3D Graphics and SpeqG Update

David Ligon
Product Manager, Staff
QUALCOMM Incorporated
Agenda

• Overview of QUALCOMM® Graphics Cores
• MSM6xxx Update, Including New Cores
• MSM7x00 Update
• MSM7850 Introduction
• SpeqG 100M Gaming Phone Alliance
Convergence Platform provides advanced graphics features not available on PSP and other handheld gaming devices:

- "Defender2"
- "Stargate"
- "Imageon" without SMI
- "Defender3" with SMI

Gameboy Advance

Nintendo DS
### Graphics Core MSM Lineup

<table>
<thead>
<tr>
<th>Gfx Core</th>
<th>Peak Performance</th>
<th>In Production</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>LT 3D</td>
<td>21M TRIS /SEC 133M PIXELS /SEC 532M PIXEL REJECT /S 798M TOTAL INST /S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LT 2D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Imageon 3D</td>
<td>4M TRIS /SEC 133M PIXELS /SEC</td>
<td>7500 DoA</td>
<td>Q1</td>
</tr>
<tr>
<td>Imageon 2D</td>
<td></td>
<td>7200 HSDPA</td>
<td></td>
</tr>
<tr>
<td>Stargate 3D</td>
<td>600K TRIS /SEC 90M PIXELS /SEC</td>
<td>7600 DoA</td>
<td>Q1</td>
</tr>
<tr>
<td>ARM 2D</td>
<td></td>
<td>7200A HSDPA</td>
<td></td>
</tr>
<tr>
<td>Defender3 3D</td>
<td>225K TRIS /SEC 22M PIXELS /SEC</td>
<td>6175 1x</td>
<td>Q3</td>
</tr>
<tr>
<td>ARM 2D</td>
<td></td>
<td>6800A DoA</td>
<td></td>
</tr>
<tr>
<td>Defender2 3D</td>
<td>225K TRIS /SEC 22M PIXELS /SEC</td>
<td>6575 DoO</td>
<td></td>
</tr>
<tr>
<td>ARM 2D</td>
<td></td>
<td>6150 1x</td>
<td></td>
</tr>
<tr>
<td>ARM-DSP 3D</td>
<td>50K - 100K TRIS /SEC 400K - 1M PIXELS /SEC</td>
<td>6550 DoO</td>
<td>Q4</td>
</tr>
<tr>
<td>ARM 2D</td>
<td></td>
<td>6100 1x</td>
<td></td>
</tr>
<tr>
<td>No 3D</td>
<td>N/A</td>
<td>6250A WDCMA</td>
<td></td>
</tr>
<tr>
<td>ARM 2D</td>
<td></td>
<td>6255A WEDGE</td>
<td></td>
</tr>
<tr>
<td>No 3D</td>
<td></td>
<td>6245 WEDGE</td>
<td></td>
</tr>
<tr>
<td>No 3D</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- CDMA UMTS
- QSC WEDGE
- QSC WDCMA
- QSC HSDPA
## Core Feature Summary

<table>
<thead>
<tr>
<th>Gfx Core</th>
<th>APIs Accelerated</th>
<th>MAX LCD</th>
</tr>
</thead>
<tbody>
<tr>
<td>LT 3D</td>
<td>OpenGL ES 2.0, Direct 3D Mobile, SM3 JSR 297, BREW Render 2D Direct Draw, GDI, OpenVG 1.1, SVG</td>
<td>WVGA 800x480</td>
</tr>
<tr>
<td>LT 2D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Imageon 3D</td>
<td>OpenGL ES 1.0 Common + some OpenGL ES 1.1, Direct 3D Mobile, SM2 JSR 184, BREW Render 2D Direct Draw, GDI</td>
<td>WVGA 800x480</td>
</tr>
<tr>
<td>Imageon 2D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stargate 3D</td>
<td>OpenGL ES 1.1 Common JSR 184</td>
<td>QVGA 320x240</td>
</tr>
<tr>
<td>ARM 2D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Defender3 3D</td>
<td>OpenGL ES 1.0 Common Lite JSR 184</td>
<td>QVGA 320x240</td>
</tr>
<tr>
<td>ARM 2D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Defender2 3D</td>
<td>OpenGL ES 1.0 Common Lite JSR 184</td>
<td>QVGA 320x240</td>
</tr>
<tr>
<td>ARM 2D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ARM-DSP 3D</td>
<td>Software / Firmware only OpenGL ES 1.0 Common Lite [no dedicated hardware]</td>
<td>QCIF+ 220x176</td>
</tr>
<tr>
<td>ARM 2D</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Increase in LCD pixel resolution requires higher graphics performance*

