"TANGO is an easy solution to simplify complexity in Heterogeneous Hardware configurations"

The objective of providing technologies and tools in order to facilitate the adoption of new Heterogeneous Hardware is under the name of TANGO. It is a fact that Hardware architectures solutions expect a big impact in other sectors such as IoT (Internet of things), Wearables, High Performance Computing (HPC), Embedded devices and more future coming technologies as Quantum Computing. TANGO, has focused on developing and deploying a range of use cases to apply research results across different domain, as a result of these use cases TANGO launched two; in HPC and in Embedded scenarios.

On one hand, the market of HPC is expected to growth in next years due to the increasing need of powerful storage centers to process data for several devices and technologies. From the period 2016-2021, is expected 6.2% CAGR in HPC market. For experts in HPC field solutions can improve energy efficiency, optimize cost, security and performance, among other quantitative results; challenges what are highly demanded by industry and society. (https://goo.gl/bkKdA2). On the other hand, Embedded market is expecting for 2021, around 700 USD Billion of incomes. This kind of technology is highly demanded because electronic devices are increasing its use globally, as well as more power efficiency and smarter devices are needed, being Embedded Hardware against Embedded Software the main actor and beneficiary of income results, over 90% share of total market, where TANGO is working to develop nice results. (https://goo.gl/d5Gzdc).

Since TANGO comes to a solid proposal, all its members got sure about the impact in heterogeneous parallel architectures because tasks at this level are increasing complexity, algorithms and environments are getting more specialized, so solutions such as TANGO, are able to face this new mixed and diversified parallel architectures, at least to open the path toward the future. As an example, TANGO approaching consist on complement actual running application platforms with new platforms incorporating multi-core CPUs and many-core GPUs and additional devices, doing this the results expected are low power consumption, more effective and optimized processes. TANGO has been increasing its maturity by little steps, during 3 years of project life. But TANGO is possibly far to be considered only a research project because its result is more than a simple project objective fulfilled. For this reason, we are proud to announce that **Final Release of TANGO Toolbox has arrived!**

TANGO Toolbox is the result of a set of tools specialized in controlling and abstracting underlying heterogeneous hardware architectures, configurations and software systems including heterogeneous clusters, chips and programmable logic devices. Toolbox provides relevant outputs such as reduce energy consumption, best performance, improving security

and reducing dependability among machines. For further details you can read a [whitepaper](#) developed by our experts.

In this final step of the project, we cannot forget the mission under TANGO determined the objectives to be following during the project life. The mission aimed to provide a framework for the exploitation of heterogeneous parallel architectures supported by a complete methodology that enables software designers to easily implement and verify applications running on such platforms including general-purpose processors and acceleration modules implemented in the latest reconfigurable technology. So, at this point, TANGO can conclude very proud of has been fulfilling every objective and strategy, successfully.

Furthermore, taking advantages of innovation challenge, it is our intention to show the best assets made by every partner contribution and share specific and technical details to keep you updated in case of considering interested collaboration or extend this research work. TANGO, propose an easy way to connect with the public out, as Open Source license everyone who feel curiosity can get in and mess around our code.

TANGO team is proud of obtaining the following objectives settled at the beginnings:

- Proposed and implement a self-adaptive reference architecture
- Extend existing software development models and technologies for Heterogeneous parallel architectures
- Develop an energy aware hardware agnostic programming environment
- Develop and evaluate a self-adaptive model with identified low power parameters and QoS metrics
- Develop hardware power consumption and software energy models

TANGO Toolbox is the solution that amalgamate a set of tools to reach these previous objectives.

Thomas Cadeau, Technical Product Owner from HPC R&D at Bull Technologies in Atos, affirms that *"In the TANGO project, we have demonstrated the gain on energy by using the set of tools evaluated in HPC use cases on a heterogeneous infrastructure"*.

Bruno Wery, R&D Manager at Deltatec, says that "*The TANGO framework is bringing a major cornerstone for integration of heterogeneous technologies: its programming model. We have demonstrated that this technology can be transferred from the HPC towards the embedded world*".

Moreover, TANGO launched the [Heterogeneity Alliance](#), a network of organizations and projects that aim to leverage tools and technologies to advance and take full advantages of future applications that will use heterogeneous architectures. Some of the advantages to be part of Alliance are: seamless feedback from the rest of members involved also in

Heterogeneous systems, updated information about new projects or investigations into this line, have more presence in events and conferences related to this topic and finally the possibility to have more impact in Europe´s organizations, experts communities and industry.

According to Karim Djemame, Scientific Coordinator at Leeds University *"TANGO is extremely useful within distributed and complex systems as it provides the right tools to handle heterogeneity".*

The initiative has been supported by the European Commission and was funded through the Horizon 2020 program, with a duration of 36 months and a budget of 3,199,625 euros. The initiative involves: global service provider Atos (Spain) and its HPC subsidiary, Bull (France); an European SME DELTATEC (Belgium); a research team at the University of Leeds (UK); CETIC - Center for Excellence in Information and Communication Technologies (Belgium); and Barcelona Supercomputing Center (Spain).

Contact info

Clara Pezuela, Project Coordinator (clara.pezuela@atos.net)