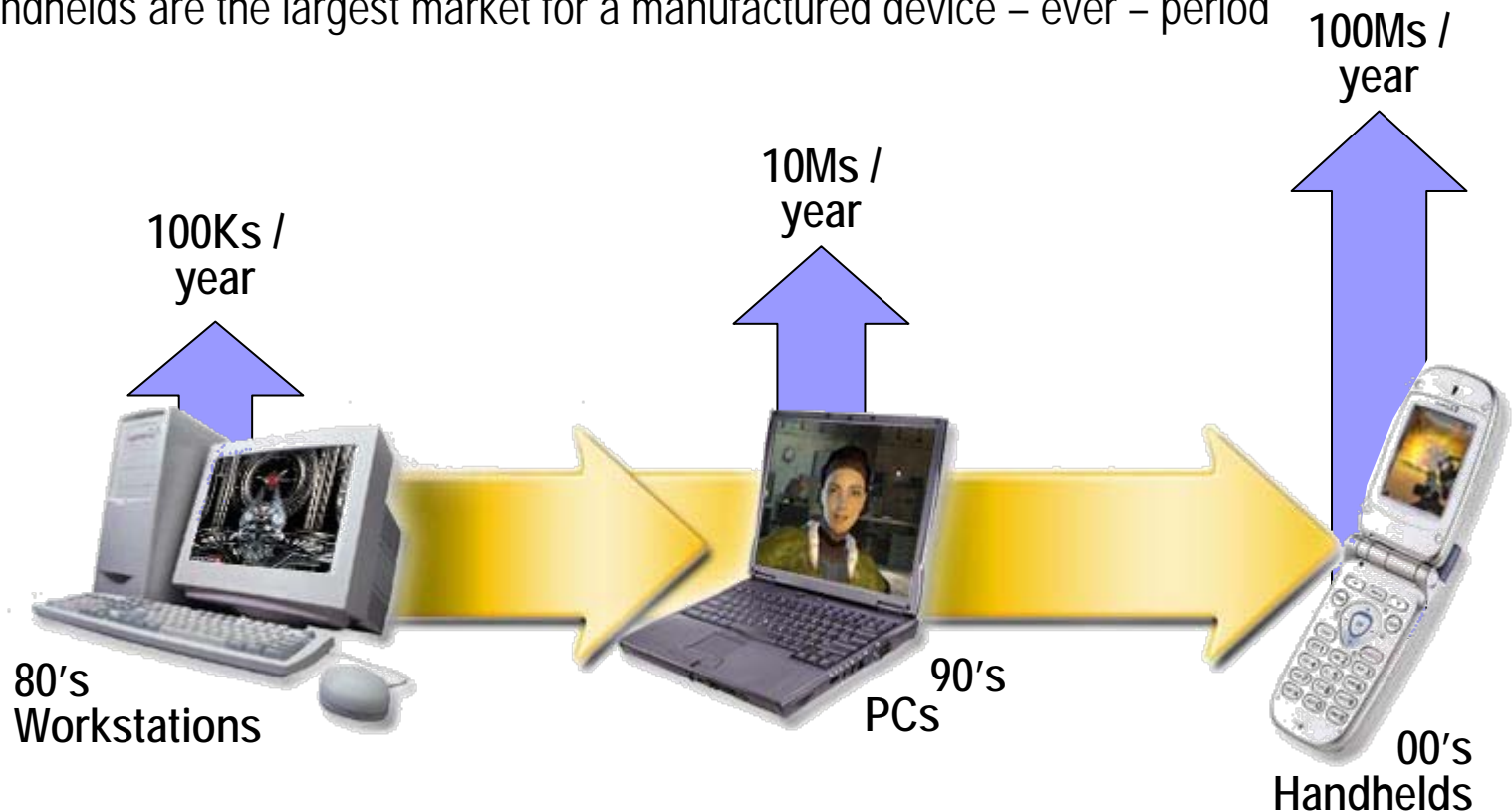
Vice President Embedded Content, NVIDIA

President, Khronos

Chairman, OpenGL ES Working Group

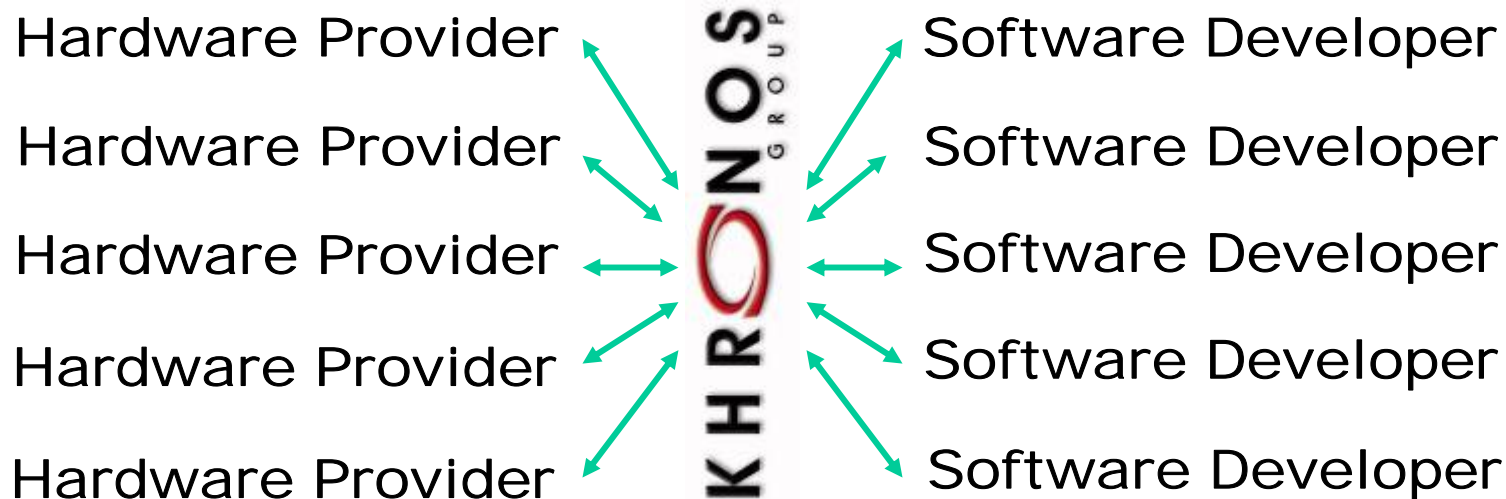
Mobile Convergence

- Handsets are becoming the predominant personal computing platform
 - Sophisticated media processing will be central to this revolution
- 50% of phones will have multimedia hardware acceleration by 2008
 - Source - Jon Peddie & Associates
- Significant opportunity for games developers
 - Handhelds are the largest market for a manufactured device – ever – period



Media APIs Enable Market Growth

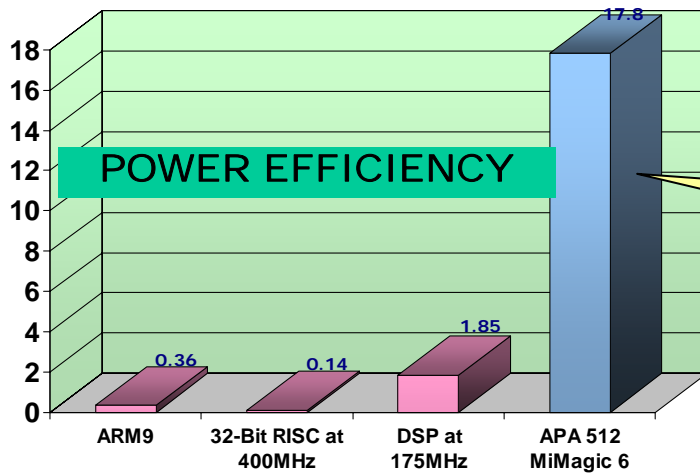
- An API is a contract between hardware and software worlds
 - Enabling both - everyone wins
- ISVs see reduced variability across multiple platforms
 - More software can reach market faster at a better level of functionality and quality
- Hardware vendors can accelerate many applications
 - Adding value to their platform



Khronos develops "Foundation-Level" APIs
 As close-to-the-metal" as possible while providing portable
 access to hardware acceleration. Great performance.
 Good foundation for higher-level engines and middleware

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



Less Power
Hardware accelerators exploit parallelism in a media pipeline to give a x10 increase in power efficiency over software

State of the art user interfaces
Smaller screens need more advanced graphics processing per pixel



