

Bringing Neuroscience to HPC

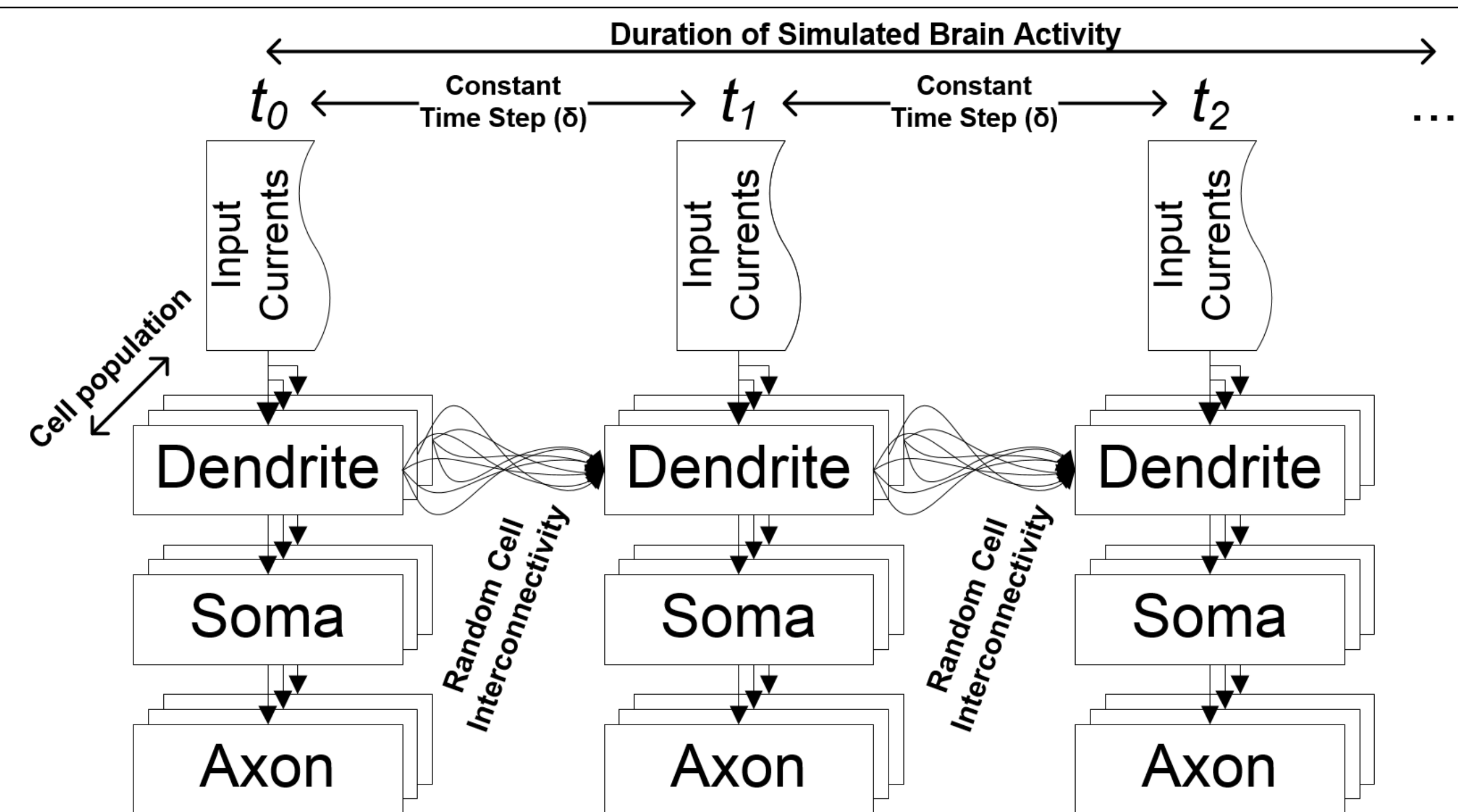