<table>
<thead>
<tr>
<th>Year</th>
<th>LCD Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>QCIF+</td>
</tr>
<tr>
<td>2004</td>
<td>QVGA</td>
</tr>
<tr>
<td>2005</td>
<td>WQVGA</td>
</tr>
<tr>
<td>2006</td>
<td>VGA</td>
</tr>
<tr>
<td>2007</td>
<td>WXGA</td>
</tr>
<tr>
<td>2008</td>
<td>WXGA</td>
</tr>
</tbody>
</table>

*Increase in LCD pixel resolution requires higher graphics performance*
"Defender & Stargate" in the MSM6xxx Platforms

ARM Processor
- Single Processor ARM 9
- Fixed Point scaler CPU

QDSP-4
- 3D Geometry and Lighting
- Audio

QUALCOMM designed 3D hardware
- 3D Rasterization
- Hardware Z buffer
- Early Z test
  - efficient processing and power
- 16K optimized texture cache

Mobile Display Processor
- Concurrent 3D rendering & LCD update
- Window/Image scaling, rotation
- Transparent, over and under layers
- Color conversions

Benefits
- Triangle and pixel system balance
- CPU freed up for game play
- Outstanding power/performance ratio
- Defender: OpenGL® ES 1.0 Lite
- Stargate: OpenGL ES 1.1 Common
- JSR 184
- uiOne™ 3D support
Hardware Provides a Better Gaming Experience with Reduced Power (Defender2 examples)

- **CarBen 1**
  - OpenGL ES Software
  - QVGA (320x240)
  - 15 locked at 15 fps
  - 137 mA
  - 157 mA with sound
  - 18 fps Max

- **Ducati Extreme 3D**
  - BREW OpenGL ES 3D
  - QVGA (320x240)
  - 20 frames per second
  - 156 mA
  - Industry standard API
  - 40% Higher Frame Rate

- **Software**
  - Ducati Extreme 3D
  - BREW SWERVE 3D
  - QVGA (320x240)
  - 14 frames per second
  - 169 mA
  - Highly Optimized Proprietary 3D API

- **Hardware**
  - CarBen 1
  - OpenGL ES Hardware
  - QVGA (320x240)
  - 15 locked at 15 fps
  - 117 mA
  - 130 mA with sound
  - 65 fps Max
Over 40 Q3Dimension Hardware Enabled Phones Across 5 Carriers (March 2005)

OpenGL ES on BREW
Other APIs
## Defender2, Defender3, and Stargate Comparison

<table>
<thead>
<tr>
<th>Feature</th>
<th>Defender2</th>
<th>Defender3</th>
<th>Stargate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Z test</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Texture compression</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Fast texture bypass mode</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Fast blending pipeline</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Hardware backface culling</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Fast geometry to pixel engine interface</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Point primitive hardware</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Viewport projection hardware</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Trilinear filter hardware</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Single pass multitexture combiner</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Color cache pre-fetch</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
“Imageon+” in the MSM7200(A), MSM7500(A), and MSM7600

**ARM 9 and ARM 11 Dual CPU**
- Fixed Point Scaler ARM 9 and ARM 11
- ARM 11 for Game Play

**QDSP-5**
- Audio

**Integrated ATI 2D/3D Hardware**
- 2D BLT and Line support
- 3D Geometry & Rasterization
- Texture compression (ATITC)
- Hardware color, Z, and stencil buffers

**Mobile Display Processor (MDP)**
- Concurrent 3D rendering & LCD update
- High quality scaling of 3D frames
- Orthogonal image rotation
- Transparent, over and under layers
- High quality color conversion
- Memory, EBI2, MDDI, and TV out

