

# Framework for Lifecycle enrichment of HPC Applications on Exascale Heterogeneous Architecture



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## Motivation

◆ Many Architecture and accelerators available



◆ No mapping rule to obtain an optimal architecture/configuration

◆ Optimality for a developer may entail:

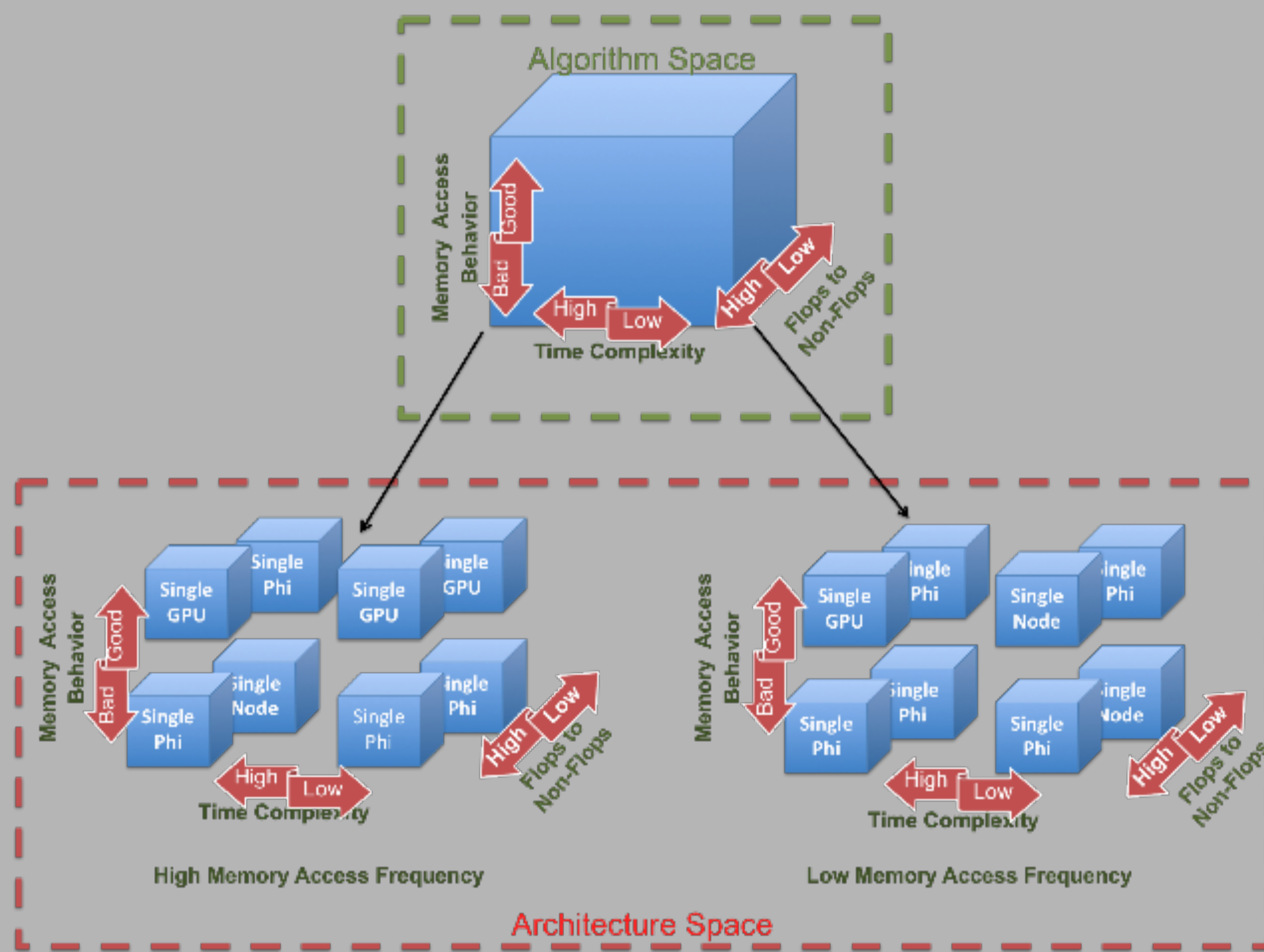
- ◆ Performance
- ◆ Speedup
- ◆ Energy saving