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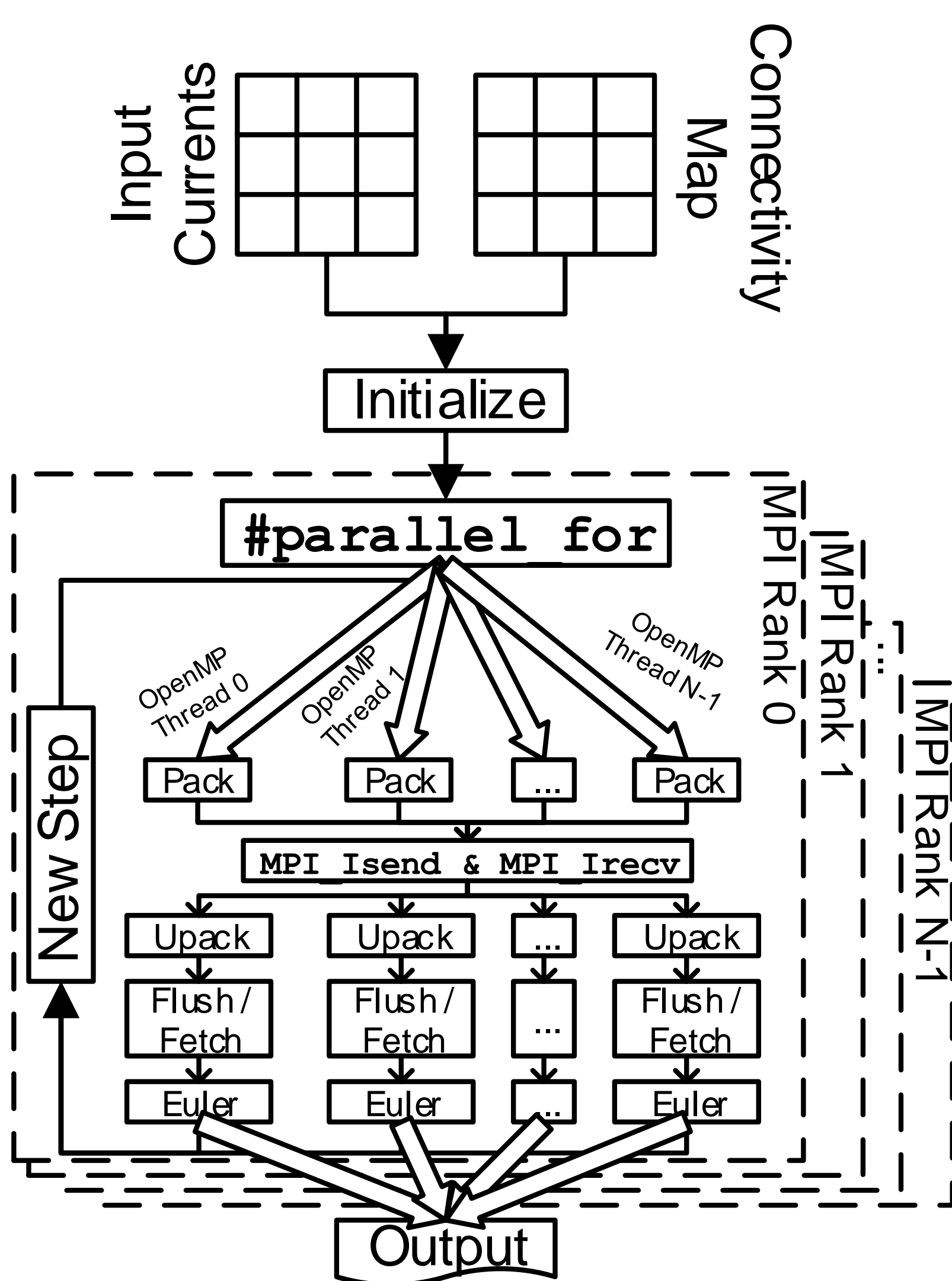
Abstract

