



**Imagination**  
TECHNOLOGIES

## **PowerVR GPU Accelerated Augmented Reality**

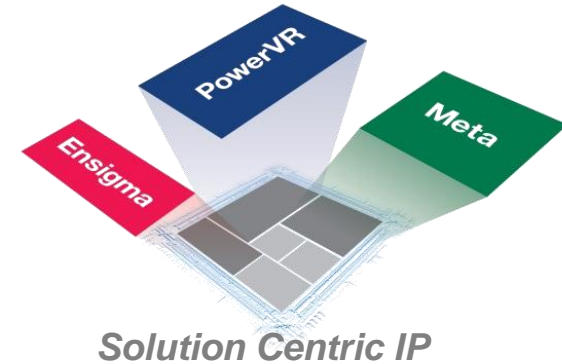
February 2012

# Company Overview



## ▪ Leading Semiconductor IP Supplier

- PowerVR™ graphics, video, display processing
- Enigma™ receivers and communications processors
- Meta™ processors – SoC centric real-time, DSP, Linux
- Licensees: Leading Semis and OEMs
- Selection of POWERVR Graphics licensees on the left
- #3 Silicon Design IP provider



## ▪ Strategic product division: PURE

- PURE digital radio, internet connected audio
- Leading deployment of Flow technology



PURE

## ▪ Established technology powerhouse

- Founded in 1985
- On London Stock Exchange since 1994
- Employees: more than 1000 worldwide
- >600m devices shipped



# Augmented Reality and GPUs



- **GPUs combined with Khronos APIs offer hardware acceleration opportunities for Augmented Reality (AR) applications:**
  - **3D Rendering using OpenGL ES 1.1/2.0 APIs**
    - High quality 3D graphics rendering
    - Can then be blended into the real world camera capture
  - **Camera Image Texture Streaming using EGL/OpenGL ES**
    - Process camera images as textures
    - Enables seamless 3D & Reality integration with minimal CPU loading
  - **Camera Image Processing using OpenCL Embedded Profile**
    - Parallel compute highly efficient on GPUs
    - Perfect match for majority of AR Video Processing and Tracking Algorithms
- **PowerVR SGX S5, SGX S5XT and S6 GPUs enable AR Hardware Acceleration**



# Video Texture Streaming for AR (1)

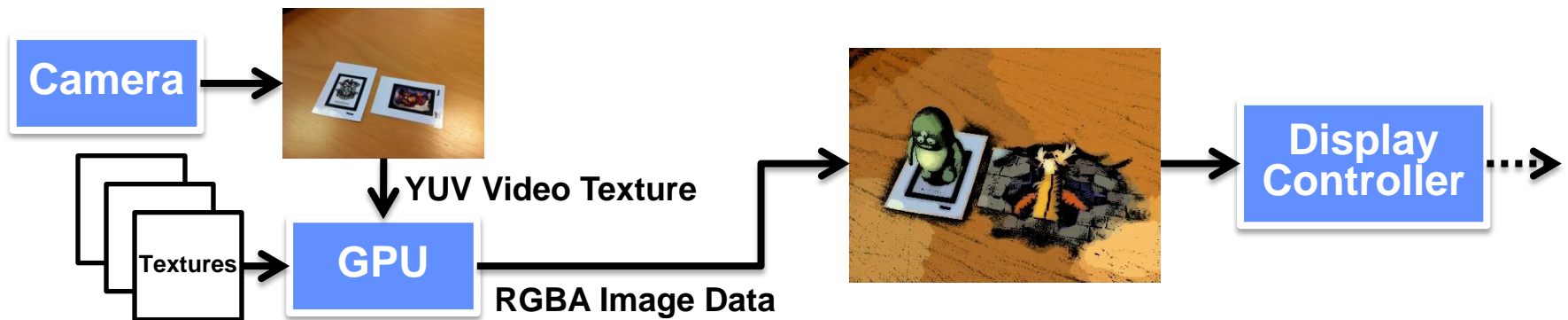
- Efficient integration of Camera images into the 3D rendering flow is essential for good performance and efficiency in AR Applications
  - Overlay – Simple combination using Alpha Blending in the Display Controller



- Critical to avoid CPU Copy and/or CPU based colour space conversions
- Overlay access mechanisms and functionality often platform specific
- Limited to basic AR processing – 3D blended on top of Reality

# Video Texture Streaming for AR (2)

- Efficient integration of Camera images into the 3D rendering flow is essential for good performance and efficiency in AR Applications
  - Texture Streaming – Advanced GPU based combination allows Processing & Distortions



- Critical to avoid CPU Copy and/or CPU based colour space conversions
- All PowerVR GPUs support Texture Streaming
  - Platform Specific Implementation exists e.g. Apple iOS
  - Vendor Specific Implementations exist e.g. IMG\_Texture\_Stream Extensions since 2005
  - Standardisation in progress e.g. Android EGL\_Image\_External