**Benefits**
- 2D Hardware for high resolution displays
- Complete 3D Hardware pipeline
- Full audio concurrency (MP3, AAC+, 3DFX)
- Integrated high speed memory system
- 3D: OpenGL ES 1.0+ Common
- JSR 184, Direct 3D - Shader Model 2
- 2D: Render2D on BREW, GDI, Direct Draw
- uiOne 3D support

Imageon + MSM 3D Engine Architecture

**SYSTEM MEMORY 1**
- Built-in

**SYSTEM MEMORY 2**
- Built-in

**ARM 9 CPU**

**MODEM**

**ARM 11 MM CPU**

**QDSP-5 (Audio)**

**Improved ATi IMAGEON 2D/3D HW**

**COLOR Z, and STENCIL BUFFERS**

**MOBILE DISPLAY PROCESSOR**

**AXI BUS (2x64 Bits)**

Included in MSM
MSM7500, MSM7200, and MSM7600 Feature Benefits

- Highly efficient “fixed function” pipeline
- Multitexture per-pixel lighting
- Up to 12x more efficient than PSP

<table>
<thead>
<tr>
<th>Simple Light Map</th>
<th>Bump Map Lighting</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Imageon</strong></td>
<td><strong>Requires 10 triangles</strong></td>
</tr>
<tr>
<td>with multitexture</td>
<td><strong>Requires 1x pixels</strong></td>
</tr>
<tr>
<td>Requires 1 rectangle</td>
<td>Requires 1x pixels</td>
</tr>
<tr>
<td>Requires 1x pixels</td>
<td></td>
</tr>
<tr>
<td><strong>PSP single texture</strong></td>
<td><strong>120+ triangles</strong></td>
</tr>
<tr>
<td>Requires 2 rectangles</td>
<td><strong>12x pixels</strong></td>
</tr>
<tr>
<td>Requires 2x pixels</td>
<td></td>
</tr>
</tbody>
</table>
MSM7xxx MDP Scaling Increases Performance by 4x

- Very high quality 4 Tap polyphase non-integer scaling
- No impact on 3D graphics pipeline performance
- **4X peak pixel performance gain by rendering at smaller resolution**
- Particularly useful for high resolution, small dimension displays
- OpenGL ES Extension allows use of scaled or full viewports
- Easily port between different size LCDs with similar aspect ratio

NOTE: QUALCOMM performance specifications are native resolution. Effective pixel performance is up to 4X specifications.
# The MSM7200(A), MSM7500(A), /MSM7600 OpenGL ES 3D Benchmark

<table>
<thead>
<tr>
<th>LCD Size</th>
<th>Rendering Quality</th>
<th>5139 CRM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native 480x640 (VGA)</td>
<td>Excellent</td>
<td>33.9 fps</td>
</tr>
<tr>
<td>Native 800x480 (WVGA)</td>
<td>Excellent</td>
<td>25.2 fps</td>
</tr>
<tr>
<td>Scaled 400x240 (WQVGA) to 800x480 (WVGA)</td>
<td>Very Good</td>
<td>52.5 fps</td>
</tr>
</tbody>
</table>

**Specs:**

3D Geometry
- Avg Triangles Rendered / Frame: 5047*
- Models: 3571* Triangles

Lighting
- Static: 20 Ray traced lights*
- Dynamic: Parallel 1x, Point 2x bump-map per-pixel lights

Textures
- Total Textures: 63* (2.33 MB with compression)

Audio
- MP3 2x (1.73 MB)

Particle Systems
- Fire/Smoke, Explosions, Missile Trails, Lens Flares, Motion Blur

VGA 7500 FPS: 32 FPS VGA*
### MSM7200(a), MSM7500(A), MSM7600 Graphics Core Performance Summary

<table>
<thead>
<tr>
<th>Performance Type</th>
<th>Native Peak Performance</th>
<th>Effective Peak Perf. Using MDP Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triangle rate</td>
<td>4M tri /s</td>
<td>4M tri /s</td>
</tr>
<tr>
<td>Pixel draw rate</td>
<td>133M pixels /s</td>
<td>532M pixels /s</td>
</tr>
<tr>
<td>Multitexture draw rate</td>
<td>67M pixels /s</td>
<td>266M pixels /s</td>
</tr>
<tr>
<td>Z/stencil reject rate</td>
<td>133M pixels /s</td>
<td>532M pixels /s</td>
</tr>
<tr>
<td>Texture filtering rate</td>
<td>133M bilinear filtered texels /s</td>
<td>532M bilinear filtered texels /s</td>
</tr>
<tr>
<td>Alpha blending rate</td>
<td>133M pixels /s</td>
<td>532M pixels /s</td>
</tr>
</tbody>
</table>
“LT” in the MSM7850