Creating Open API Standards

Open Membership

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

Open Standards

Publicly available on web-site
Royalty-free



Open Standard Platform for Embedded Rich Media Acceleration

Cross Platform

Enabling diverse handheld and
embedded markets

Promoting Ecosystem

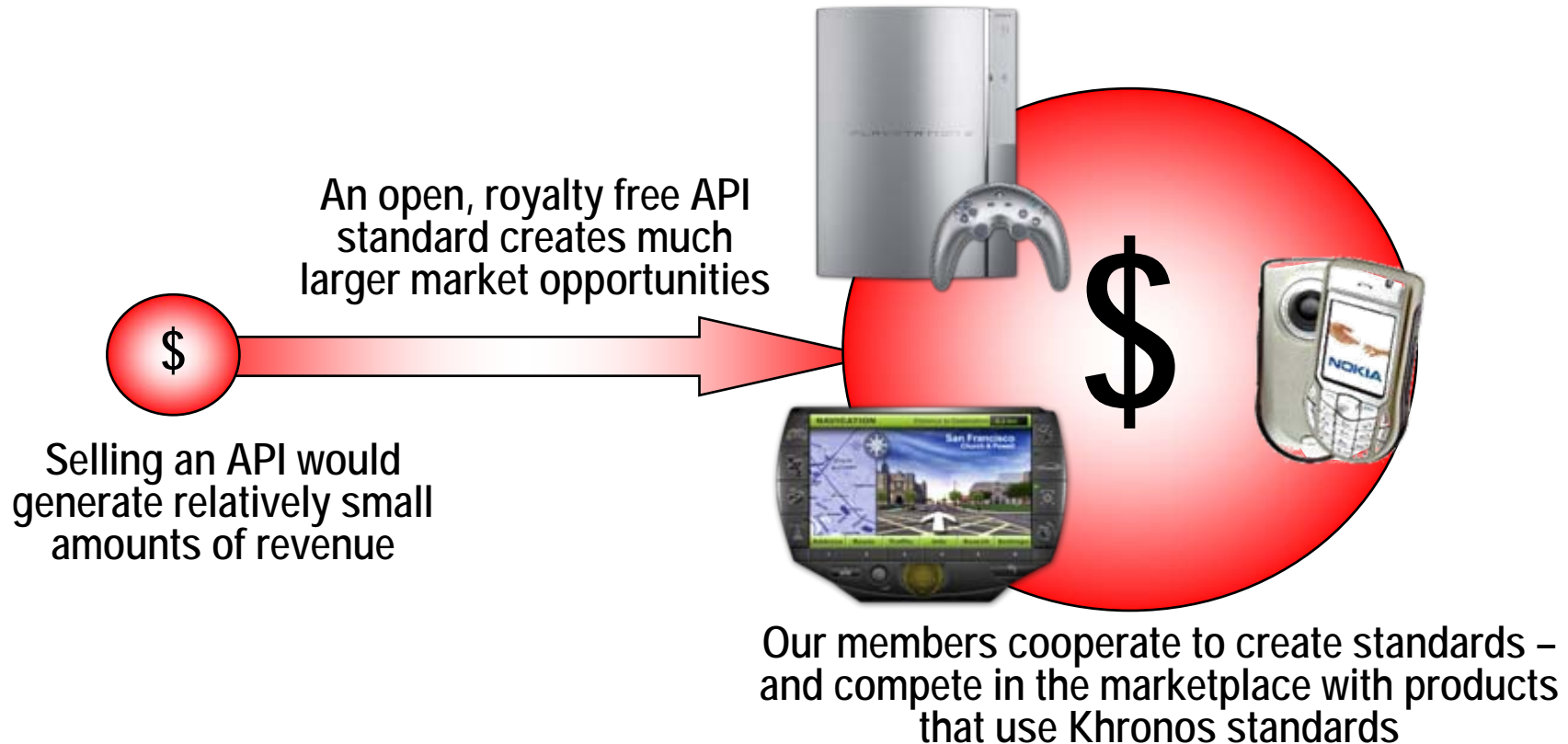
Conformance tests, tools,
developer materials and outreach

Khronos has a PROVEN reputation for
the TIMELY creation of HIGH-QUALITY,
ROYALTY-FREE standards



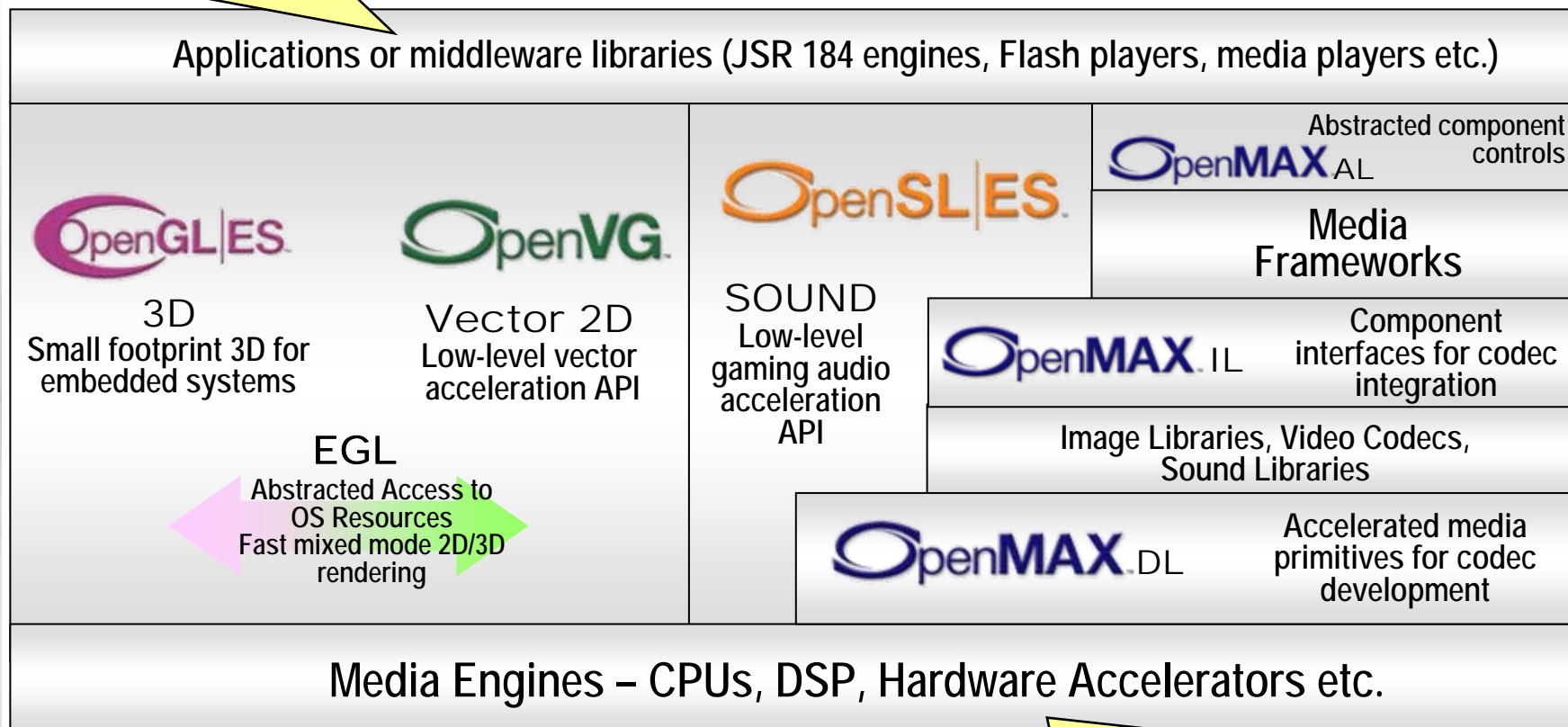
How Does Khronos Make Money?

- It doesn't!
- Khronos is purely a non-profit organization
 - Funded by member dues – to cover costs
- Our members make money by selling PRODUCTS enabled by standards
 - NOT trying to charge for the standard itself



