

New project to plug the software-stack support gap for energy-efficient computing

Due to fundamental limitations of scaling at the atomic scale, coupled with the heat density problems associated with packing an ever-increasing number of transistors in a unit area, Moore's Law has slowed down. Heterogeneity aims to solve the problems associated with the end of Moore's Law by incorporating more specialized compute units in the system hardware and by utilizing the most efficient compute unit for each computation. However, while in recent years significant advances have been made to support heterogeneity for performance, for power- and energy-efficient computing it is severely lacking.

The overall objective of the LEGaTO project is to produce a software stack to support energy-efficient heterogeneous computing. The project will strive to achieve this objective by employing a task-based programming model which is energy efficient by design coupled to a dataflow runtime, while simultaneously ensuring security, resilience and programmability.



Specifically, the LEGATO project aims to:

- improve the energy efficiency of heterogeneous hardware by an order of magnitude through the use of the energy-optimized programming model and runtime
- reduce the size of the trusted computing base by at least an order of magnitude
- reduce meantime failure rate fivefold while decreasing the energy consumption
- improve FPGA programmer productivity fivefold by leveraging novel features of dataflow hardware design

As stated by [Osman Unsal](#) and [Adrian Cristal](#), coordinators of the LEGaTO project: "Moore's Law is slowing down, and as a consequence hardware is becoming more heterogeneous. In the LEGaTO project, we will leverage task-based programming models to provide a software ecosystem for Made-in-Europe heterogeneous hardware composed of CPUs, GPUs, FPGAs and

dataflow engines. Our aim is one order of magnitude energy savings from the edge to the converged cloud/high-performance computing (HPC).”

The energy-efficient software toolset for heterogeneous hardware developed within the LEGaTO project will be applied in three use cases:

- **Healthcare:** a decrease in energy consumption in the healthcare sector and an increase in healthcare application resilience and security – both critical requirements in this area.
- **Smart homes and smart cities:** the project will demonstrate how programming can be simplified and energy savings made through the use of the LEGaTO project software–hardware framework for the Internet of Things (IoT), smart homes and smart cities applications. Sensitive sensor information and actuator instructions can be received and sent via the developed secure IoT gateway.
- **Machine learning (ML):** improve energy efficiency by employing accelerators and tuning the model architecture at runtime.

About LEGaTO

The [LEGaTO](http://www.legato-project.eu) (Low Energy Toolset for Heterogeneous Computing) project is funded by the European Commission with a budget of more than €5 million and will last 3 years from its beginning on 1 December 2017. The partners of the project are Barcelona Supercomputing Center (BSC, Spain), Universität Bielefeld (UNIBI, Germany), Université de Neuchatel (UNINE, Switzerland), Chalmers Tekniska Högskola AB (CHALMERS, Sweden), Machine Intelligence Sweden AB (MIS, Sweden), Technische Universität Dresden (TUD, Germany), Christmann Informationstechnik + Medien GmbH & Co. KG (CHR, Germany), Helmholtz-Zentrum für Infektionsforschung GmbH (HZI, Germany), TECHNION - Israel Institute of Technology (TECHNION, Israel), Maxeler Technologies Limited (MAXELER, United Kingdom).

Further information: <http://www.legato-project.eu>



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