Mali Ecosystem
For
Next Generation Smart Devices

Leon Zhang
APAC Ecosystem Marketing Manager, MPD
OVERVIEW
Momentum over last 12 months

- ARM® Mali™ GPU graphics leadership position
  - #1 in graphics enabled DTVs (>70%)
  - >20% Android™ smartphones
  - #1 in Android tablets (>50%)

- Mali Graphics: Leadership in DTV
  - ARM Cortex™-A9 and Mali-400 MP chosen by majority of OEMs

- Roadmap to Leadership In Mobile
  - Momentum in Android smartphones driven by Samsung, MediaTek, Spreadtrum, ST-E, Leadcore

- Mali GPUs #1 graphics processor in Android tablets
Leading mobile devices with Mali-T604

- ARM, with Cortex and Mali enabling Google to create market leading devices

Google Nexus 10 Tablet
- Google announced the Nexus 10 tablet
  - Based on Samsung Exynos 5250
  - Cortex-A15 and Mali-T604
  - Android 4.2 GED with 299DPI
  - Renderscript Compute on Mali-T604

Google Chrome Book
- Google announced the new Chromebook based on Samsung Exynos 5250
- Laptop level of performance from mobile SoCs
ECOSYSTEM
Mali Ecosystem Benefits

- Promote silicon & dev boards
- Connect with developers
- Maximize strong partnerships
- Joint marketing activities
- Developer resources
- Showcase visually stunning demos
Leverage Mali Ecosystem Partnership
USER INTERFACE
The UI Experience

- User interfaces exploit the Mali GPU
  - Overlay and alpha blending
  - Complex Transitions
  - Animated icons
  - Video as texture
  - Gesture driven UI
- Increasing GPU performance required for demanding UIs in the future
- Ranging from basic 2D UIs at low resolutions to stereoscopic 3D effects at 1080p with multiple video streams
User Interface Demos from Partners

- Focus on HTM5 & Flash for next generation of UI
- Optimizations to their 3D engine and 3D Algorithms

- Graphics acceleration via OpenGL ES, DirectFB
- A/V Plug-in
- API for C and Lua

- 3D IPTV / STB UI (1080p)
- Rapid UI development using Inflexion
User Interface Demos from Partners

Provide Security, enabling technologies, and interactive applications to the Digital Pay-TV world

- MediaHighway Middleware for STB
- InfiniteTV for OTT on connected TVs

- Provider of 3D UI for DTV in China
- Provider of UI for key Silicon vendors in China
GAME
The Gaming Experience on Mali GPUs

- Engaging with more APAC Gaming partners

- Working with Gaming partners to Optimize for ARM CPUs and Mali GPUs
  - Game Engine providers
  - Game Middleware
  - As well as Game Studios and Developers

- Dedicated engineering support
- Lead access to early hardware
- Introductions to OEMs, Operators and Silicon Providers
- Joint Marketing activities
- Access to the ARM channel and events
Typical Game Structure

Game Specifics
(Camera, AI, Player Mechanics, Gameplay, Game Objects, Animations, Specific Shaders, Game Data, etc...)

Scene Graph
(Scene Management, Render Decisions, High Level Culling, etc...)

Renderer
(Material Management, Shaders, Object Sorting, Postprocessing, etc...)

Scripting
(Event System...)

Geometry

Physics

Audio

Networking

Plugs-ins
(Physics, Lighting, AI, Fluid Dynamics, UI, etc...)

System Libraries (File System, Communications, Threading, STL, Android SDK & NDK etc...)

Operating System (iOS, Android, Linux, etc...)

Drivers (OpenGL ES, DirectX, OpenCL etc...)

GPU

CPU

Typical Game Structure

Typical Game Structure
Working with Cocos2d-x

- Cocos2d-x: Top 2D mobile gaming engine around the world
- Working with Cocos2d-x (Engineer to Engineer) to support profiling, optimizations, ETC1 and z-order implementations on Mali device
- So far 35% performance improvement has been achieved
- See the official thanks message from Cocos2d-x
Working with Unity

- Strategic Relationship (Engineer to Engineer)
  - Mali specific optimizations
  - Further collaborations for next gen Mali, Compute
  - Mali Guide for Unity users

- Collaboration with UNION programme
  - Optimised Madfinger’s Shadowgun on LG Smart TV
Other Game Engines

- **Epic Games – Unreal Engine**
  - Worked with Epic to port and optimise Epic Citadel demo on Nexus10 (released on Google Play in Jan’13)
  - Further collaborations for next version.
    - Targeting Next Gen Mali

- **Havok – Vision Engine**
  - The leading Physics Middleware provider today
  - Also now have the Vision Game Engine
    - Very good engine for rendering extremely complex scenes whilst keeping a smooth frame rate
  - Helped optimize their impressive Fantasy demo, showing what great visuals you can achieve with Mali
Other Game Studios...

- **Fishlabs**
  - High end mobile game developer, responsible for Galaxy on Fire 2, and Sports Car Challenge
  - Worked closely with Fishlabs to ensure their games are optimised for Mali and have Anti-aliasing turned on for greater visual quality
    - Galaxy on Fire 2 & Sports Car Challenge

- **Digital Legends**
  - High end mobile game developer responsible for Battlefield 2, Bruce Lee, and The Respawnables
  - Experienced in porting console titles as well as holding their own IP
  - Worked closely with them to optimise their games to Mali
GPU COMPUTING
Mali GPU Compute is here now!