Khronos API Stack

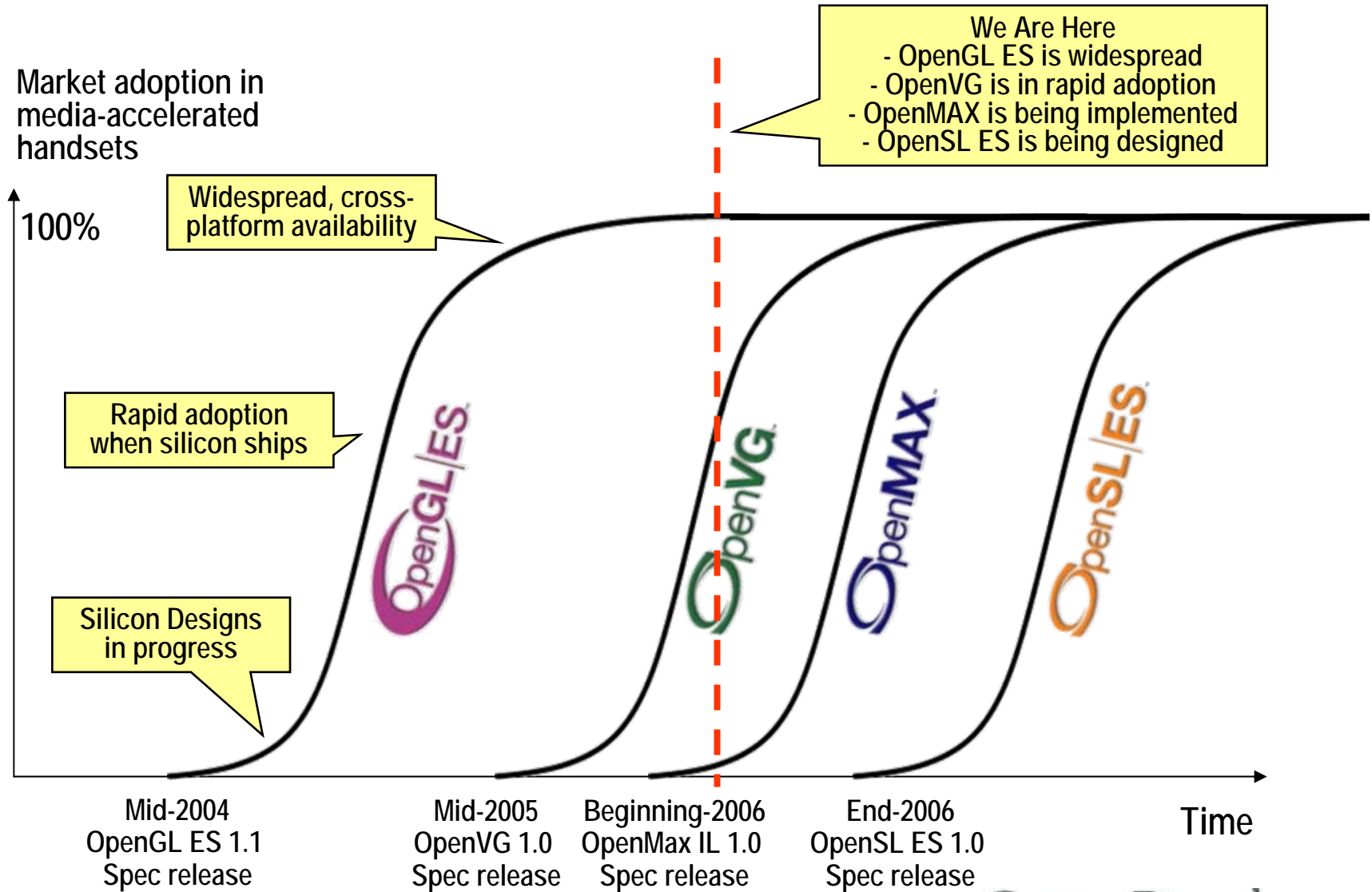
The Khronos API family provides a complete ROYALTY-FREE, cross-platform media acceleration platform



Khronos defines low-level, FOUNDATION-level APIs.
“Close to the hardware” abstraction provides portability AND flexibility

Adoption of Khronos APIs

Market adoption in
media-accelerated
handsets



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Accelerated
Vector Graphics

OpenVG™

Vector Graphics for Mobile Devices

- Vector graphics used in many popular formats such as Flash, SVG, PDF
 - High-quality user interfaces, screen savers, 2D Games
 - Portable mapping and GPS applications, E-book readers and text packages
- High-quality 2D vector graphics use scalable Bezier curves
 - Path based for scaling and positioning at full quality - not polygon based
 - Easy porting of full quality 2D content to different screen sizes
- But all 2D vector graphics usually run un-accelerated!
 - Works OK on high-performance PCs
 - Not effective on low-powered handset CPUs
- We need to enable accelerated mobile 2D vector graphics!



single-color



textured



linear gradient



radial gradient



curve



line

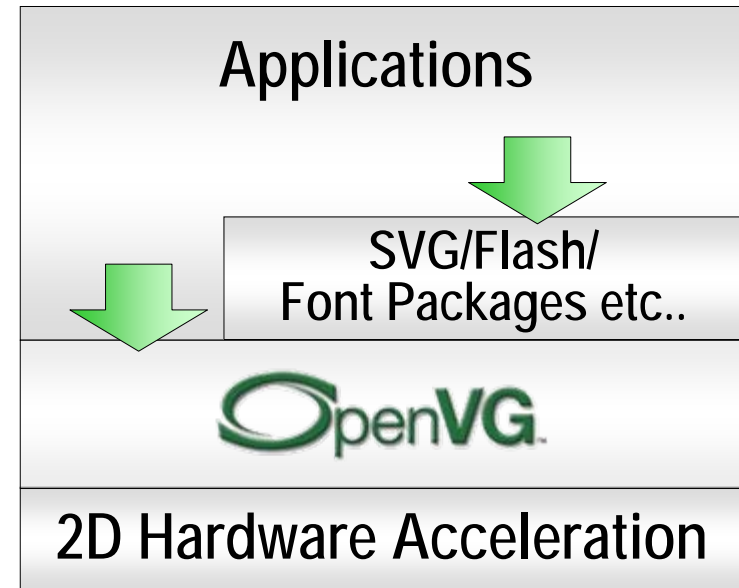


polygon



OpenVG – Accelerated Vector Graphics

- **OpenVG ACCELERATES** existing formats – such as Flash
 - NOT a competitor to Flash, SVG etc.
 - Enables popular vector formats to run with faster performance and less power
- **OpenVG 1.0 released at Siggraph 2005**
 - Open, royalty-free standard
 - Developed in just 12 months
- **Uses OpenGL-style syntax**
 - Easy to learn for OpenGL developers
- **Will be supported by graphics silicon**
 - Dedicated 2D engines AND full 3D engines
- **Conformance tests under construction**