# AR Video Streaming Examples

## iPhone4S with PowerVR SGX543MP2



- **String**

- Framed Image based Marker tracking and 3D Positioning



**String**<sup>™</sup>  
Augmented Reality



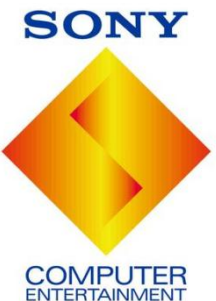
# AR Video Streaming Examples

## Sony PS Vita with PowerVR SGX543MP4+



### ▪ Reality Fighters

- 3D Fighting game in your own living room
- Complex interactions and distortions of the environment



## ▪ Obvious Engine

- Natural Feature Tracking
- Interaction between Camera Content and 3D Content – e.g. distortions, depth complexity



Augmented Reality Technology



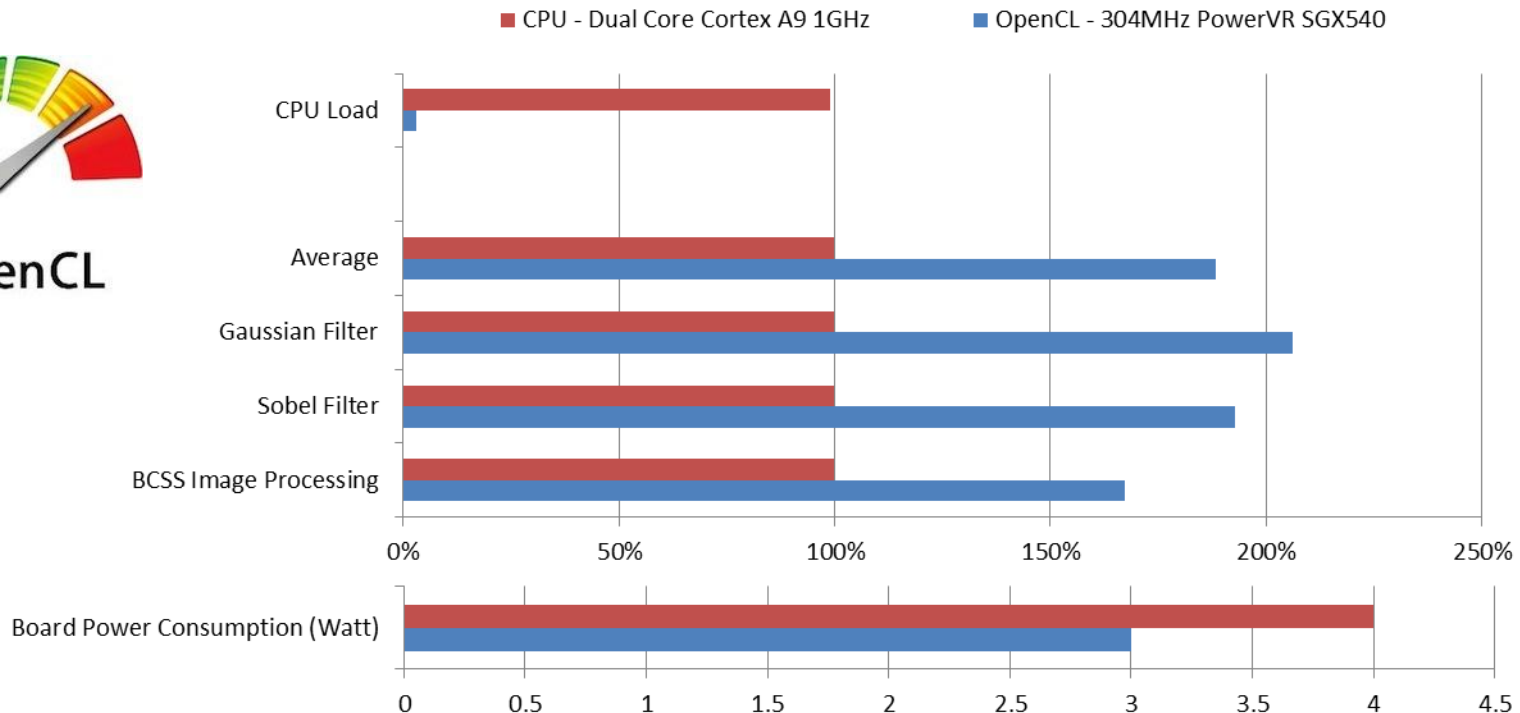


# GPGPU Compute for AR

- AR algorithms are highly parallel in nature and thus a perfect fit for the massive parallel compute capabilities of PowerVR GPUs



OpenCL



- GPGPU on PowerVR offers significant advantages over CPU based processing**
  - Offloads the CPU for other tasks – from 100% down to 1 or 2 % loading
  - Higher performance for parallel algorithms – near 2x (304MHz GPU vs. 1GHz Dual CPU)
  - Offers lower power consumption – almost 1 Watt less power consumed

