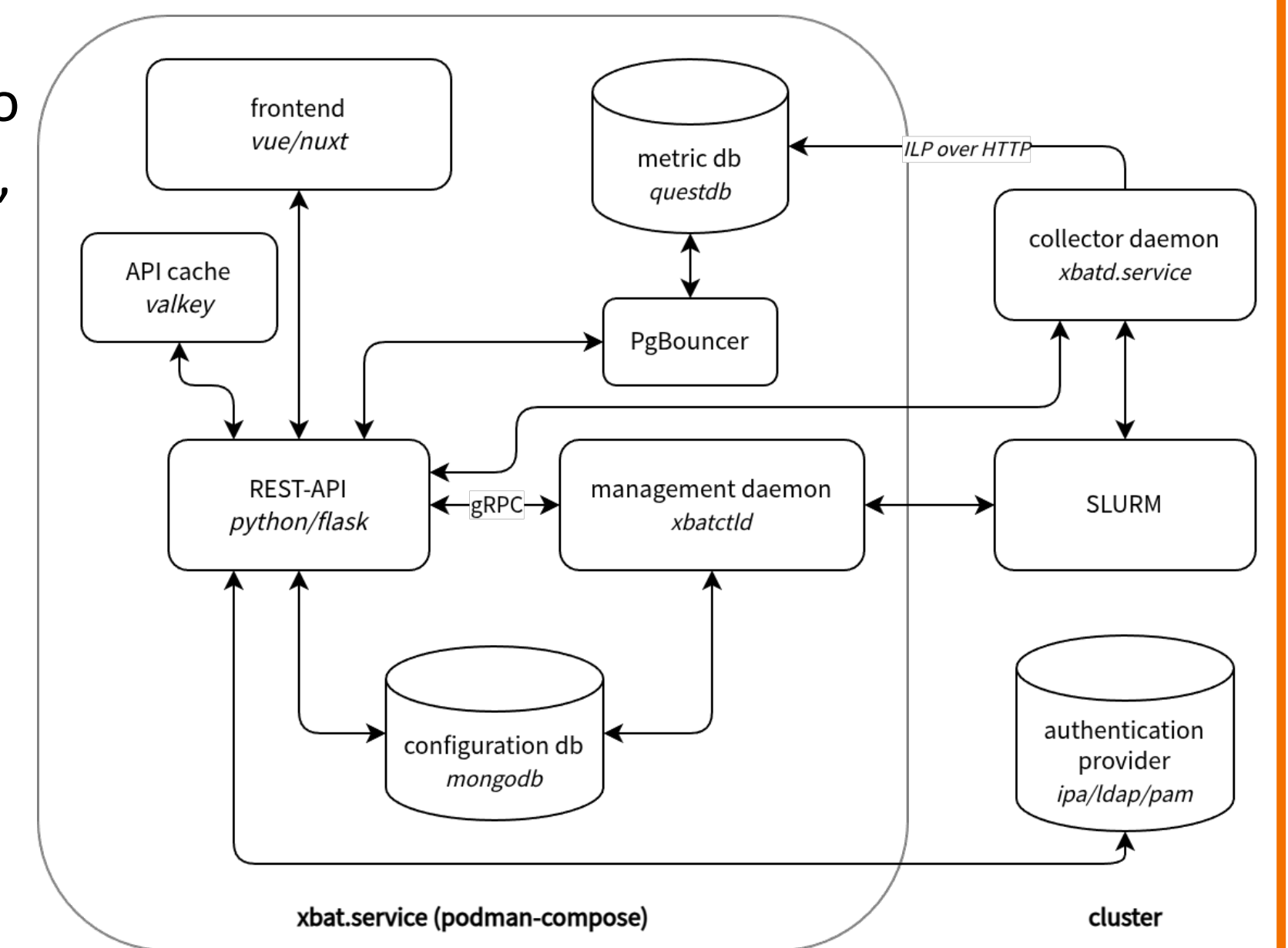


# xbat – An Easy-to-Use and Universally Applicable Benchmarking Automation Tool for HPC Software within the Project hpc.bw (dtec.bw)

