A lightweight software stack and synergetic meta-orchestration framework for the next generation compute continuum

Project Summary
NEPHELE is a RIA (Research and Innovation Action) project funded by the Horizon Europe programme under the topic “Future European platforms for the Edge: Meta Operating Systems”. Its vision is to enable the efficient, reliable and secure end-to-end orchestration of hyper-distributed applications over programmable infrastructure that is spanning the compute continuum from Cloud-to-Edge to IoT, removing existing openness and interoperability barriers in the convergence of IoT technologies against cloud and edge computing orchestration platforms, and introducing automation and decentralised intelligence mechanisms powered by 5G and distributed AI technologies.

Areas of Research
• Virtualization of IoT devices and IoT technologies interoperability based on the development of an open-source software stack, called as VOSTack.
• Convergence of IoT with edge and cloud computing technologies based on the development of Virtual Objects and Composite Virtual Objects that can be part of application graphs.
• Synergetic orchestration mechanisms for the computing continuum considering various synergies among agents and edge/cloud computing stakeholders.
• AI-assisted orchestration mechanisms to increase automation and decentralized intelligence.

Project’s added value, impact, innovation and results
The NEPHELE project introduces two core innovations, namely:
• An IoT and edge computing software stack (VOSTack) for leveraging virtualization of IoT devices at the edge and supporting openness and interoperability aspects in a device-independent way.
• A synergetic meta-orchestration framework for managing distributed applications in the compute continuum based on the adoption of a “system of systems” approach.

It also provides:
• Open-source software aligned with the W3C Web of Things (WoT).
• Demonstrations in the areas of disaster management, logistic operation in ports, smart buildings and remote healthcare services.
• Numerous publications in international journals, conferences, workshops.

Follow-up and new project ideas
Intelligent orchestration solutions over multi-cluster/multi-cloud infrastructures based on intent-driven approaches and the integration of AI mechanisms; Extension of the open-source IoT Software Stack (VOSTack) with advanced security and network management mechanisms, as well as consideration of various IoT devices, including robotics. Integration with pilots and demonstrators.

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