Towards EXtreme scale Technologies and Accelerators for euROhpc hw/Sw Supercomputing Applications for exascale

Innovative Two-Phase Cooling Solutions for the Exascale Computing Systems

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TEXTAROSSA: Towards EXtreme scale Technologies and Accelerators for euROhpc hw/Sw Supercomputing Applications for exascale

TEXTAROSSA is an European project funded by EuroHPC (The European High Performance Computing Joint Undertaking)

The project will develop core technologies for computing architectures towards exascale-class systems.

Objectives: to realize the EuroHPC roadmap for energy-efficiency, high-performance and secure services by enabling new computation paradigms for HPC, AI and HPDA applications

Innovative Two-Phase Cooling system for thermal control
**TEXTAROSSA:** Towards EXtreme scale Technologies and Accelerators for euROhpc hw/Sw Supercomputing Applications for exascale

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<th>Participant No.</th>
<th>Participant organisation name</th>
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Thermal Control of Electronics: Problem

Driven by the continuous increase in power loads and continuous miniaturization of processors, thermal management presents a complex challenge to thermal engineers.

Present cooling solutions are not adequate (air cooling, heat pipes, liquid cooling) for demanding electronics and future requirements.
Thermal Control of Electronics: Problem

COOLING TECHNOLOGIES

Air (Natural/Forced Convection, Sensible Heat)

Liquid (Natural/Forced Convection, sensible heat)

Phase Change (evaporation & condensation, latent heat)

Evaporative Liquid Cooling

Given the rate of heat dissipation and the maximum allowable component temperature, the graph helps to determine the appropriate cooling technology.

Temperature difference is the difference between the case surface temperature (max. allowable value) and the ambient temperature.

Surface heat flux is determined by dividing the power dissipation rate to the exposed surface of the device.

Temperature difference versus heat flux for some heat transfer mechanisms

Kraus and Bar-Cohen, 1983
Thermal Control of Electronics: Solution

Two-Phase cooling technology
Evaporative Liquid Cooling

Two-Phase Mechanically Pumped Loop: a new cooling technology for the next generation of electronic components (Data Centers)

The innovative feature of this system is the use of flow boiling heat transfer (latent heat) for cooling electronic devices. Compared to traditional cooling systems, significantly higher heat transfer coefficients can be achieved at significantly lower flow rates and pumping power.

Flow boiling is one of the most efficient cooling systems. It is the cooling systems of the components of fusion reactor (ITER).
Thermal Control of Electronics: Solution

Two-Phase cooling technology
Direct to Chip Two-Phase Cooling

Features:
1. Decrease energy consumption.
2. Increase processing capacity
3. Increase density
3. Safety: dielectric fluids

![Image of thermal control system](image-url)
TEXTAROSSA: Two-Phase Cooling

WP 3 Development of the two-phase cooling technology
Leader: InQuattro.
Partners: ATOS, E4-Company, ENEA, Politecnico di Milano

The Two-Phase Cooling system will be installed in two server configurations:

1. FPGA platform (E4-Company)
2. GPU platform (ATOS)

Objectives
1. Performances (thermal power dissipation, energy efficiency)
2. Modeling of the cooling system
3. Development of thermal and power management strategies
In Quattro is a registered Italian start-up (July 2018) with a strong expertise in thermal management systems for terrestrial and space applications.

In Quattro develops and manufactures advanced two-phase cooling solutions for thermal management of high performance computers and high power electronics.

In Quattro is a spin-off of ENEA (Italian National Agency for New Technologies, Energy and Sustainable Economic Development).

In Quattro is included in the ESA (European Space Agency) Business Incubation Centre in Rome (Regione Lazio), Italy.
In Quattro - Who We Are

In Quattro was formed by four researchers of ENEA with strong background in Two-Phase Thermal Management of nuclear reactors and of components for space.

The team has 14 years of experience in microgravity thermal management systems, and have been performing many parabolic-flight campaigns in the frame of ESA projects.
In Quattro team is formed by 11 people in different areas: thermal engineering, legal, marketing, management, design, electronics, sensors
THANK YOU FOR YOUR ATTENTION!

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