

1. Projektziel

Who are we? LEO Trek is a research and development project conducted at the Distributed Systems Group (DSG) at TU Wien. The project team is composed by Asst. Prof. Nastic, Cynthia Marcelino, and Thomas Pusztai. The goal is to provide open, reusable building blocks for computing across the Edge–Cloud–Space 3D continuum.

What is it? LEO Trek is an open-source toolkit for orchestrating, simulating, and optimizing serverless and AI workflows in the Edge–Cloud–Space 3D Continuum. It consists of several modular software components, including:

- **Stardust:** a scalable simulator for the 3D Continuum. Github: <https://github.com/polaris-slo-cloud/stardust-go/>
- **HyperDrive:** an SLO-aware serverless scheduler for the 3D Continuum. Github: <https://github.com/polaris-slo-cloud/hyper-drive/>
- **ChunkFunc:** a workflow resource optimizer that accounts for input size and cost–performance trade-offs. Github: <https://github.com/polaris-slo-cloud/chunk-func/>
- **FedCCL:** a Federated Learning Framework. Github: <https://github.com/polaris-slo-cloud/fedccl>
- **Databelt:** a state management framework for serverless workflows in the 3D Continuum. Github: <https://github.com/polaris-slo-cloud/databelt/>
- **Gaia:** a serverless runtime for automated CPU/GPU selection for serverless AI. Github: <https://github.com/polaris-slo-cloud/gaia/>

Each module is self-sufficient, containing its own documentation. They can be used independently and combined as needed.

Who is it for and how does it help? LEO Trek is designed for researchers, platform engineers, and third-party developers working on distributed, serverless, and edge systems. It explains the system architecture, core components, and extension points, enabling reuse, evaluation, and further development of the open-source codebase.

How does it work? LEO Trek is composed of a set of modular components that enable simulation, scheduling, optimization, state management, and hardware acceleration in the 3D Continuum. The components can be used independently or combined, allowing both users to run simulations and evaluations and developers to extend or integrate the system. Each component is provided as a self-contained open-source repository that includes all information required to build, configure, use, and further develop the software.

2. Projektergebnisse

1	Projektzwischenbericht	CC BY 4.0	netidee.at/leo-trek
2	Projektendbericht	CC BY 4.0	netidee.at/leo-trek
3	Entwickler_innen-DOKUMENTATION	CC BY Apache 2.0	netidee.at/leo-trek/leo-trek &

			https://github.com/polaris-slo-cloud/stardust https://github.com/polaris-slo-cloud/hyper-drive https://github.com/polaris-slo-cloud/chunk-func https://github.com/polaris-slo-cloud/fedccl https://github.com/polaris-slo-cloud/databelt https://github.com/polaris-slo-cloud/gaia
4	Anwender_innen-DOKUMENTATION	CC BY Apache 2.0	netidee.at/leo-trek/leo-trek & https://github.com/polaris-slo-cloud/stardust https://github.com/polaris-slo-cloud/hyper-drive https://github.com/polaris-slo-cloud/chunk-func https://github.com/polaris-slo-cloud/fedccl https://github.com/polaris-slo-cloud/databelt https://github.com/polaris-slo-cloud/gaia
5	Veröffentlichungsfähiger Einseiter / Zusammenfassung	CC BY	netidee.at/leo-trek/leo-trek-0
6	Dokumentation Externkommunikation zur Erreichung Sichtbarkeit/Nachhaltigkeit (als Teil des Endberichtes)	CC BY	netidee.at/leo-trek/leo-trek
7	Stardust Simulator for the 3D Continuum * Scalable simulator for evaluating algorithms for the 3D Continuum * Extensible for future evaluation scenarios * 1 Scientific publication	Apache 2.0	github.com/polaris-slo-cloud/stardust
8	LEO Trek Serverless Scheduler for the 3D Continuum * SLO-aware scheduler for serverless	Apache 2.0	github.com/polaris-slo-cloud/hyper-drive

	workflows * Capable of handling large infrastructure sizes (e.g., 5.000 nodes) * 1 Scientific publication		
9	LEO Trek Serverless Platform for the 3D Continuum * Serverless platform that integrates the LEO Trek Scheduler and orchestration components * Capable of handling large infrastructure sizes (e.g., 5.000 nodes) * 6 Scientific publication	Apache 2.0	github.com/polaris-slo-cloud/leo-trek

3. Geplante weiterführende Aktivitäten nach netidee-Projektende

After the conclusion of the netidee project, several follow-up activities are planned to ensure sustainability and further impact of the results. All developed software artifacts will continue to be maintained as open-source projects, including bug fixes, documentation improvements, and compatibility updates with evolving serverless platforms. The project results form the foundation for ongoing and future scientific work. The developed models, simulators, and systems will be extended and evaluated in larger-scale and longer-term experiments, including additional workload classes, hardware accelerators, and emerging Edge-Cloud-Space use case scenarios such as Serverless Compound AI. Several follow-up publications are planned, building on the existing results and addressing open research challenges identified during the project.

4. Anregungen für Weiterentwicklungen durch Dritte

The project results are modular and reusable, enabling further development by researchers, developers, and practitioners. Third parties can extend the simulator and system components to explore new routing, scheduling, optimization, state management, or hardware acceleration approaches, or integrate them into existing serverless platforms. The results can also serve as a reference architecture for designing serverless and AI-enabled systems in distributed and resource-constrained environments.