ARM 9 and Scorpion Lite Dual CPU
- Fixed Point Scaler ARM 9
- Scaler & Vector Floating Point Scorpion

QDSP-5
- Audio

Integrated ATI 3D Hardware
- Programmable graphics pipeline
- Unified vertex and pixel processor
- Early Z test
- Same high quality texture compression and dedicated memory as MSM7x00

Mobile Display Processor (MDP)
- Concurrent 3D rendering & LCD update
- Same high quality image/frame processing as MSM7x00
- Memory, EBI2, MDDI, and TV out

Benefits
- Programmable graphics effects
- Improved performance and efficiency
- Full audio concurrency (MP3, AAC+, 3DFX)
- Integrated high speed memory system
- Multimedia Interoperability
- 3D: OpenGL ES 2.0
- 3D: JSR 184, Direct 3D Shader Model 3
- 2D: OpenVG, SVG, GDI, Direct Draw
- uiOne support
MSM7850 LT Shader Graphics

- XBOX 360 graphics scaled for mobile devices
- Highly compatible API and functionality
- Scaled by ATI
Pipeline Differences

- **MSM7200(A), MSM7500(A), MSM7600 Fixed Function Pipeline**
  - Highest performance and power for a given chip area

- **MSM7850 Programmable Pipeline**
  - Highest flexibility for advanced gaming effects
MSM7850 LT and Scorpion Performance Benefits

- **Compatibility mode for MSM7x00 Platforms**

- **Up to 3X Imageon Performance**

- **Developer programmable for specialized effects**
  - Triangle and pixel performance automatically balanced on LT

- **Highly efficient Unified Shader**
  - Triangle and pixel performance automatically balanced on LT

- **Up to 512 textures on the LT vs 2 on the Imageon in a single pass**
  - Games typically use less than 4

- **Early depth reject 4 pixels/clock vs 1 pixel/clock on Imageon**
  - Early depth test reduces pixel processing requirements
  - 532M pixels/sec peak reject for LT vs 133M pixels/sec for Imageon

- **2 and 4 Sample Multi-Sample Anti-Aliasing at full rendering speed**

- **Scorpion vector floating point processor big advantage for game developers**
  - Venum vector processor for physics, skinning, tessellation, etc.
Scorpion Mobile Microprocessor Core

- **Scorpion** – low power, high performance superscalar CPU developed by QCT
  - First to develop 1GHz CPU for battery powered wireless applications
  - Low power, low leakage, 65-nm process
  - Specifically designed and optimized for MSM solutions
  - ARM v7 compliant; QCT is an ARM architecture licensee

- **VeNum 128 bit SIMD** – low power, high performance multimedia coprocessor
  - Up to 2X performance boost for multimedia applications

### Feature Comparison

<table>
<thead>
<tr>
<th>Feature</th>
<th>Intel XScale PXA270</th>
<th>Cortex-A8* (Tiger)</th>
<th>Scorpion*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency</strong></td>
<td>624MHz</td>
<td>&lt; 600MHz TI OMAP 3 is 550MHz</td>
<td>up to 1GHz</td>
</tr>
<tr>
<td><strong>Instruction set</strong></td>
<td>V5 WMMX</td>
<td>V7 64 bit Neon</td>
<td>V7 128 bit VeNum</td>
</tr>
<tr>
<td><strong>Performance</strong></td>
<td>780 DMIPS</td>
<td>1200 DMIPS</td>
<td>2100 DMIPS</td>
</tr>
<tr>
<td><strong>Power @ 600 MHz</strong></td>
<td>480 mWatts</td>
<td>300 mWatts</td>
<td>240 mWatts</td>
</tr>
</tbody>
</table>

**CPU Delivers Up To 16x Performance Over Previous QCT Generations**

Collaboration Between QCT and ARM on v7 Architecture

![Graph](image.png)