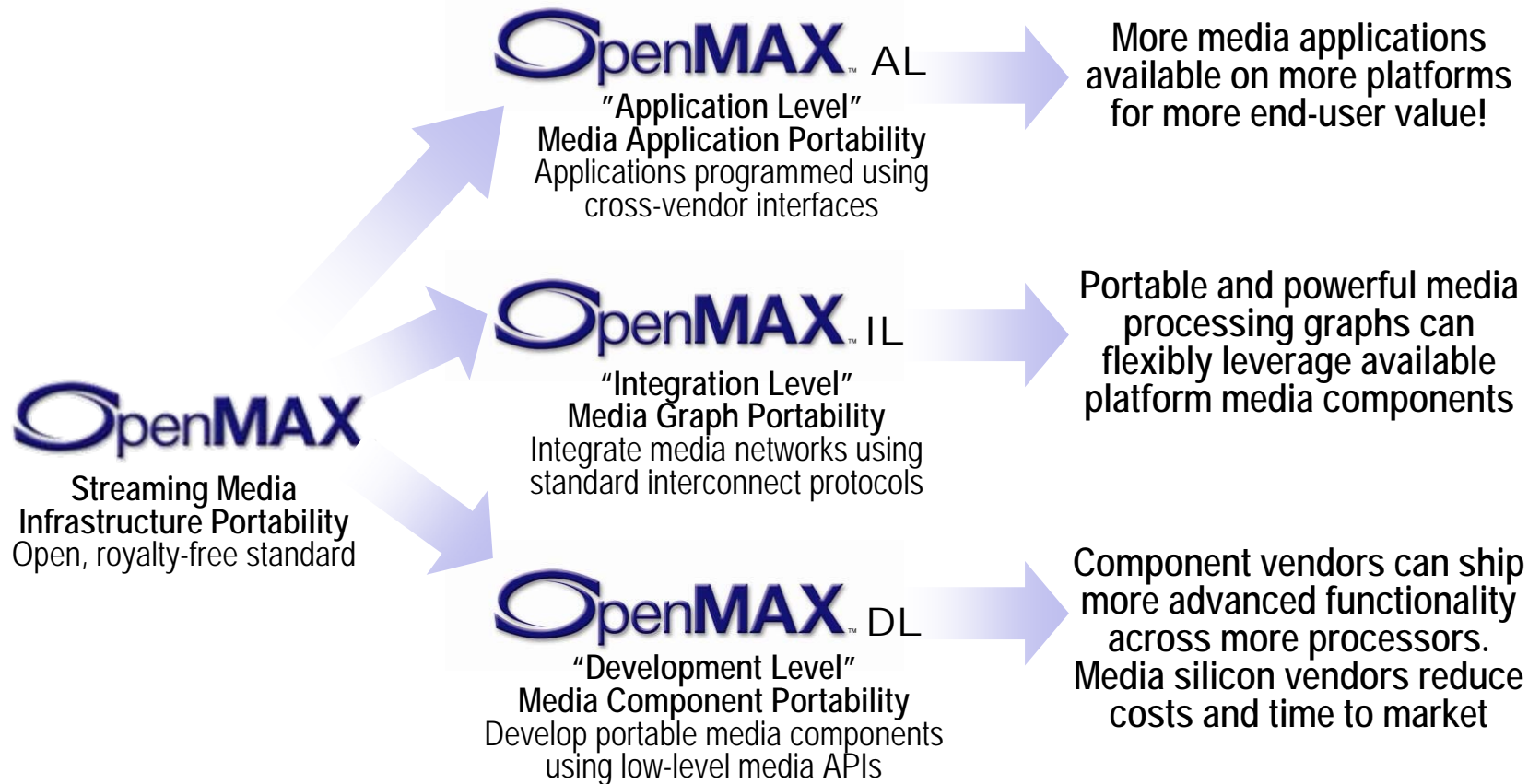


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Streaming Media Portability

OpenMAX™

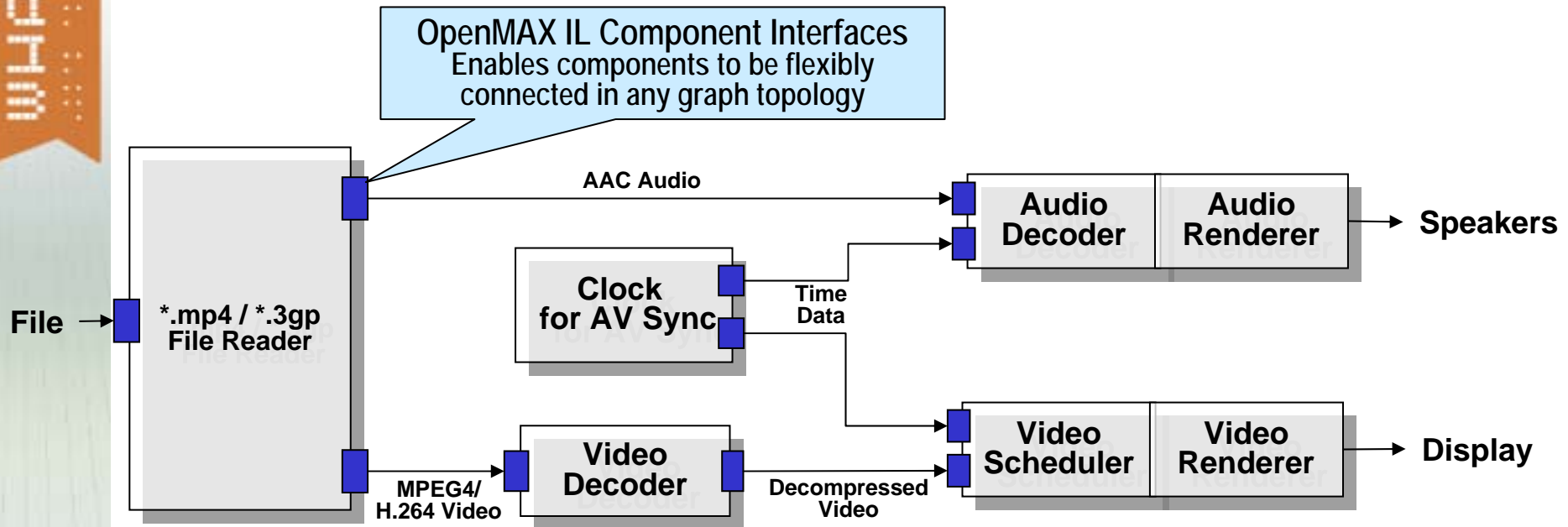
OpenMAX - Three Layer Solution



OpenMAX defines three holistically designed media open standards to provide complete streaming media infrastructure portability

OpenMAX IL Example Graph

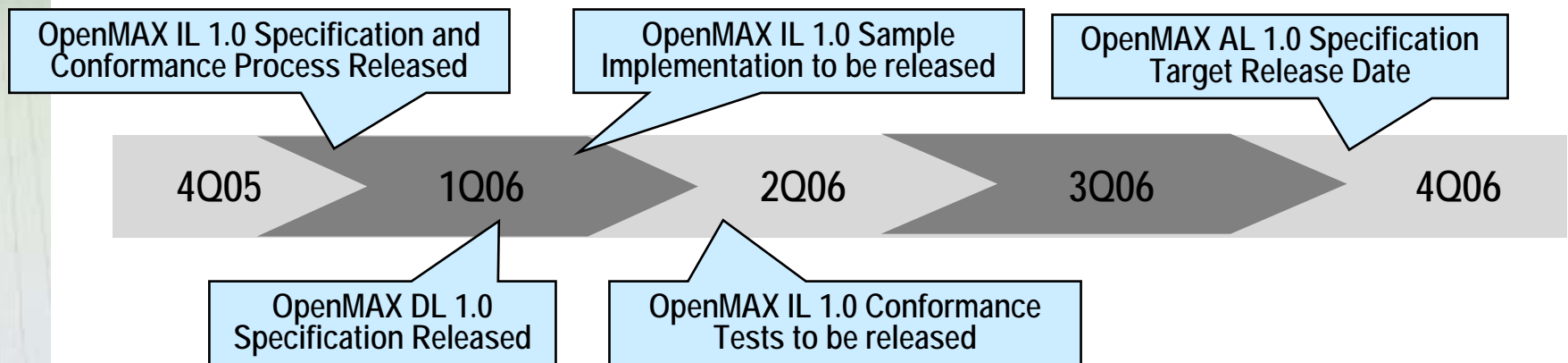
- Standardized component interfaces enable flexible media graphs
- Includes multi-stream synchronization



Example: MPEG-4 video synchronized with AAC audio decode

OpenMAX Summary

- Created with strong industry consensus and participation
 - ARM, ATI, Beatnik, Broadcom, Emuzed, Fraunhofer, Freescale, Infineon, Intel, Motorola, Nokia, NVIDIA, Philips, SKY MobileMedia, Samsung, Sasken, Siemens, STMicroelectronics, Symbian, Texas Instruments
- Specification is open and royalty-free using Khronos IP framework
 - Delivered with sample implementations and conformance tests
- Available on wide variety of architectures and operating systems
 - To enable true streaming media portability



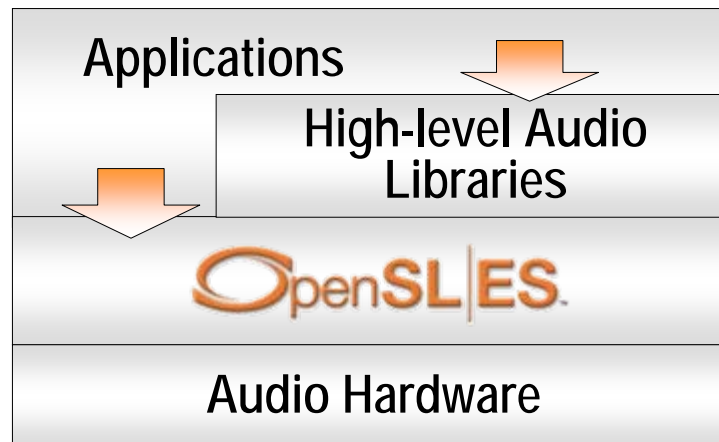
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Accelerated
Embedded Audio

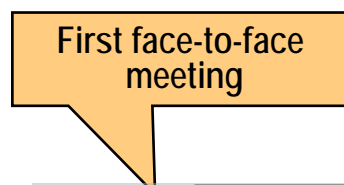
OpenSL|ES™

OpenGL ES – Solving an Audio Crisis

- Many different proprietary audio APIs
 - Even playing a simple sound is different on different platforms
- No standard way to access any available hardware
 - Lots of work for developers to re-write code for every platform
- Need a unified native audio acceleration API
 - Targeting handheld devices
- API for games developers - low-latency sound generation for games
 - Advanced audio functionality: 3D positional audio, reverb, SP-MIDI
- Cross-platform foundation for a wide range of higher-level audio APIs
 - OpenAL, Java sound APIs (JSR-135 and JSR-234)

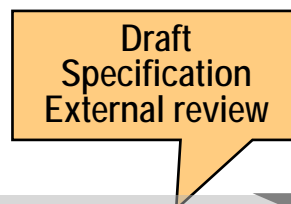


Working Group Milestones



4Q05

1Q06



2Q06

3Q06



4Q06

Strong industry quorum of leading audio hardware and software companies.
Open call for call for participation

