Maestro, the Data- and Memory-Aware Middleware for Digital Twin Engines

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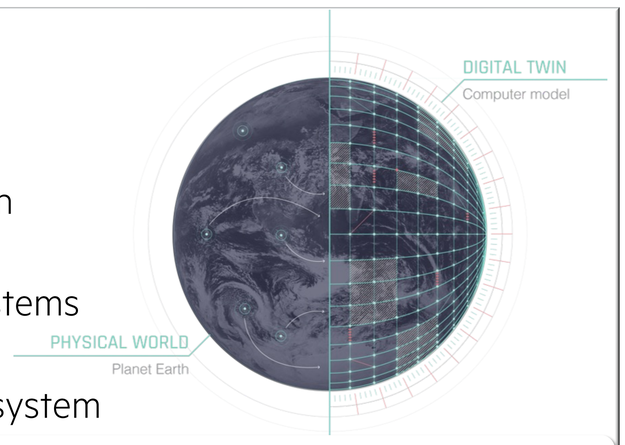
Digital Twins

(L1) Descriptive
- retroactive analysis

(L2) Informative:
- monitoring & simulation

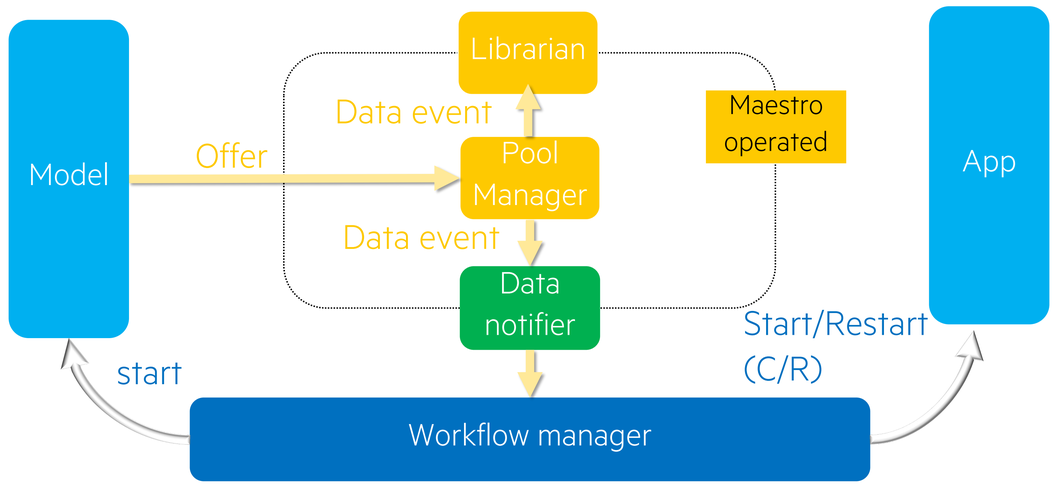
(L3) Predictive:
- predict evolution of systems

(L4) Living:
- self-adapts to the real system



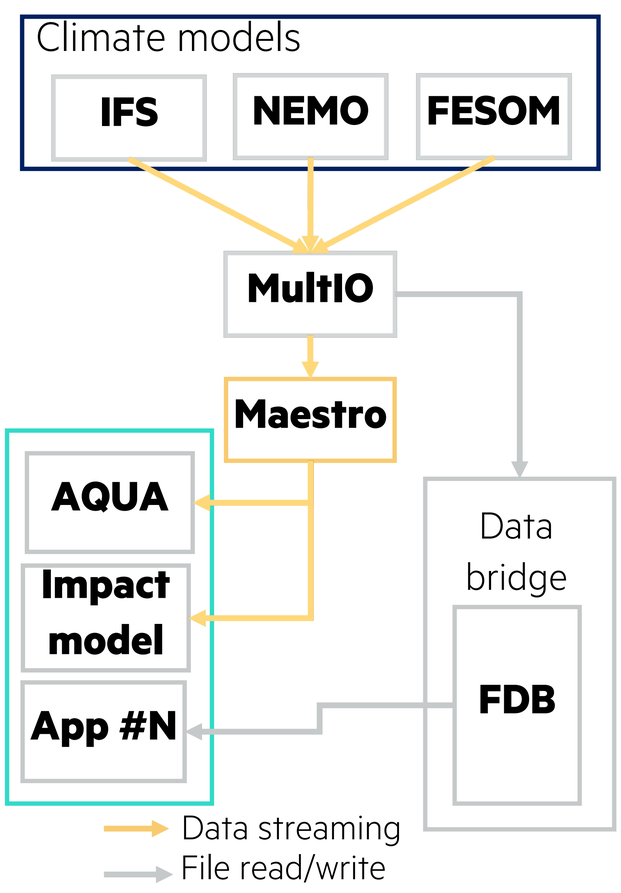
Digital twins exacerbates the data orchestration problem in HPC