- **Certified Khronos Conformant**
  - OpenCL 1.1 Full Profile on Linux and Android

- **Mature, Proven in Silicon**
  - Samsung Exynos 5 Dual, implements Full Profile
  - OpenCL and Renderscript DDK available now
  - Proven performance benefits with Kishonti Benchmarks

- **Shipping in real products**
  - Google Chromebook
  - Google Nexus 10
  - InSignal Arndale Community Board

- **API exposed for developers**
  - OpenCL on Linux for Arndale platform
  - Renderscript computation on Android for Nexus 10
Mali GPU Computing Demos

- Physics Simulation (ARM)
- OpenCV Face Detection (ARM)

http://goo.gl/rE61Q
DTV OEMs feedback on OpenCL Use Cases

- **Upscaling**
  - Larger resolutions require significantly more processing power
  - Artefacts generated in today’s algorithms become more evident on larger media, more computation and post-processing is required

- **Convert from 2D to S3D**
  - Complex depth estimation algorithms
  - More accuracy/quality requires more computation and computational complexity

- **Complement hardware codecs**
  - Pre-processing (stabilize, transcode)
  - Post-processing (colour-conversion, filters)

- **Information extraction**
  - Feature/object detection
  - Live superimposition of information

- **User Interfaces**
  - Tracking of multiple viewers
  - Multi-viewer gesture based UI and speech
  - Dynamic auto-stereoscopying
Mali GPU Computing Ecosystem

Computational Photography and Advanced Imaging
- Morpho
- apical
- Synthesis Corporation

Services, Libraries and Tools
- MulticoreWare
- ArcSoft
- codeplay
- AccelerEyes

High Performance Computing
- nag
- Mentor Graphics
- Mont Blanc

Computer Vision Applications
- crunchfish.com
- metaio
- SoftKinetic
- eyeSight

Multimedia Processing
- Ittiem
- Dolby
- Squid Design Systems
- Aricent Group

Large number of additional engagements protected by confidentiality agreement
AUGMENTED REALITY
The Augmented Reality Experience

- Encompasses advanced features from several areas
  - AR = <Augmentation> + Gaming + 3D + Navigation + more
  - Augmentation can be local info, social media content or user specific data
- Utilise the power of the quad core Mali GPU to overlay 3D effects on to the view of the real world
- Rich ecosystem of partners
- ARM present at top AR events!
ARM in the AR Value Chain

Platform/IP

Middleware

Presentation

Application/Content

User/Vendor

ARM

Certified Developers

CPU & GPU powered devices from various silicon vendors

OEM
Marketing and Ad.
Network Operator
Education
You and Me
BROWSER
Acceleration of Rendering

- Layout Compositing, CSS Animation
- Scaling, zooming, panning, progressing rendering
- CSS 3D
- WebGL

The GPU can improve the performance of certain features
Rendering Acceleration on Mali

- Improve different aspects of the browsing experience

- Accelerate parts of the rendering engine using the Mali GPU

- Accelerate HTML5 elements using the GPU
  - Canvas Element – Text & Font rendering – Image scaling – Compositing – CSS animations – etc.

- Improvement of WebGL (OpenGL ES mapping to Javascript)

- Improvements targeting Graphics rendering in various web layout engines
  - “GraphicsContext” in Webkit (Chrome, etc.),
    - Will benefit a wide range of browsers and applications
  - Gecko (Firefox) and Presto (Opera)
Collaboration with Webkit Partners

- **Company100** provides **CanvasGL** GPU Acceleration Library for WebKit
  - CSS3 Animation (Accelerated Compositing)
  - HTML5 2D Canvas (Accelerated 2D Canvas)
  - Optimized for Mali
  - Evidence of improvement in Webkit using Mali GPUs

- **Igalia** provides Open Source Consultancy
  - Specializing in Webkit-GTK (Cairo)

- **Access Netfront NX** browser for TV/STB based on WebKit
  - Support for HTML5 acceleration using OpenGL ES 2.0 has been added
  - Collaboration started to optimize even further on Mali

- **Espial TV Browser** based on WebKit
  - Collaboration started to optimize even further on Mali
Other HTML5 Layout Engines

- **Opera Presto**
  - Opera browser popular in TV
  - Engaged with Opera to optimize Presto on Mali
  - However Opera decided to stop Presto development & switch to WebKit
    - Will leverage the optimisation work on Mali

- **Mozilla Gecko – Firefox OS (AKA Boot to Gecko)**
  - Mozilla announced Fireforx OS for mobile
    - Based on Linux kernel & Gecko HTML5 layout engine
  - Proof of concept was recently shown off running on Samsung GALAXY S II – [http://youtu.be/rfQs_TP1Q6Y](http://youtu.be/rfQs_TP1Q6Y)
    - Already running on **Mali-400 MP**
  - Engaged with Mozilla to optimize Gecko on Mali
  - Demonstrated Spreadtrum based phone @ MWC 2013
TOOLS & DEVELOPER CENTER
Mali Tools

- Mali SDK Releases
  - OpenGL ES SDK
  - OpenCL SDK
- Emulation
  - OpenGL ES 1.1/2.0 Emulator
  - OpenGL ES 3.0 Emulator
- Texture Compression Tool
  - V4.1 released
- Shader Development Studio
- Offline Shader Compiler
- Online Shader Editor
- Mali Graphic Debugger
- DS-5 Toolchain & Streamline
Develop for ARM® Mali™ GPUs and you develop for all major device platforms