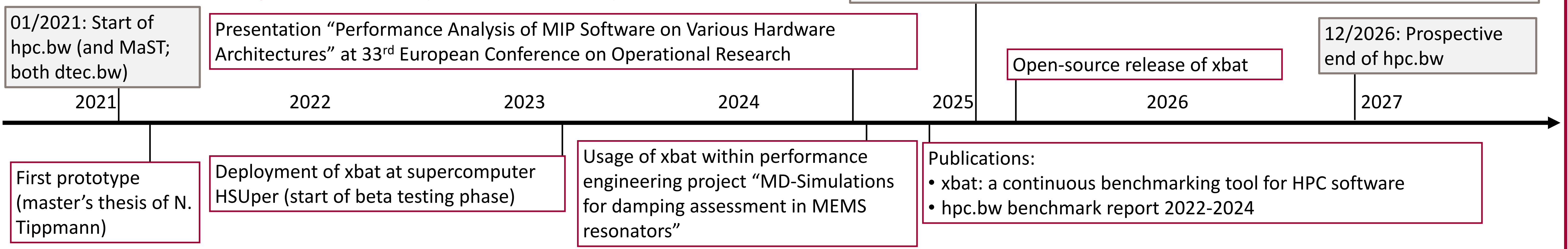
## Simplifying HPC application benchmarking and optimisation through xbat (extended benchmarking automation tool)



- Automate job configuration, submission and benchmarking process through web interface or Slurm CLI, making it easy to conduct parameter or scalability studies
- In-depth data collection of up to 140 performance metrics (mainly LIKWID) for CPU, memory, I/O, interconnect, energy, GPU and FPGA
- Measurements performed at lowest possible resolution and aggregated to provide them at thread, core, NUMA, socket, device, node and job level
- Measurements displayed within extensive, customisable and interactive graph system; graphs and underlying data can be exported
- Seamless integration into existing cluster installations
- Extensive online documentation, guides and public demo instance