**NOTE:** Scorpion is based on ARM v7 architecture. VeNum is based on ARM SIMD Neon architecture.
## MSM7850 LT Graphics Core Performance Summary

<table>
<thead>
<tr>
<th></th>
<th>Native Peak Performance</th>
<th>Effective Peak Perf. Using 4X MDP Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triangle rate</td>
<td>Up to 21M tris /s</td>
<td>Up to 21M tris /s</td>
</tr>
<tr>
<td>Pixel draw rate</td>
<td>133M pixels /s</td>
<td>532M pixels /s</td>
</tr>
<tr>
<td>Z/stencil reject rate</td>
<td>532M pixels /s</td>
<td>2128M pixels /s</td>
</tr>
<tr>
<td>Vector Instruction rate</td>
<td>133M instructions /s</td>
<td>532M instructions /s</td>
</tr>
<tr>
<td>Total Instruction rate</td>
<td>798M instructions /s</td>
<td>3192M instructions /s</td>
</tr>
<tr>
<td>Texture filtering rate</td>
<td>133M bilinear filtered texels /s</td>
<td>532M bilinear filtered texels /s</td>
</tr>
<tr>
<td>Alpha blending rate</td>
<td>133M pixels /s</td>
<td>532M pixels /s</td>
</tr>
</tbody>
</table>
Introducing

SpeqG™

100 million gaming phone alliance
SpeqG - 100M Gaming Phone Alliance (GPA) Proposition

- Alliance between Content Providers, Carriers, OEMs, and QUALCOMM to jump start a healthier gaming ecosystem

High volumes of 3D hardware enabled handsets with consistent APIs enable better games with better consumer value and higher ARPU.
3D Gaming Value Proposition

- 100M GPA Compliant Handsets combined with high speed 3G networks enable higher quality premium 3D mobile games at higher retail price points

3D hardware accelerated games offer a higher quality consumer experience

3D games fetch 40% to 90% higher price points on Verizon 3G network

- Bomberman 3D $4.5/mo Japan
- Brother In Arms 3D $9.49 un $3.49/mo US
- Need For Speed 3D $13.49 un $5.49/mo US
- Bomberman 2D $2.7/mo Japan
- Brother In Arms 2D $6.99 un $2.99/mo US
- The Sims II 2D $7.99 un $3.99/mo US
ARPU Generating Services: Games and More...

Games

Avatar Applications

3D UIs

GPS/Mapping
QUALCOMM SpeqG Role

- **QUALCOMM:**
  - Develop SpeqG specification with Carrier, OEM and Content Provider
  - Host and maintain SpeqG web site
    - Public Site: SpeqG member list, SpeqG content videos, SpeqG Handset list
    - Private site: Distribution of Specification, benchmarks, tools, training materials, sample applications
  - Produce developer tools, training materials, community tools, discovery tools such as the BREW Signature Solution
  - Work with CP to provide benchmarks and verification tools
  - Produce marketing materials

- **SpeqG Specification**
  - Minimum requirements for high volumes of phones
  - Focus on most important common requirements for phones
  - Plenty of room and suggestions for differentiation
  - Two-tiered specification to successfully support 3D gaming:
    - 100M GPA Mainstream Handsets
    - 100M GPA High-End Handsets
  - Verification tools for SpeqG devices
  - Includes 3D graphics performance and APIs (BREW, JAVA and WinMobile)
QX Products for MSM Development and Optimization

The problem for game developers:
Custom development for each MSM™ 3D platform
Every component is a time consuming process

The solution:
Provide the components every developer needs

Custom shader tools development
- Shader Authoring Environment
- FX Framework
- FX & Shader Database
- Custom Engine Optimizations
- Script Authoring Environments
- Digital Content Creation Tools
- Custom Exporters optimizations
- 3D Content Database
- Manual Tuning Process
- On-Device Profiling
- Low-Level Graphics Engine
- Per MSM Platform

Custom Engine Optimizations
- Shader Authoring Environment
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QX Shader Pro™
- Shader Authoring Environment
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QX Engine™
- Shader Authoring Environment
- FX Framework
- FX & Shader Database
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- 3D Content Database
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QX Profiler™
- Shader Authoring Environment
- FX Framework
- FX & Shader Database
- Custom Exporters optimizations
- 3D Content Database
- Manual Tuning Process
- On-Device Profiling
- Low-Level Graphics Engine
- Per MSM Platform

Provided on the SpeqG Secure Web Site
Significant Carrier/Developer/OEM tools and documents available through the secure SpeqG Member web site
“How do I Join the 100M Gaming Phone Alliance and grab a share of the potential $3.5B SpeqG gaming market?”

