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## **EUROPEAN UNION FUNDS RESEARCH INTO LOW POWER GRAPHICS**

### **GPU CONSORTIUM AWARDED €2.97M R&D GRANT TO RESEARCH AND DEVELOP POWER AND PERFORMANCE ANALYSIS FOR APPLICATIONS RUNNING ON LOW POWER GRAPHICS PROCESSOR UNITS**

Graphics researchers at Samsung Electronics UK have teamed up with mobile graphics specialists Codeplay, Think Silicon and TU Berlin to develop a tool for enabling smartphone batteries to last longer while running advanced video games and using the camera.

The EU Commission has awarded a European GPU consortium a grant of 2.97 million Euros to research and develop a novel tool chain for analysing, visualizing, and improving the power efficiency of applications on mobile Graphics Processor Units (GPUs).

The consortium includes three European technology companies: Codeplay, the Edinburgh based GPU technology company, Think Silicon (a Greek low gate-count Graphics Semiconductor IP Core company) and Samsung Electronics UK Ltd. TU-Berlin (Germany), a European University, completes the group.

#### **The key objectives of the 2 and a half years research project are:**

- Define new industry standards for resource and performance monitoring to be widely adopted by embedded hardware GPU vendors (Khronos group)
- Define a methodology for accurate power estimations for embedded GPU.
- Enhance existing Dynamic Voltage and Frequency Scaling (DVFS) mechanism for optimum power management with sustained performance.
- To improve the power efficiency of compute and graphics applications running on mobile GPUs
- Build a unique power and performance visualization tool which informs application and GPU device driver developers of potential power and performance improvements.

**Andrew Richards, Codeplay CEO said:**

“Working within this expert team across business and academia to analyse power consumption of videogames and camera processing is a fabulous opportunity for us at Codeplay. It will enable us to solve a very challenging problem: lengthening battery life of smartphones while running the most advanced graphics processing.”

**Ben Juurlink, project coordinator and professor at TU Berlin, adds:**

“Searching for the performance and energy bottlenecks in applications running on embedded GPUs is like searching for a needle in a haystack. It is absolutely crucial that application developers are supported in this challenging task by smart analysis and visualization tools. Current embedded GPUs are powerful enough to execute immersive applications that we could only dream of a few years ago. However, all this compute power is good-for-nothing if the battery lasts for a few minutes only.”

**Philip Harmer, of Samsung commented:**

“Consumers have become used to powerful, responsive graphics in mobile phones. They now rightly expect long battery life too. The LPGPU2 project will provide an advanced analytic tool for developers to improve the power usage and performance of their applications.”

**Dr Iakovos Stamoulis, Think Silicon CTO adds:**

“The severely constrained power budget of new mobile and IoT/wearable devices with rich immersive multimedia capabilities shifts the design focus from performance to power in order to meet the toughest specifications. It is of absolute importance to holistically optimize systems at all levels: hardware, algorithmic and application software to minimize power consumption. LPGPU2 Project will provide the means to measure, explore and identify energy usage, which is of utmost importance to achieve the required efficiency.”

## **About TU Berlin – <http://www.tu-berlin.de>**

TU Berlin looks back at a long and distinguished tradition of teaching and research. In 1799 its most important predecessor, the Building Academy, was founded. In 1946 the university was re-established under the name of Technische Universität Berlin. The seven Faculties of the university offer 100 courses of study from the fields of engineering and natural sciences, economics and business, planning sciences, humanities and the social sciences. Enrolment at TU Berlin is about 32,000 and about 315 professors and an academic staff of 2,600 instruct the students, making it one of the largest technical universities in Germany.

TU Berlin participates in the project through the Embedded Systems Architectures (*Architektur eingebetteter Systeme*, AES) laboratory of the School of Electrical Engineering and Computer Science. The AES laboratory investigates and teaches the field of computer architecture, ranging from low-power embedded systems to massively parallel high-performance systems. Its current

research focuses include multi-/many-core architectures and GPUs, development and optimization of highly scalable parallel applications, and (architecture support for) parallel programming models. More information on the AES laboratory is available at <http://www.aes.tu-berlin.de/en>.