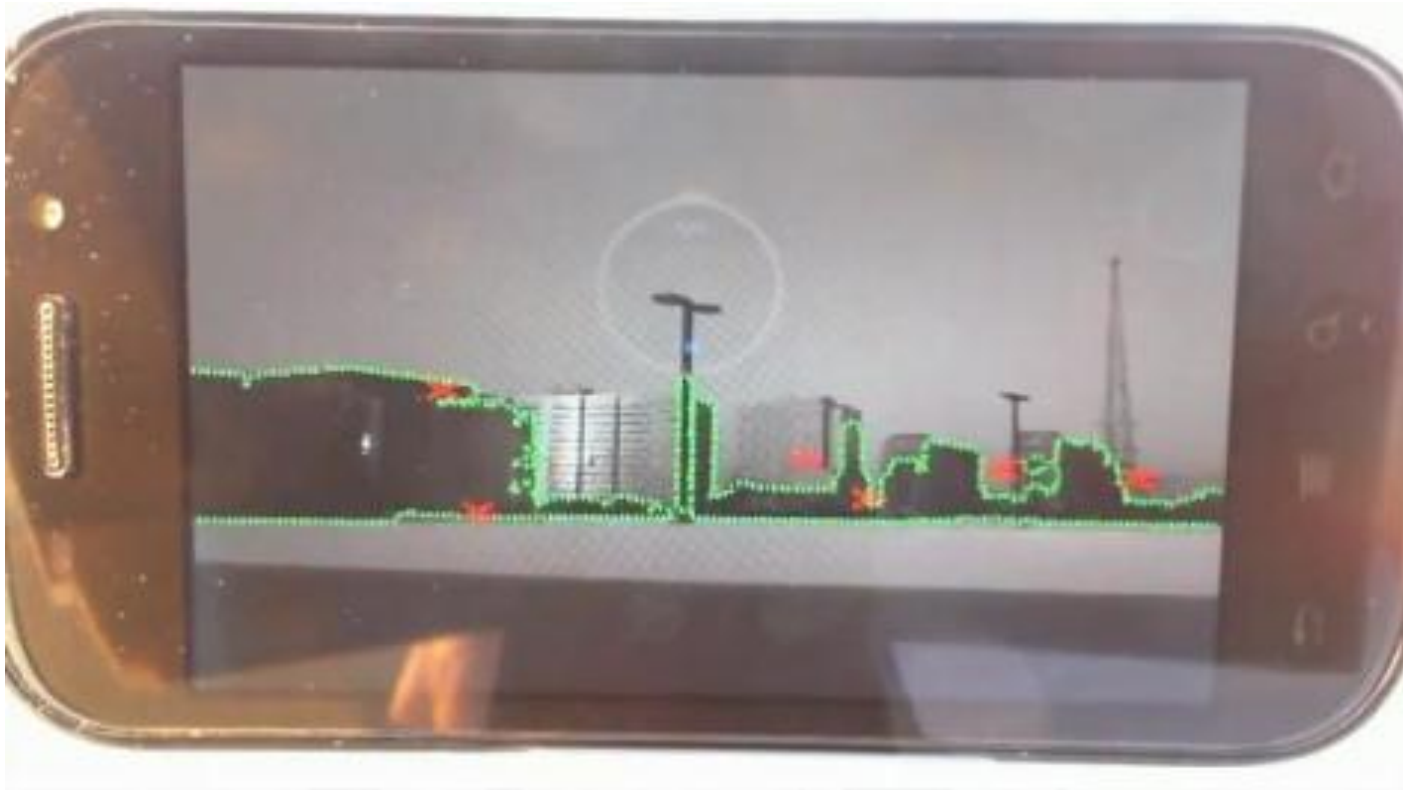
# AR GPGPU Examples

## Samsung GalaxyS – with PowerVR SGX540



- **Feature tracking with Chan/Vese Active Contours**

- Higher performance and lower power consumption than using ARM Cortex A9 CPU



# GPU Accelerated AR Resources

## Toolkits, Guidelines and Support Resource



- **Many AR Toolkits and frameworks available today**
  - Most are focussed on Apple iOS and/or Android
  
- **Some useful AR links to check:**
  - Accelereyes - <http://www.accelereyes.com/products/mobile>
  - Obvious Engine - <http://obviousengine.com/>
  - String - <http://www.poweredbystring.com/>
  - Metaio - <http://www.metaio.com/>
  - ARToolkit - <http://www.hitl.washington.edu/artoolkit/>
  - Vuforia - <https://developer.qualcomm.com/develop/mobile-technologies/augmented-reality>
  
- **Need help with OpenGL ES for PowerVR enabled devices ?**
  - Visit [www.khronos.org](http://www.khronos.org) for API Specifications
  - Check [www.powervrinsider.com](http://www.powervrinsider.com) for latest tools and guidelines
  - Contact [pvrdevtech@imgtec.com](mailto:pvrdevtech@imgtec.com) for technical support
  
- **Interested in GPGPU and OpenCL or want to see the demos running ?**
  - Visit our booth here at MWC - Stand in Hall 1 - 1D45



**Imagination**  
TECHNOLOGIES

## **PowerVR GPU Accelerated Augmented Reality**

February 2012