Framework for Planning, Executing and Monitoring Cooperating Computations

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1 Introduction

Realistic simulations need very powerful computers for their run. Computing infrastructures are growing in parallelism and becoming more diverse. This heads towards using more sophisticated computational techniques to take full advantage of the machine power. Furthermore, advanced knowledge of supercomputer's architecture and submission systems is required. Such a big human effort can become a bottleneck because a non-negligible number of person hours has to be invested daily.

2 k-Dispatch Overview

The k-Dispatch provides a service offering automated scheduling, execution and monitoring of cooperating extensive computations. It presents a middle layer between user applications and remote computational resources.
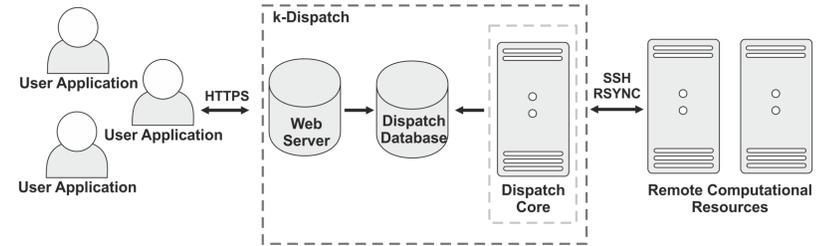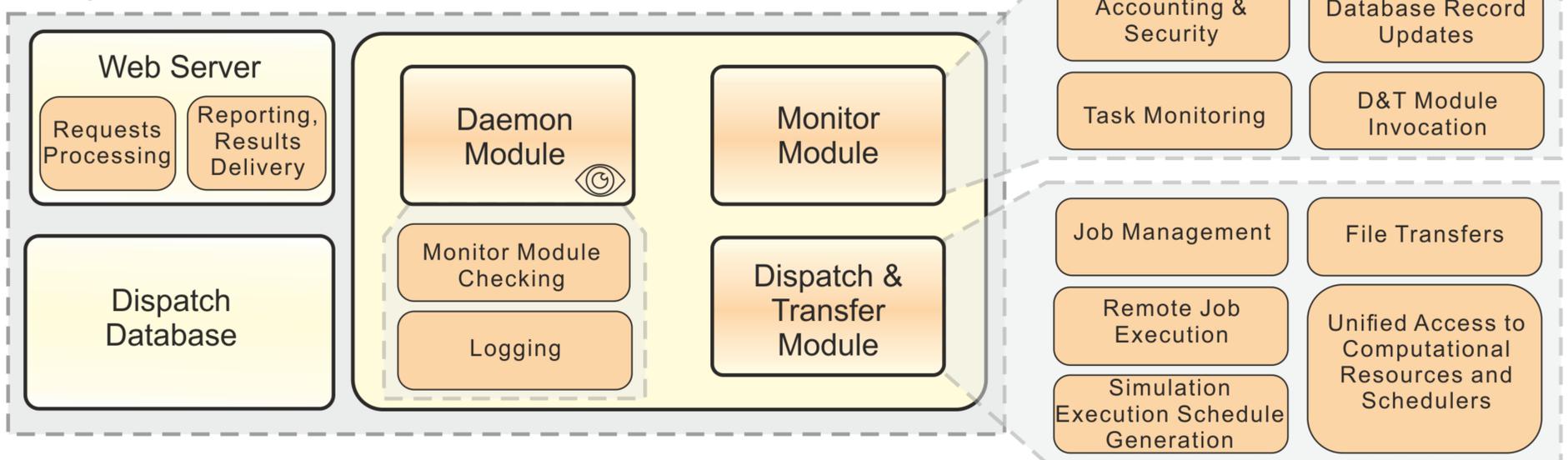
The k-Dispatch is being developed as a part of the k-Plan software used for offline model-based treatment planning for therapeutic ultrasound treatments, e.g., tissue ablation and ultrasonic neurostimulation.
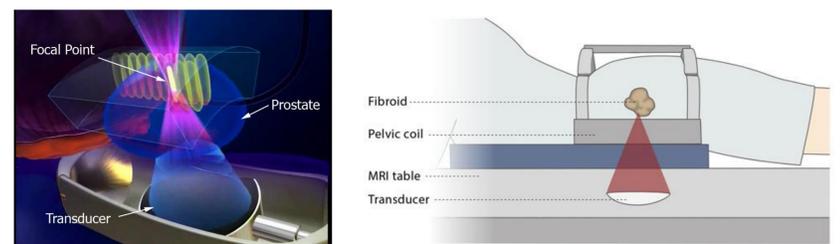
3 k-Dispatch Architecture

The k-Dispatch consists of three modules – the dispatch and transfer module, the monitor module, and the daemon module. The web server and the dispatch database might be physically decoupled to improve reliability. This approach presents HPC as a service since it unifies the access to different computational resources and their schedulers. It provides supporting functions such as user authentication and authorization, encryption, file transfers, job management, monitoring, reporting, billing, and notification mechanism. The web server provides the only access point and communication with user applications using standard web services. The dispatch and transfer module is the only module that communicates with computational resources.

k-Dispatch

Web Server
- Requests Processing
- Reporting, Results Delivery

Dispatch Database

Daemon Module
- Monitor Module Checking
- Logging

Monitor Module

Dispatch & Transfer Module

- Accounting & Security
- Database Record Updates
- Task Monitoring
- D&T Module Invocation

- Job Management
- File Transfers
- Remote Job Execution
- Unified Access to Computational Resources and Schedulers
- Simulation Execution Schedule Generation

4 Simulation Execution Schedule

Simulation execution schedule is a task graph defining simulations to be executed on a particular level of the graph and mutual dependencies. The simulation execution schedule is based on the specific treatment planning file describing the surgery workflow. The yellow rectangles represent coupling interfaces between models which may differ in computational demands.
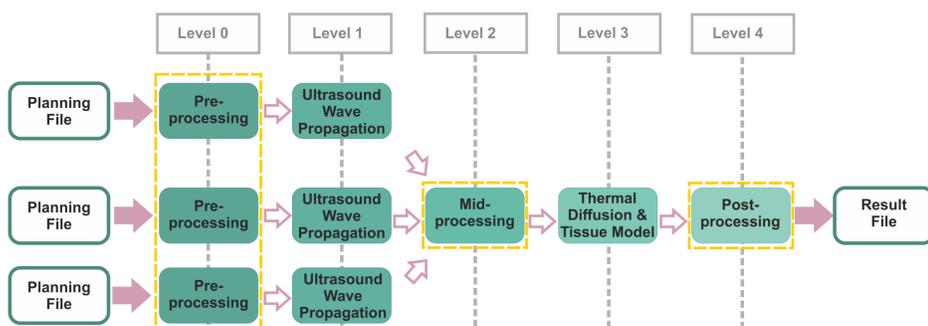
5 Open Questions

There are a couple of challenges to be addressed soon. That is the selection of the most convenient computational resource for particular given tasks, its run configuration, e.g., number of processor cores, heterogeneous architectures support, and an effective coupling interface between them.

6 Conclusions

The k-Dispatch offers the HPC as a service which could reduce the complexity of daily administrative tasks.

The generic design of the k-Dispatch enables connection of various user applications and unifies the access to different computational resources.

The detection and execution of concurrent tasks and a level of fault tolerance is supported.