## **About Codeplay - <http://www.codeplay.com>**

Codeplay is internationally recognized for expertise in Heterogeneous Systems, and has many years of experience in the development of Compilers, Runtimes, Debuggers, Test Systems, and other specialized tools.

Codeplay has delivered standards-compliant systems for some of the largest semiconductor companies in the world, focusing specifically on high-performance heterogeneous processor solutions for CPUs, GPUs, DSPs, FPGAs and other specialized imaging and vision processors. Working within The Khronos™ Group to define new open standards such as OpenCL™, SPIR™, SYCL™, and Vulkan™, and leading the creation of new System Runtime and Tools standards through the HSA Foundation, Codeplay has earned a reputation as one of the leaders in compute systems.

The vast expertise gained in building optimized close-to-the-metal technology for customers has been utilized in developing Codeplay's ComputeSuite™ product. It combines the high-level ComputeCpp™ easy-to-use C++ standard development tools, with the low-level ComputeAorta™ heterogeneous runtime technology to ensure that open standards-based parallel software can run on the widest possible range of platforms and devices. By being modular and standards-based, software developers can mix and match components to ensure that their software runs anywhere and exploits the full power of the underlying system.

Throughout its history, Codeplay has also participated in international research projects, with partners from the largest hardware vendors to the most cutting-edge startups, and the expert academics in our field. The focus of these projects has covered optimizing high-performance graphics techniques at low power for mobile and embedded devices, ensuring that performance is portable and investigating its impact across a variety of different heterogeneous systems, and analyzing whether new compilation techniques can assist in making software faster and more power-efficient. The results of this research provide the drive for products that are made available to customers and associated developers.

## **About ThinkSilicon - <http://www.think-silicon.com>**

Think Silicon develops Graphics Processors (GPUs) and Display Processors/Controllers for the IoT, Wearable and broader display devices markets, and its growing demand for ultra-low power, area and memory constrained SoCs. A cost efficient but still vibrant 3D/2D graphics experience is a key element to succeed but without sacrificing visual performance and dispense the ability of ultra-low power consumption. Think Silicon's configurable GPUs have a wide range of operation areas and

applications such as fitness, lifestyle, healthcare, infotainment, automotive, security etc. and can drive displays from 1.32" up to 6.0" and resolutions from 320x320 up to full HD. The Display Controller IP is a powerful "Swiss Army Knife" which contains multiple smart tools and functionalities to compose graphics and process video signals up to 8K resolutions on multiple layers.

Think Silicon's IP has been licensed to leading semiconductor companies for display, multimedia, VoIP, Wearables applications and microcontroller and IoT platforms.

Think Silicon S.A. was founded in 2007, has locations in Patras, Greece (DC + HQ), Toronto, Canada (HQ North America) and San Jose, CA, USA (Sales office).

## **About Samsung Electronics UK Ltd. - <http://www.samsung.com>**

Samsung Electronics Co., Ltd. inspires the world and shapes the future with transformative ideas and technologies that redefine the worlds of TVs, smartphones, wearable devices, tablets, cameras, digital appliances, printers, medical equipment, network systems, and semiconductor and LED solutions. We are also leading in the Internet of Things space with the open platform SmartThings, our broad range of smart devices, and through proactive cross-industry collaboration. We employ 319,000 people across 84 countries with annual sales of US \$196 billion. To discover more, and for the latest news, feature articles and press material, please visit the Samsung Newsroom at [news.samsung.com](http://news.samsung.com).

Samsung R&D Institute UK based in Staines-upon-Thames near South West London is a division of Samsung Electronics (UK) Ltd. Samsung R&D Institute UK is responsible for driving the company's involvement within the Khronos Group. Samsung sits on Khronos' board as a Promoter member, and our engineers actively participate in multiple working groups, particularly focussed on standardisation in the graphic-OS integration domain and shaping future graphics APIs. Since January 2014, we have taken on the role of chairing the EGL working group, and subsequently also chairing Khronos' Technical Advisory Panel, which discusses new standardisation ideas and cross working group topics. Samsung was also instrumental in forming the Window System Integration sub-group for the Vulkan API, which we now chair.

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