<table>
<thead>
<tr>
<th><strong>ANTAREX</strong></th>
<th>AutoTuning and Adaptivity appRoach for Energy efficient eXascale HPC systems</th>
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<tr>
<td><strong>Call:</strong></td>
<td>H2020-FET-HPC-1-2014</td>
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<tr>
<td><strong>Type of action:</strong></td>
<td>H2020: Research &amp; Innovation Actions (RIA)</td>
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<td><strong>Topics:</strong></td>
<td>HPC Core Technologies, Programming Environments and Algorithms for Extreme Parallelism and Extreme Data Applications</td>
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<td><strong>Subtopic</strong></td>
<td>b) Programming methodologies, environments, languages and tools</td>
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<td><strong>Project Coordinator</strong></td>
<td>Cristina Silvano, Politecnico di Milano</td>
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<td><strong>EC Contribution</strong></td>
<td>3, 115, 251 euro</td>
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<td><strong>Project start:</strong></td>
<td>September 1st, 2015 (duration 3 years)</td>
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<td></td>
<td>Kick-off meeting held at CINECA (Italy)</td>
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To reach the DARPA’s target of **20MW** of **Exascale supercomputers** projected to 2020, current supercomputers must achieve an energy efficiency “quantum leap”, pushing towards a goal of **50 GFlops/W**.

Heterogeneous systems currently dominate the top of the **Green500 list** and this dominance is expected to be a trend for the next coming years to reach the target of 20MW Exascale supercomputers.

**Energy-efficient heterogeneous supercomputers** need to be coupled with a radically new software stack capable of exploiting the benefits offered by heterogeneity at all the different levels (supercomputer, job, node) to meet the scalability and energy efficiency required by the Exascale era.
Target Scenario

- To reach the DARPA’s target of 20MW of Exascale supercomputers projected to 2020, current supercomputers must achieve an energy efficiency "quantum leap" towards the goal of 50 GFlops/W.

The main goal of the ANTAREX project is to provide a breakthrough approach to express by a Domain Specific Language the application self-adaptivity and to runtime manage and autotune applications for green and heterogeneous High Performance Computing (HPC) systems up to the Exascale level.
1. Dynamic self-monitoring and self-adaptivity or «autotuning» HPC applications with respect to changing workloads, operating conditions and computing resources.

2. Programming models and languages to express self-adaptivity and extra-functional properties.
   - Introducing a separation of concerns between extra-functional strategies (self-adaptivity, parallelisation, energy/thermal management) and application functionality by the design of a new aspect-oriented Domain Specific Language.

3. Exploiting heterogeneous computing resources in Green HPC platforms by runtime resource and power management
The ANTAREX Approach

- Introducing a new DSL (as and extension of the LARA language) for expressing **adaptivity and autotuning strategies**.
- Enabling performance/energy control loops by introducing **software knobs** (application parameters, code transformations and code variants) to be tuned w.r.t. the execution environment and the dynamic workload properties.
- **Runtime adaptive resource allocation and power management** (job dispatching, task scheduling, dynamic voltage/frequency scaling and cooling control).
- **Monitoring** the evolution of the supercomputer as well as the application status to provide feed-back to the ANTAREX energy/performance-aware software stack.
Progress beyond state-of-the-art

Programming Models, Language & Compilers

Application Scenarios

Self-Adaptivity & Application Autotuning

Runtime Resource & Power Management

Target HPC Systems
Two HPC application scenarios

1) A biopharmaceutical HPC application for accelerating drug discovery provided by Dompé and to be deployed on the 1.2 PetaFlops heterogeneous NeXtScale Tier-1 Intel-based IBM system at CINECA.

2) A self-adaptive navigation system provided by SYGIC to be used in smart cities and deployed on the server-side on an heterogeneous Intel-based PetaFlops class system given by IT4Innovations Supercomputing Center.