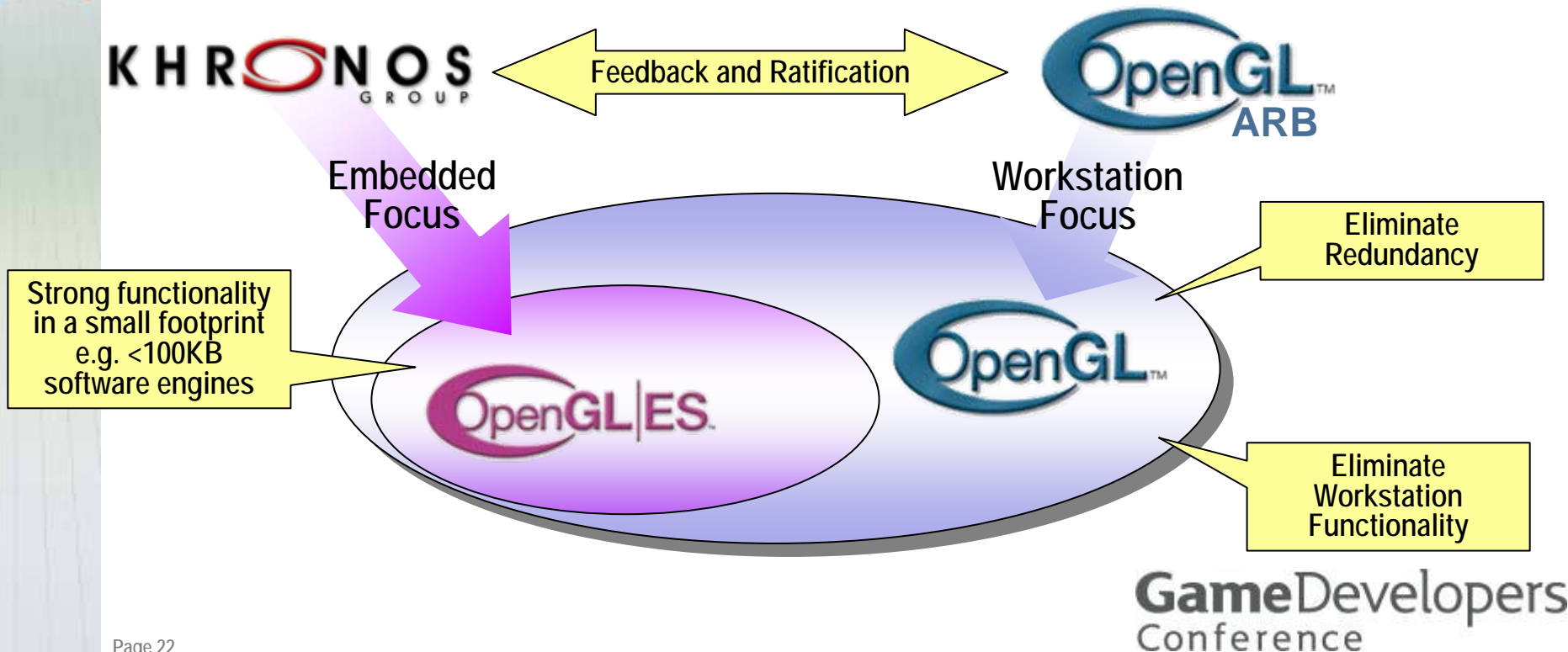
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Industry Standard
Embedded 3D

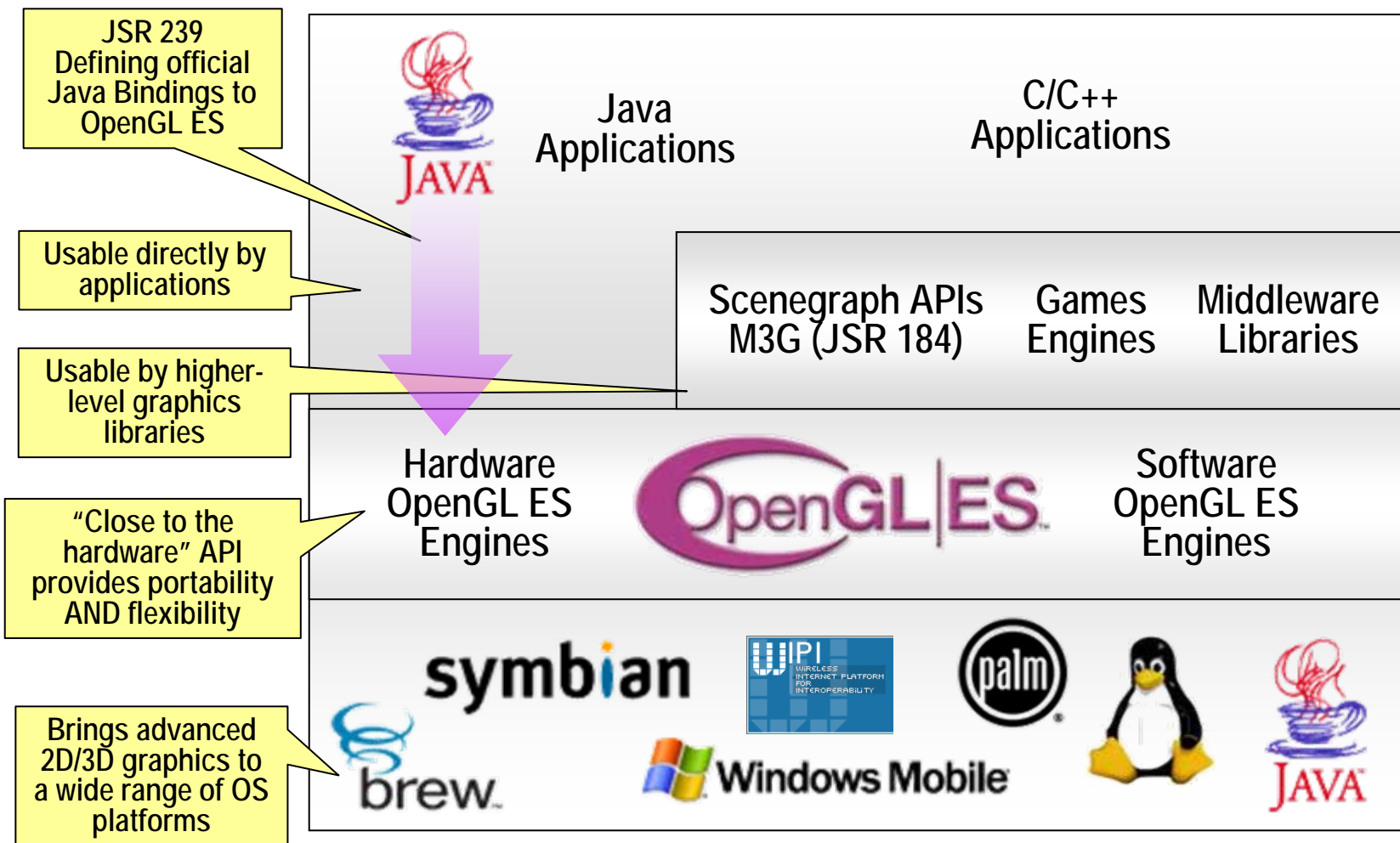
OpenGL|ESTM

OpenGL ES API Standard

- **Small-footprint subset of OpenGL**
 - Created with the blessing and cooperation of the OpenGL ARB
- **Powerful, low-level API with full functionality for 3D games**
 - Available on all key platforms
- **Fully extensible**
 - Enables vendor differentiation and exploration of new functionality



OpenGL ES – Central to Mobile 3D



OpenGL ES – Two Track Standard

- Two tracks - manage mobile graphics through programmable transition
 - With maximized portability and minimized platform costs
- OpenGL ES 2.0 ruthlessly eliminates redundancy – just like 1.X
 - Deprecates all fixed functionality that can be replaced by shaders
 - Significant reduction in engine cost and driver complexity
- Platforms can ship either or both 1.X and 2.X libraries
 - Cheaper, more flexible than one large driver with both fixed and programmable functions
 - With full backwards compatibility maintained in each track
- OpenGL ES 2.X does NOT replace OpenGL ES 1.X
 - Will always need lowest cost, non-programmable hardware for certain high-volume devices

OpenGL ES 1.X – Fixed Function Acceleration

OpenGL ES 1.1

- For software and fixed functionality hardware
- All 1.X specifications are backwards compatible