Coupling with Workflow

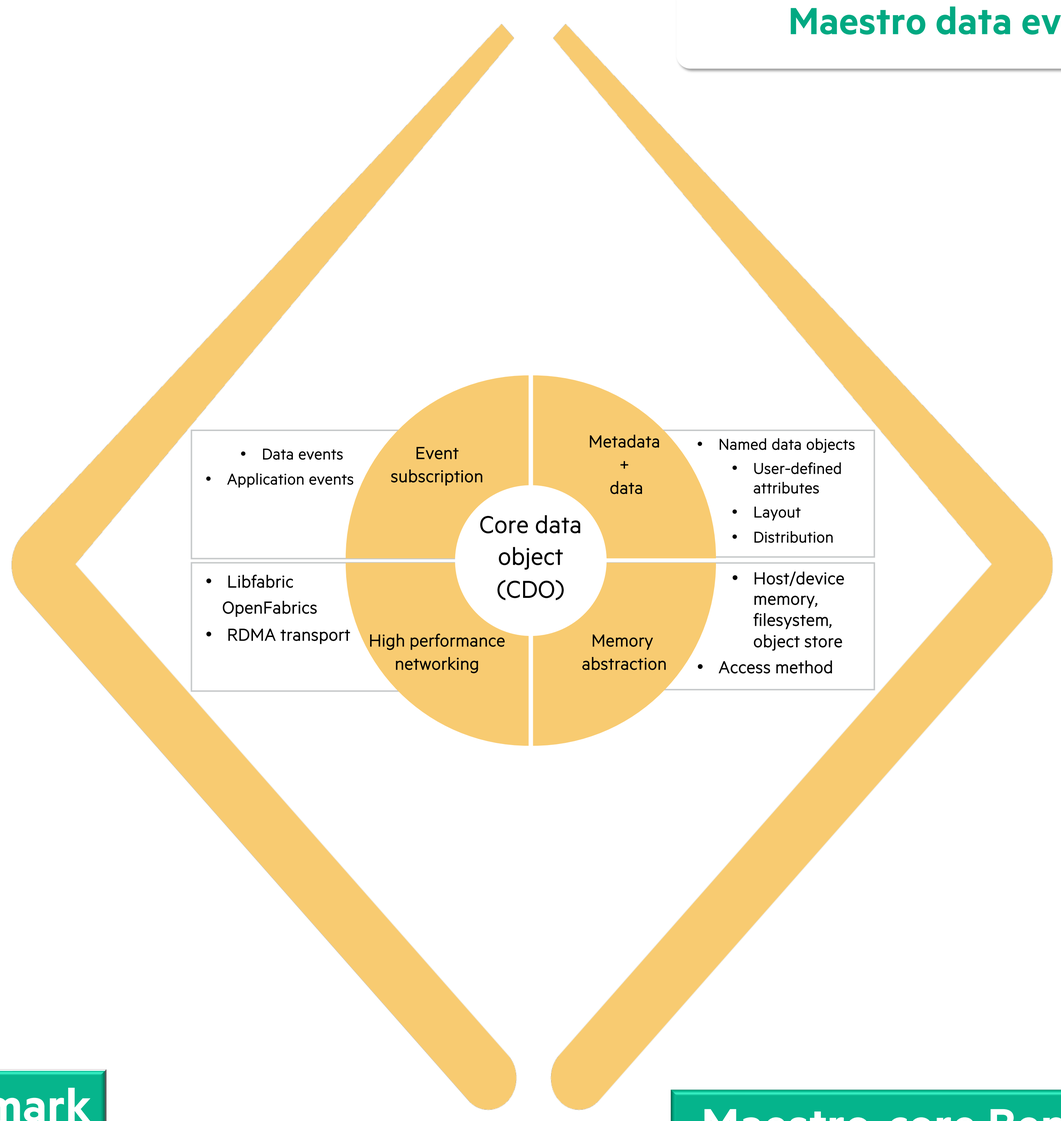


Maestro data events drives the workflow execution

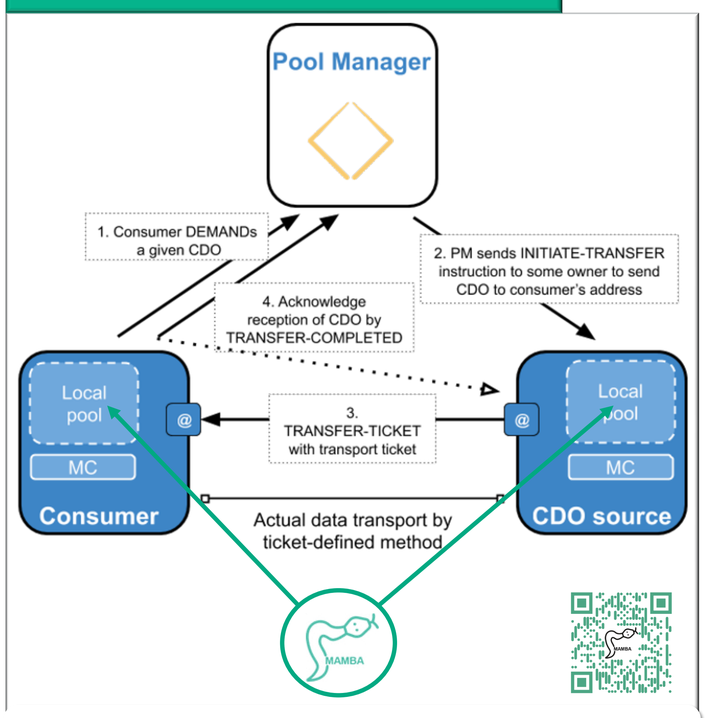
Climate Adaptation Twin



Bypassing filesystem with Maestro



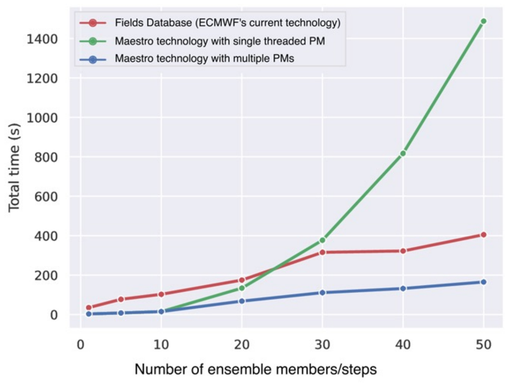
Peer-to-Peer Transport



Direct RDMA between components

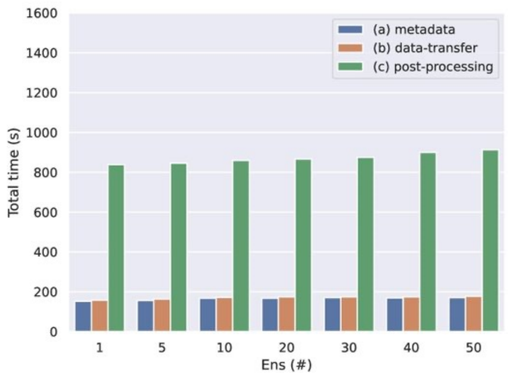
Code
https://gitlab.com/maestro-data/maestro-core/
Documentation
https://maestro-core.readthedocs.io/

IFS Product Generation Benchmark



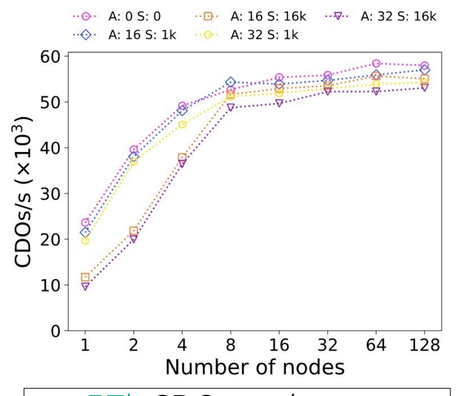
- Perfect scaling with multiple pool managers
- Up to 2.5 speedup compared to FDB

- 26 min. deadline, I/O to product generation, the bottleneck
- Up to 50 ensembles generated



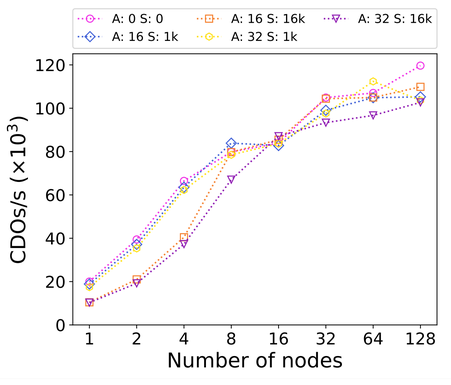
https://www.ecmwf.int/en/about/media-centre/science-blog/2022/secondment-ecmwf-maestro-project

Maestro-core Benchmark



- 119k CDO-ops/s
- 1 CXI NIC/Node
- Two CQ processing thread

- 57k CDO-ops/s
- 1 CXI NIC/Node
- Single CQ processing thread



Declaring Maestro CDOs of various number of attributes (A) and attribute sizes (S)

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