- Brain Modelling is a very busy area for HPC research [1, 2, 3, 4, 5]
- Neuroscientific networks feature heavy computations and connectivity
- Neuron models range from black-box approaches to electrochemically accurate ODEs [6, 7]
- A new age of HPC-assisted tools are necessary for satisfactory simulation

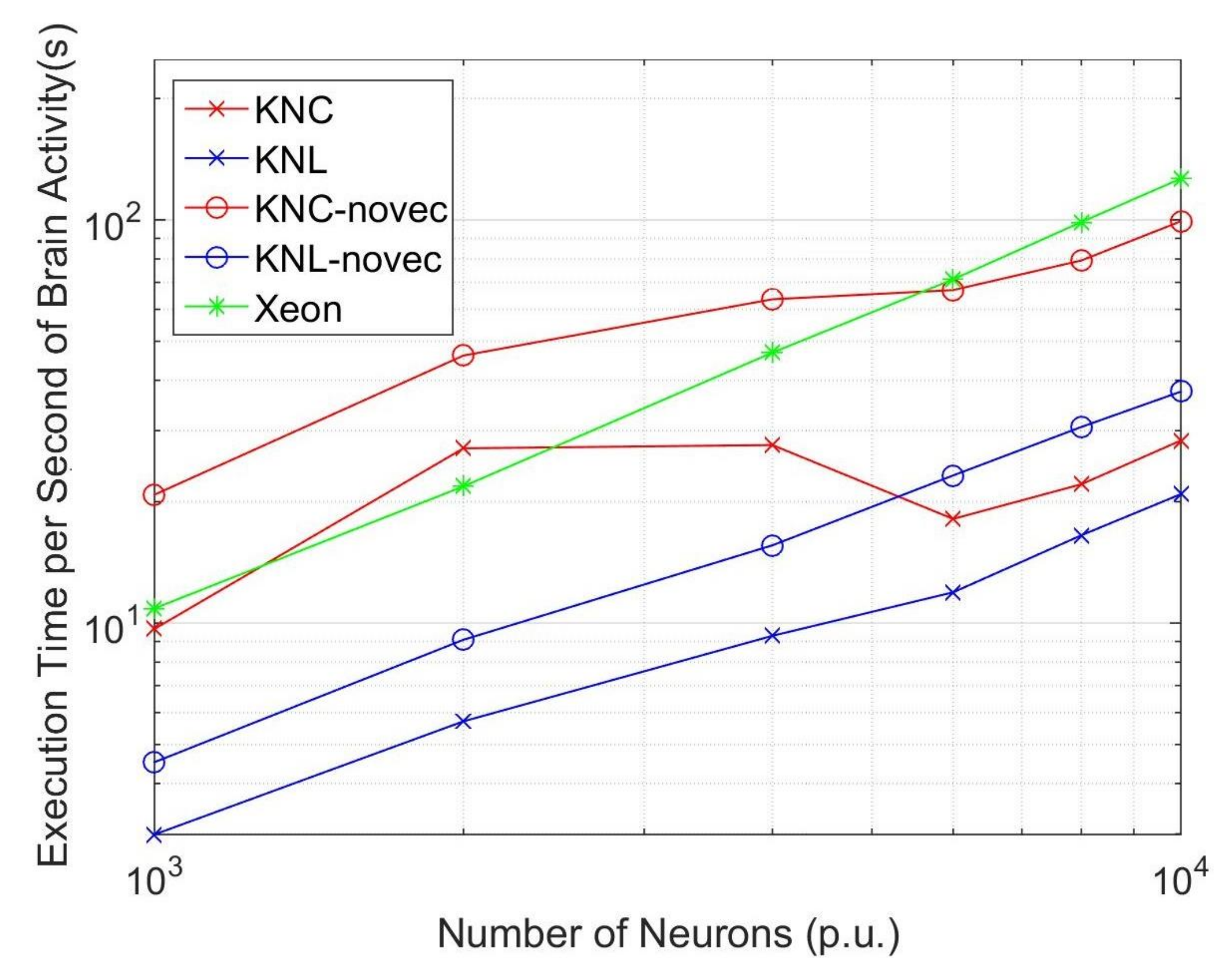
- GOAL1:** Develop high-performance neuronal simulators on HPC hardware
- GOAL2:** Create a robust online service for neuroscientific workloads