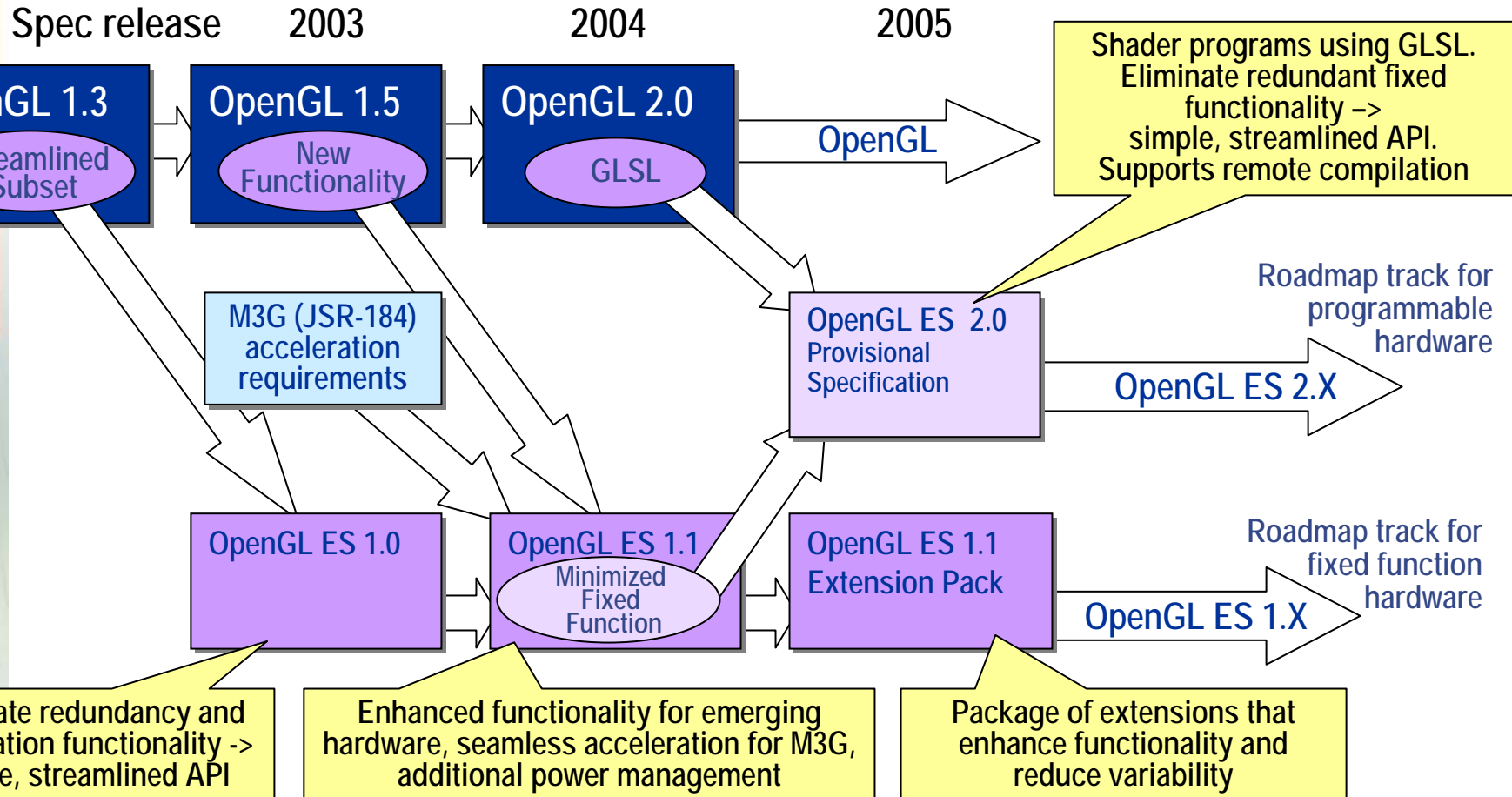
OpenGL ES 2.X – Programmable Acceleration

OpenGL ES 2.0

- Vertex & pixel shaders through GLSL ES shading language
- All 2.X specifications will be backwards compatible



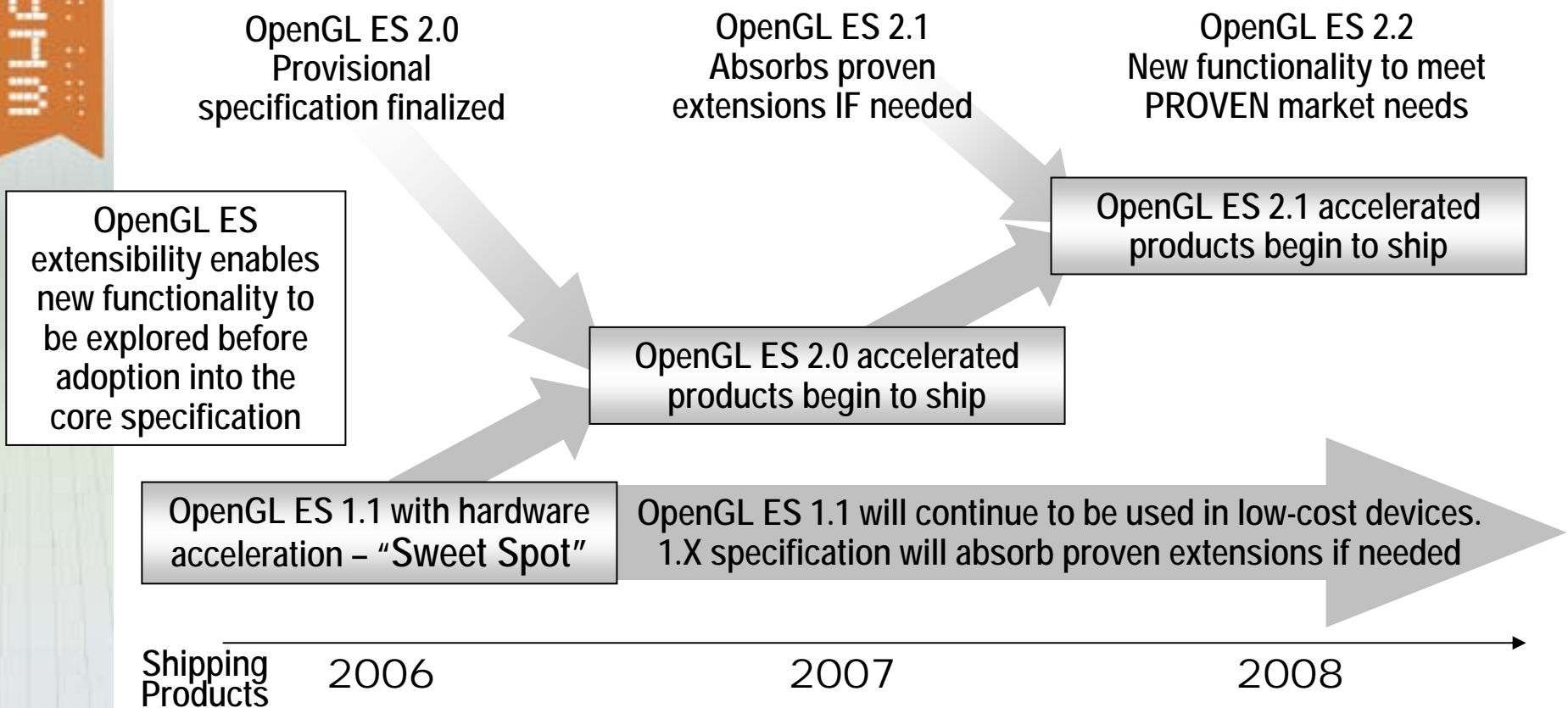
OpenGL ES DNA



Minimize differences between 1.X and 2.X tracks to ease programmable transition

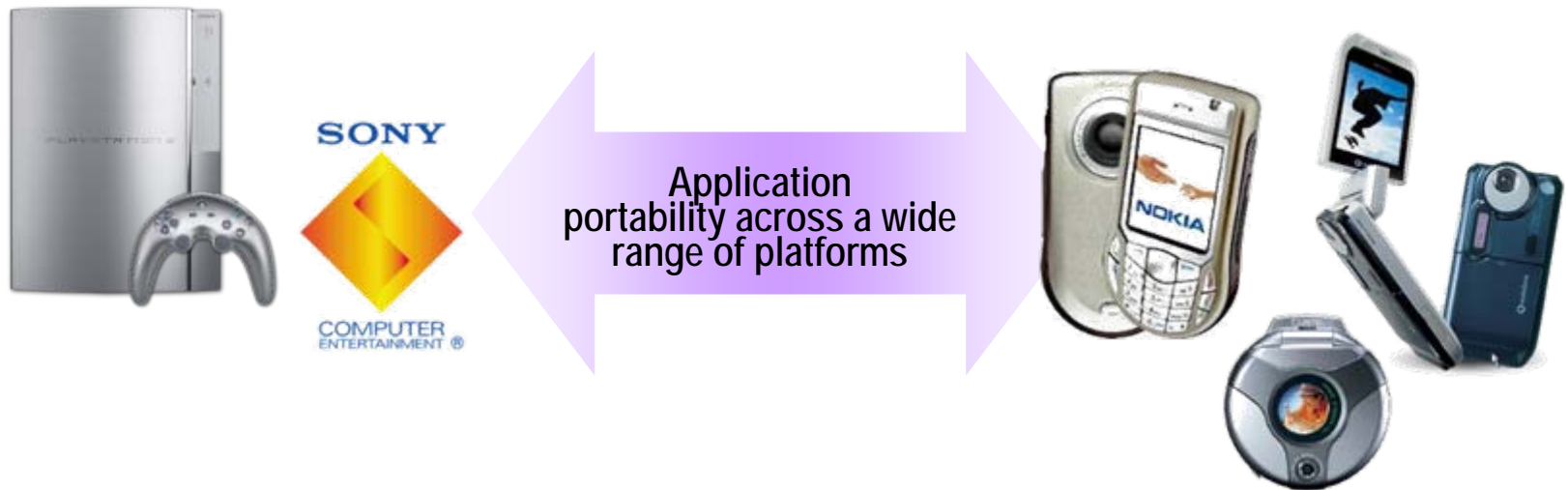
OpenGL ES Roadmap

- Stability and reducing fragmentation is currently the key concern
 - More important than new functionality in the current phase of market development
 - Industry is still absorbing and implementing current OpenGL ES specifications