Sign simple Agreement to participate in the 100M GPA, by Category

<table>
<thead>
<tr>
<th>Content Provider</th>
<th>Mobile Operator</th>
<th>OEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>• More revenue</td>
<td>• Higher ARPU from gaming sector</td>
<td>• Higher handset differentiation with carriers</td>
</tr>
<tr>
<td>• Higher return on investment per title to recover higher development cost for 3D</td>
<td>• Reduction in subscriber churn</td>
<td>• Increased handset value with distribution channels</td>
</tr>
<tr>
<td>• Make available SpeqG tuned commercial titles for revenue generation</td>
<td>• Mandate graphics API, graphics performance and SpeqG features in relevant phone models</td>
<td>• Incorporate SpeqG features in phones (better form factor, multi-button press, etc)</td>
</tr>
<tr>
<td>• Provide tuned demo content for promotion, testing and preload on handsets</td>
<td>• Enhance game discovery through preloads, deck visibility and multiplayer gaming community services</td>
<td>• Provide early access SpeqG devices to Content Providers</td>
</tr>
<tr>
<td>• Share SpeqG enabled content portfolio and roadmap</td>
<td>• Participate in joint marketing</td>
<td>• Preload demo content to increase consumer awareness</td>
</tr>
<tr>
<td>• Participate in joint marketing</td>
<td></td>
<td>• Participate in joint marketing</td>
</tr>
</tbody>
</table>
Conclusions

• QUALCOMM provides a wide range of best-in-class integrated graphics hardware for mobile 3D services
• All hardware features are available through industry standard APIs in the BREW environment
• QUALCOMM has new 3D graphics cores for select MSM6xxx Platforms - 100% backwards compatible with existing cores
• The MSM7850 incorporates the Scorpion low power floating point processor and an OpenGL ES 2.0 GPU
• The MSM 3D feature set improves performance even higher than published specifications while reducing power usage
• The SpeqG 100M Gaming Phone Alliance between Mobile Operators, Content Developers, and OEMs will accelerate a multi-billion dollar gaming market
Conclusions

- **3G + 3D** has shown to provide higher ASP and higher ARPU for gaming and graphics related services.

- **QUALCOMM** provides a wide range of best-in-class integrated graphics solutions with the MSM7200 comparable to the DS or PSP.

- Single Chip Integrated graphics solution outperforms coprocessor, with lower cost, and higher volumes.

- Graphics performance is easily accessible through standard APIs such as OpenGL ES, Direct 3D Mobile and JSR 184.

- Top tier content providers are supporting QUALCOMM’s MSM Platforms.
  - And QUALCOMM is supporting top-tier content providers.

- **100M Gaming Handset Alliance** between Microsoft, QUALCOMM, Content Providers, Service Providers, OEMs, will accelerate a multi-billion dollar gaming market.
MSM7850 LT Supports Current and Proposed Future API Standards in Hardware

• 3D APIs
  – Supports OpenGL ES 2.0 specification which will be completed in 2007
    > As does PS3
    > Supports proposed OpenGL ES 2.1 specification expected ratification in 2008
  – Supports DX9 + some DX10 functionality
    > As does XBOX 360
    > Microsoft Shader Model 3
    > Current Windows Mobile D3D API is DX7, Shader Model 2
  – Supports Java JSR 297
    > Programmable API replacement for JSR 184

• 2D
  – OpenVG 2D API
    > Hardware accelerated base API for SVG and Flash
  – Windows Mobile Direct Draw, GDI, and GPE

• Backwards compatible with MSM7500
  – Compatibility mode for MSM7500 OpenGL ES on BREW
  – Available DX7 driver compatible with MSM7500
  – JSR 297 is a superset of JSR 184
  – QUALCOMM provided tools for cross-MSM-platform optimization
Thank You