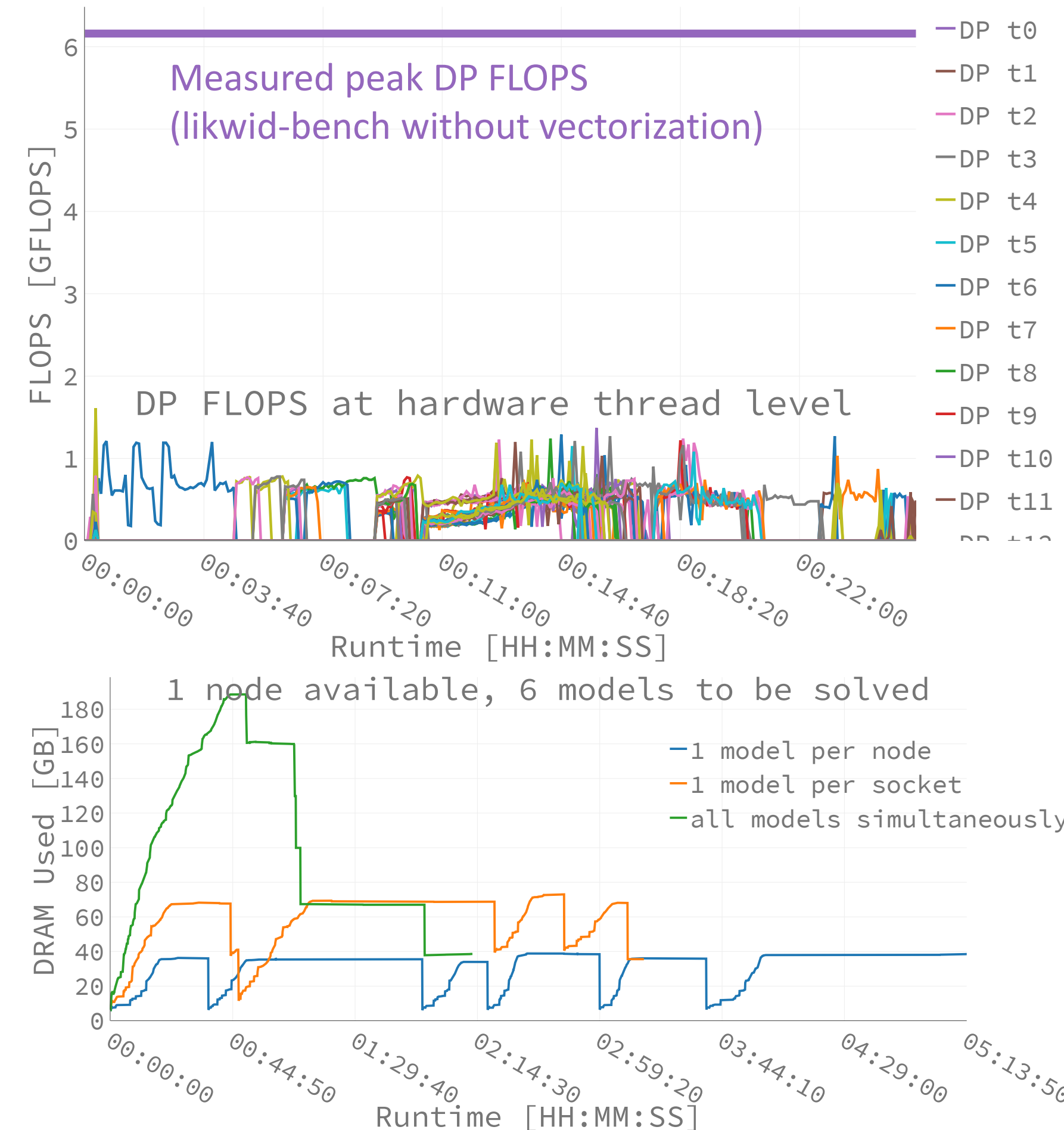


## Timeline of xbat usage and development within hpc.bw



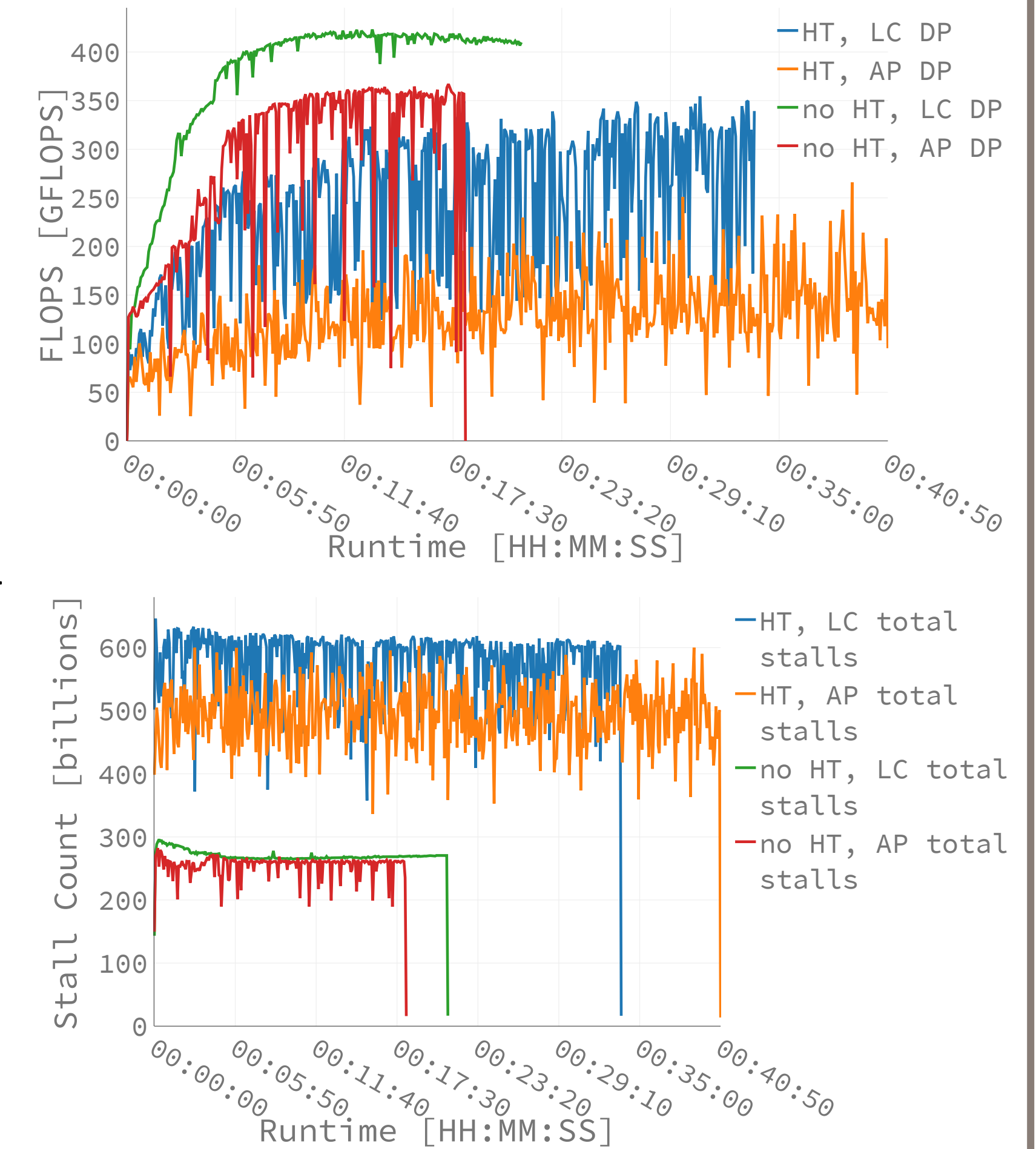
### Field of application: Gurobi

- Mathematical optimisation
  - Closed-source commercial solver
  - Usually used on machines (or one node of a cluster) with a moderate number of cores (soft limit of 32 threads)
- Observations:
- Several phases with majority of FLOPS performed by one (or a few) thread(s)
  - Running more models simultaneously on an HSUPER node (2x Intel Xeon Platinum 8360Y) decreases runtime and increases RAM usage
  - Oversubscribing a node seems to be advisable



### Field of application: ls1 mardyn

- Molecular dynamics simulation
  - Open-source software
  - Can leverage large clusters with many nodes
  - Usually uses linked-cell (LC) data structure to store particles
  - Can support the node-level auto-tuned particle simulation library AutoPas (AP)
- Observations:
- Using hyperthreading (HT) leads to lower FLOPS, more stalls and higher runtimes
  - Best setup is AP with no HT (1167 s), worst setup AP with HT (2487 s)



### Conclusion

- xbat helps to investigate behaviour of software to optimise hardware usage