OpenGL ES – More than Handhelds

- OpenGL ES will be available for Playstation 3
 - Sony made public announcement at GDC in San Francisco in March 2005
 - All interactive demos at E3 were using OpenGL ES
- **Powerful portability for console and handset titles**
 - Previous generation console games can be deployed on 100s of millions of cell phones



THE POWER OF COOPERATIVE OPEN STANDARDS
 A growing infrastructure of OpenGL ES tools and platforms are creating one of the world's largest opportunity for games developers

Mobile 3D Graphics Ecosystem

Synergistic Development of authoring and acceleration standards under one body.
Third party tools and debuggers.
gDEDebugger ES announced at GDC 2006



Market demand
for Handheld 3D

Industry
Cooperation

Khronos drives
OpenGL ES roadmap
to meet market needs



Open API
Standards

Conformance
Tests

OpenGL ES 1.1 Conformance Tests
released Aug'05 with peer review
conformance process. Working
Group is tightening conformance and
Khronos is developing OpenGL ES
2.0 tests

Great 3D
Applications

Tools



Benchmarks



FUTUREMARK
CORPORATION

JBenchmark

High-quality
platforms



Futuremark
3DMarkMobile06
JBenchmark 3D. Soon
see consumer benchmark
interest as on the PC?

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Native Gaming Platform

OpenK  D E

Good Titles Gaining Attention

- Users place a premium on compelling media-enabled handsets
 - Smooth 3D gaming functionality, MP3 audio and TV in the palm of your hand
 - 3D benchmarks to enable consumer comparisons now appearing
- Users pay more for premium 3D gaming content
 - 50-100% price increase for 3D games over 2D games is common
 - 3D UI/Avatar/messaging applications will enable new levels of personalization
- Multi-user content encourages higher network usage
 - OTA provisioning 3D applications and levels
 - Real-time, multi-player networking

**BUT – compelling media applications not happening fast enough.
Systemic industry issues threaten to stall mobile media**

Spider-Man 2: The Hero Returns
Sony Pictures



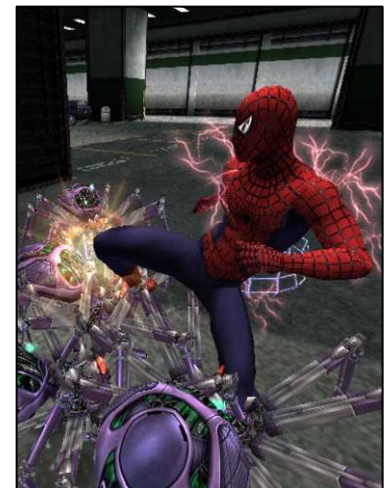
2D

Spider-Man 2 3D: NY Subway
Sony Pictures



3D Software

Spider-Man 2
Activision



3D with HW Acceleration

Barriers to Great Mobile Content

Barrier #1 - Platform Variability

Each phone supports different selection of APIs
Often available APIs do not work reliably - needs workarounds
Need to port to and support 100s of platform variants



Titles are failing to meet customer expectations and cost more to port than to develop
Price per title is being held artificially low
Difficult for ISVs to get return on investment
Holding back development of innovative content



Barrier #2 - Performance

Java is architected for safety not speed
Most handsets have no way to deploy a C native title
The capability of OpenGL ES silicon is not being unleashed

"Native Content Platform"

1. A cross-platform set of native APIs for media application development
2. A consistent method to provision, install and run native C applications across diverse platforms

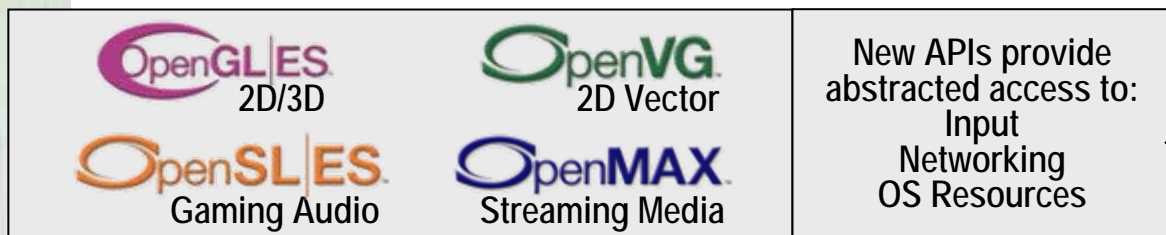


OpenKODE

"Khronos Open Development Environment"

OpenKODE Native API Platform

- Enable high-performance, source-portable, native media applications
 - Through a coherently designed API platform
- OpenKODE collects Khronos media APIs into a single platform
 - Rigorous conformance testing to ensure reliable API implementations
- Add “missing” APIs needed that prevent portable media applications
 - Input, Networking and OS resource abstraction
- Functionally similar to the DirectX platform
 - Except cross-platform, royalty-free and streamlined for mobile platforms
- Enable a native content platform familiar to PC and console developers
 - Encourage application porting and reduced learning curve for many developers



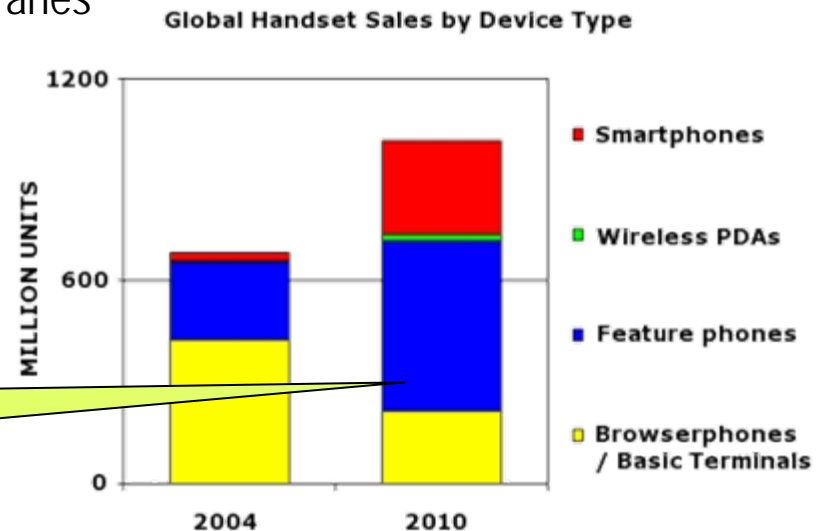
New APIs complete a coherent development environment for source portable media applications

OpenKODE

Need for Native Deployability

- OpenKODE needs to be available on maximum number of OS
 - For widest application portability
- Smartphone OS are able to download and link native applications
 - Windows Mobile, Symbian, Linux
- But >80% of the handheld market today uses feature phone OS
 - Many RTOS do not have the capability to link and load a native application
- OpenKODE considering defining formats to enable a on-handset linker
 - Enabling feature phones to download and link OpenKODE applications
- Include standardized dependency information
 - Enable dynamic download of OpenKODE libraries
 - Accelerate market ecosystem velocity