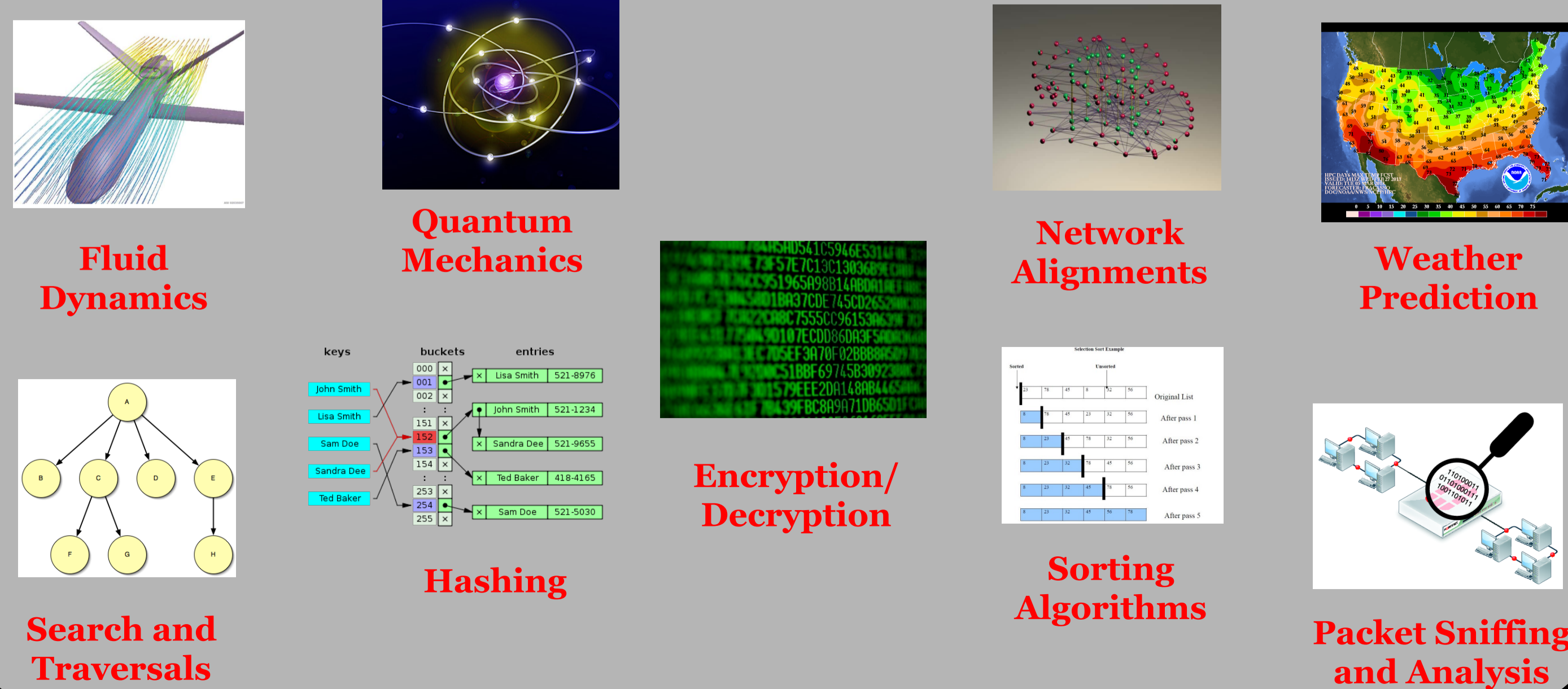
Reduction in optimized application development