- Continuous integration can be enhanced by xbat to automate benchmarking and to obtain feedback about performance changes between different software versions

### Outlook

- Extends monitoring capabilities
- Increased focus on statistics and analysis
- Automated bottleneck and anomaly detection
- Assistance towards creation of hardware-aware performance models of a software

### Acknowledgments

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Website HSU  
www.hsu-hh.de



Website xbat  
www.xbat.dev

### Project-related publications:

- Tippmann, N./Auweter, A./Das Sharma, A./Leinen, W./Neumann, P. and Fink, A. (2024): xbat: A Continuous Benchmarking Tool for HPC Software. openHSU. <https://doi.org/10.24405/16783>
- Preuß, H./De Nayer, G./Das Sharma, A./Jarmatz, P./Leinen, W./Jafari, V./Horn, R./Breuer, M./Fink, A. and Neumann, P. (2024): hpc.bw Benchmark Report 2022-2024. openHSU. <https://doi.org/10.24405/17134>
- Duffek, J./Bechelaoui, I./Leinen, W./Preuß, H./Schlumbohn, S./Schumann, Y./Dethof, F./Keßler, S./Rathmann, M./Kleinschmidt, J./Kolling, A./Schmidt-Lauff, S./Fink, A./Stiemer, M./Mayr, M. and Neumann, P. (2024): hpc.bw: An Evaluation of Short-Term Performance Engineering Projects. openHSU. <https://doi.org/10.24405/16802>



Website hpc.bw  
www.hsu-hh.de/hpccp



Website dtec.bw  
www.dtecbw.de