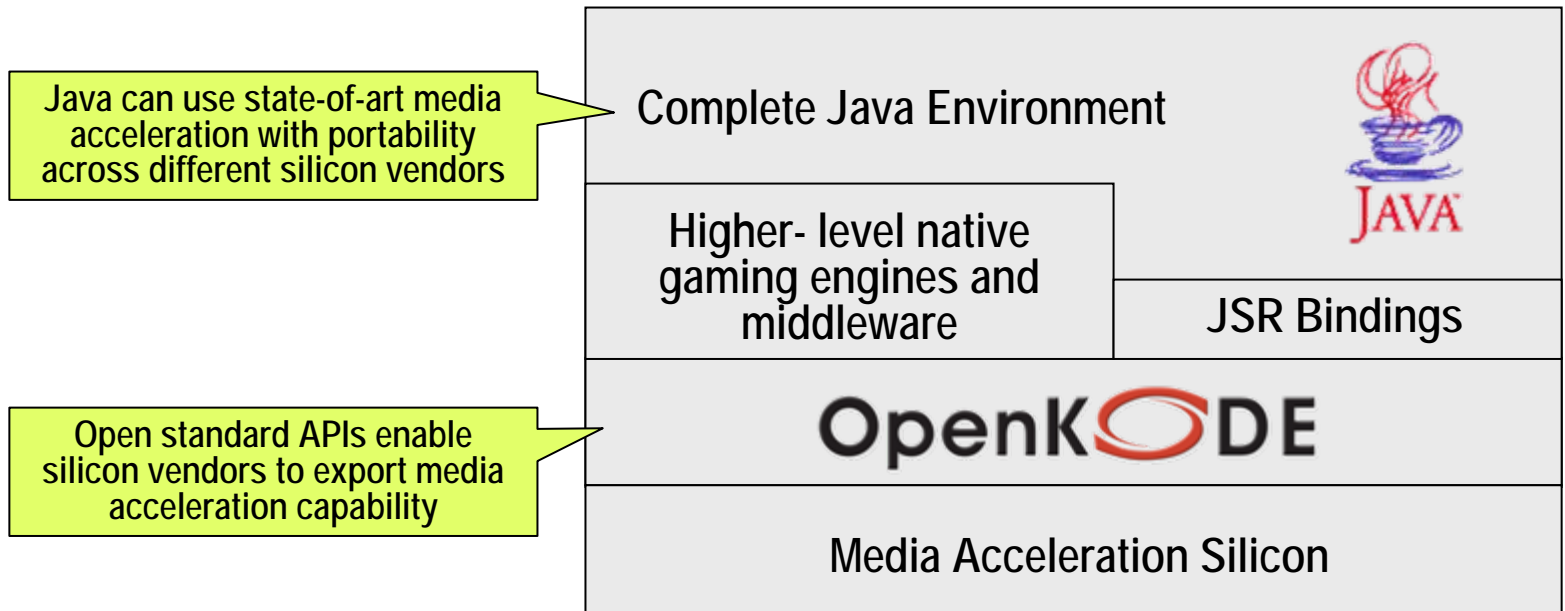
OpenKODE needs to enable smart phones AND feature phones with a native media platform to provide the maximum market for OpenKODE applications



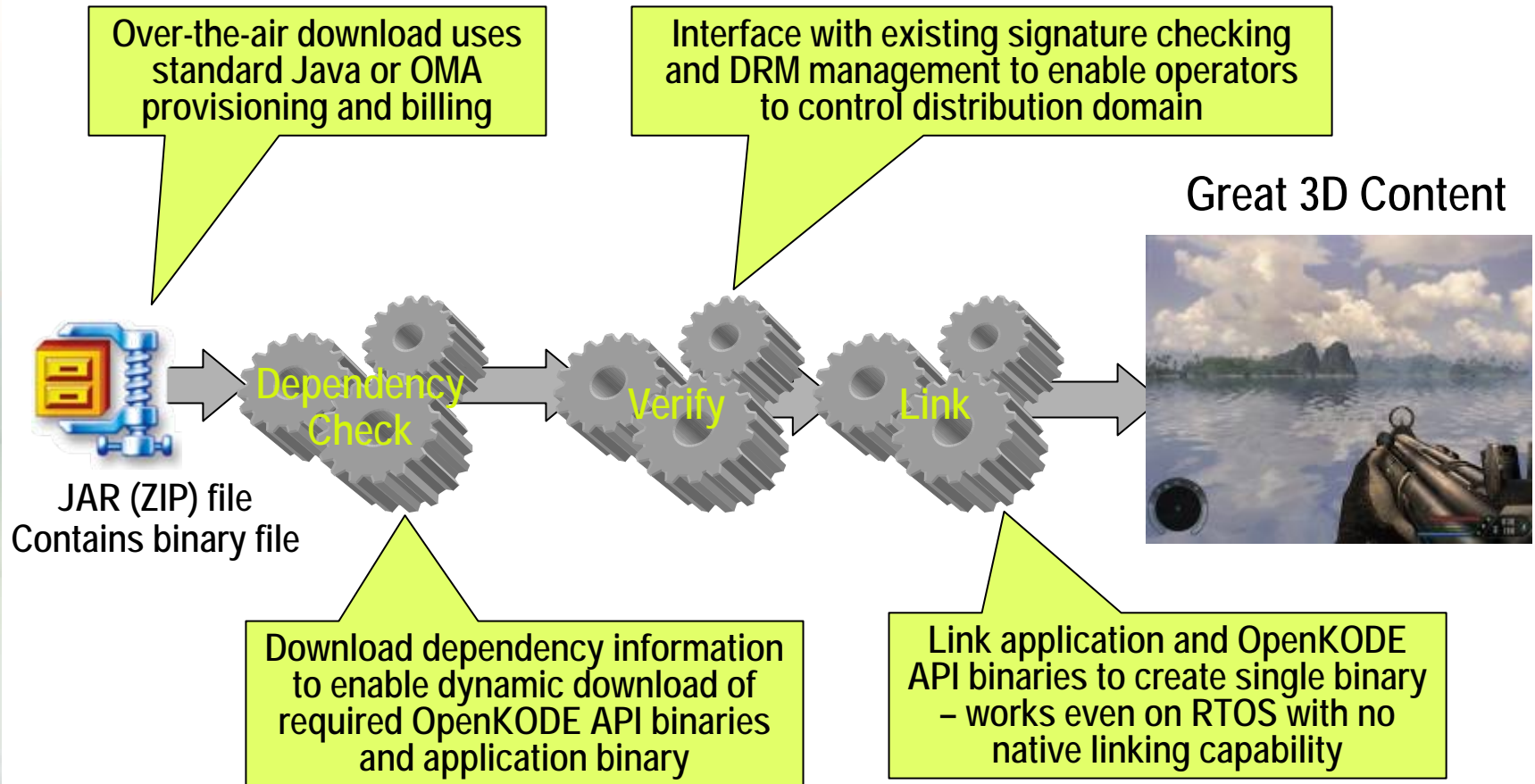
Source: Strategy Analytics, Oct. 2005

OpenKODE and Java

- OpenKODE complements Java – low-level access to media acceleration
 - Use all Java infrastructure – provisioning, billing, key JSRs
- Possibly looking to leverage OSGi and JSR232
 - For flexible component provisioning
- OpenKODE needs high-efficiency Java/native process communications
 - Possibly will use CHAPI



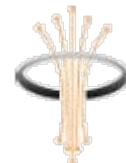
OpenKODE Native Deployment



Possible Consortium Liaisons



Device
Interfaces
e.g. camera



OSGi – for flexible
Java component
provisioning



KWISF
WIPI 3.0
Adoption of
OpenKODE

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OMTP

Carrier platform
recommendations

Provisioning,
DRM,
Device
Management



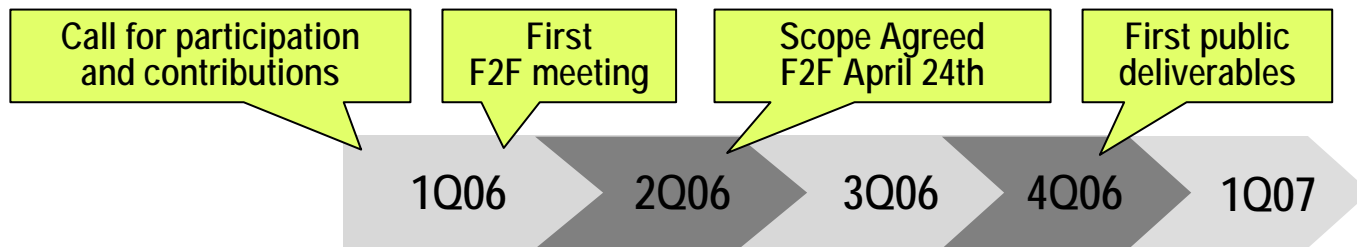
Provisioning,
Java
interfaces



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OpenKODE Milestones

- Aiming for OpenKODE 1.0 release in 2006
 - Keeping things as simple while delivering significant ISV benefit
- Restrict scope to media applications and games
 - Narrow focus will enable rapid development
- Maximize leverage of existing mobile infrastructure
 - E.g. enable flexible Java invocation of native libraries, applications and engines
- OpenKODE is NOT:
 - An operating system, DRM scheme, provisioning scheme or a carrier certification process
 - But it will interface with all of the above
- Working for wide industry adoption on many platforms
 - Java, Symbian, WIPI, Linux, Windows (through 3rd parties), Brew, Nucleus



Why Use Khronos Standards?

- **Khronos is creating a complete, coherent media acceleration platform**
 - To reduce development and deployment costs and increase market opportunity
- **"Foundation Level" APIs**
 - Close to the silicon – fundamental, flexible functionality needed on every platform
- **Designed by industry experts**
 - The industry leaders in media silicon, platforms and software are all Khronos members
- **Flexible, fast-track roadmap evolution**
 - Effective and streamlined process – specification updates every 12 months if needed
- **Royalty-free**
 - Khronos is committed to generating market opportunities for its members and the industry
- **Any company is welcome to join Khronos!**
 - Only \$5,000 / year membership fees