HPC Simulator

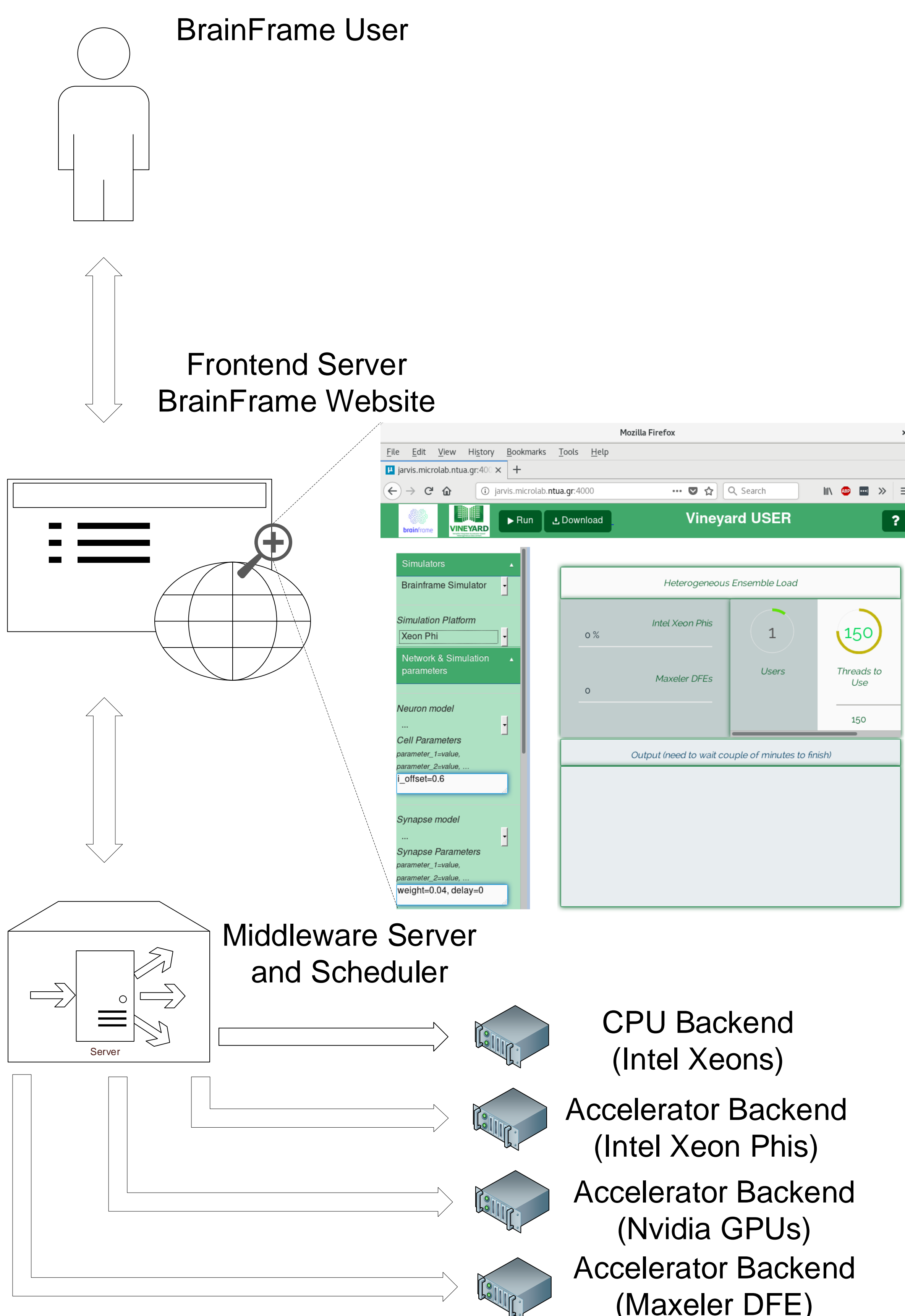


- Accelerated via OpenMP and MPI libraries
- Extensive usage of vectorized instructions
- Tested on Intel Xeon Phi 1st (KNC), 2nd (KNL) generation and Xeon CPUs [8, 9]
- Simulating realistic, complex networks



Featured Networks with 500 synapses per neuron [10]

BrainFrame System



- BrainFrame:** an online service for conducting accelerated neuroscientific experiments
 - modular, dockerized system for sustainability and adaptability
- Front End:** utilizes simple GUI to offer the user two options:
 - quick neuronal network setup (select from drop-down menus) or
 - explicit experiment design (python scripting)
- Middleware:** intermediate station:
 - translates user network configuration based on community-standard Python package for simulation of neural network models (PyNN) [11]
 - schedules simulation based on backend availability and workload parameters
- Backend Cloud:** heterogeneous ensemble of HPC hardware:
 - backend performance profile depends on experimental setup

References

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