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CLOUD STARS



Advances in decentralization, sustainability and AI workloads in cloud environments

(INESC-ID)

Researchers from INESC-ID are contributing to the development of more efficient, decentralized and sustainable computing infrastructures through research addressing key challenges across the Edge–Cloud continuum. Three recent papers explore complementary approaches to energy-aware resource management, serverless workflow scheduling, decentralized graph processing, and AI workload scheduling in the context of the EU CloudStars project.

The work in *EROS: Energy-Aware Resource Orchestration for Sustainable Smart City Infrastructure [1]* proposes a machine-learning-based approach to resource orchestration across Cloud, Fog and Edge infrastructures. EROS uses predictive models to estimate the energy impact of different resource-allocation decisions, aiming to reduce energy consumption while respecting application latency requirements. Evaluations using smart-city application scenarios highlight the potential of intelligent resource management to support more sustainable and reliable computing infrastructures.

Serverless dataflows are addressed in *Cost-Aware Predictive Planning for Decentralized Serverless Workflow Scheduling [2]*, with a decentralized framework designed to improve the execution of serverless workflows. By using historical execution data to predict task duration, data-transfer costs, output sizes and worker startup overheads, the framework can make more informed decisions about resource allocation and workflow scheduling. Its predictive planning approach aims to balance execution time and resource consumption, demonstrating how workload-aware decisions can make serverless computing more cost-effective.

Finally, the work in *Griph: Edge-enabled Graph Storage and Processing [3]*, presents a decentralized framework for storing and processing graph data across resource-constrained edge devices. By distributing graph partitions among multiple workers, Griph enables data processing closer to where it is generated, while supporting graph queries and analytical operations. The evaluation demonstrates how distributing workloads can reduce individual resource demands and improve performance for larger graphs, highlighting the potential of decentralized architectures for scalable edge computing.

During this period, Serhii Ivanenko from INESC-ID was hosted by Vassilis Vassiliadis IBM Research at Dublin for a secondment focusing on improving workload scheduling in shared, multi-tenant Kubernetes environments, with particular emphasis on AI workloads and their competing resource demands. The work has explored how workload characteristics can be used to dynamically adapt job-level resource requests and limits, including CPU, memory, and GPU resources, to reduce queuing times, improve cluster utilization, and minimize resource fragmentation. The goal is to optimize job completion time, scheduling latency, as well as fairness across workloads of different classes or teams, and overall resource efficiency, while preserving workload isolation and cluster stability.

[1] Giselly Alves Reis, Luís Veiga, and Maycon Peixoto. “EROS: Energy-Aware Resource Orchestration for Sustainable Smart City Infrastructure.” In Proceedings of the 12th IEEE International Smart Cities Conference - Shaping Sustainable Futures (ISC2 2026). IEEE, 2026.

[2] Diogo Jesus and Luís Veiga. “Cost-Aware Predictive Planning for Decentralized Serverless Workflow Execution.” In Proceedings of the 21st International Conference on the Economics of Grids, Clouds, Systems, and Services (GECON 2026). Springer, Lecture Notes in Computer Science, 2026.

[3] André Gonçalves and Luís Veiga. “Griph: Edge-enabled Graph Storage and Processing.” In Proceedings of the 17th IEEE International Conference on Cloud Computing Technology and Science (CloudCom 2026). IEEE, 2026.

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