## Application to Architecture (A2A) Framework

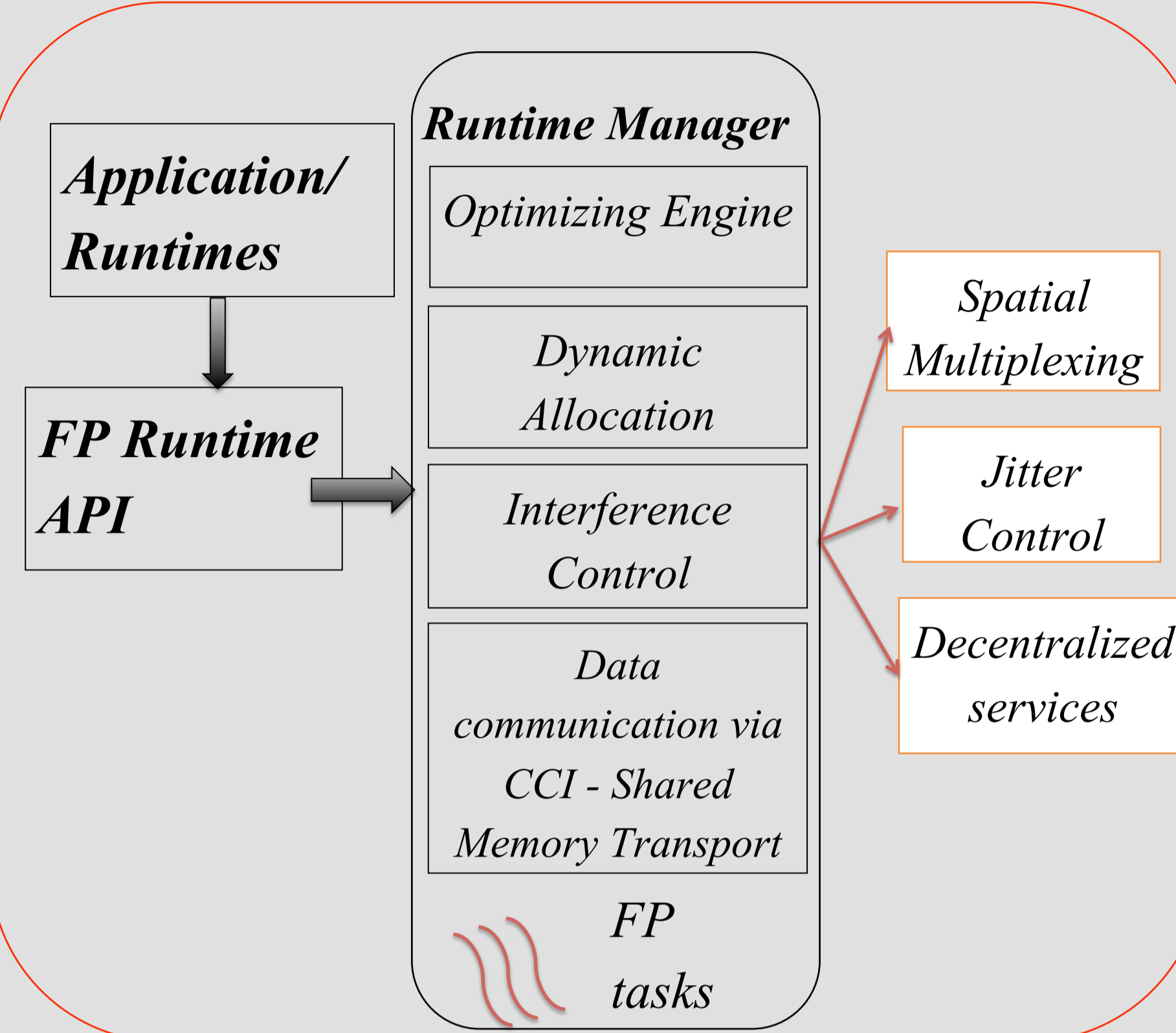


### BENCHMARK APPLICATIONS



## Heterogenous Functional Partitioning (FP) Framework

Schematic of FP runtime



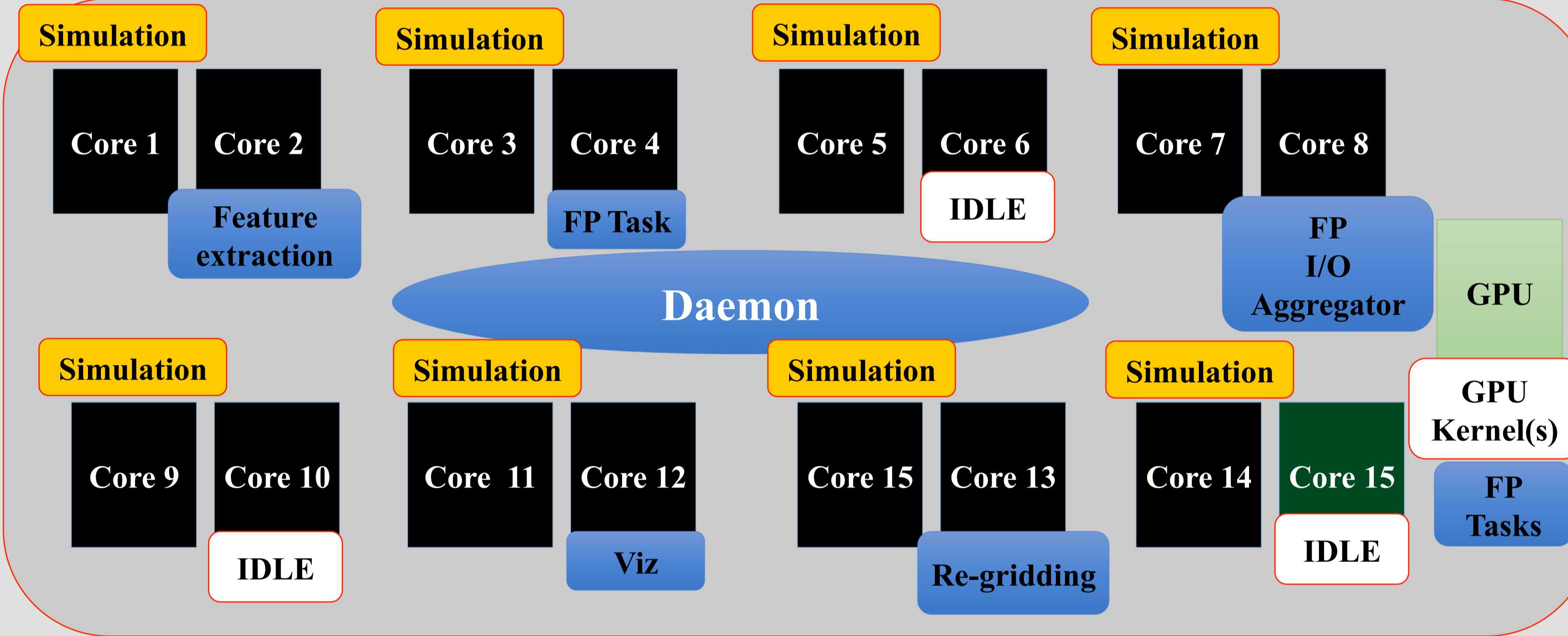
Usage Model

```
//Start the FP daemon
FP_Init()
;User Code
..
;User Code

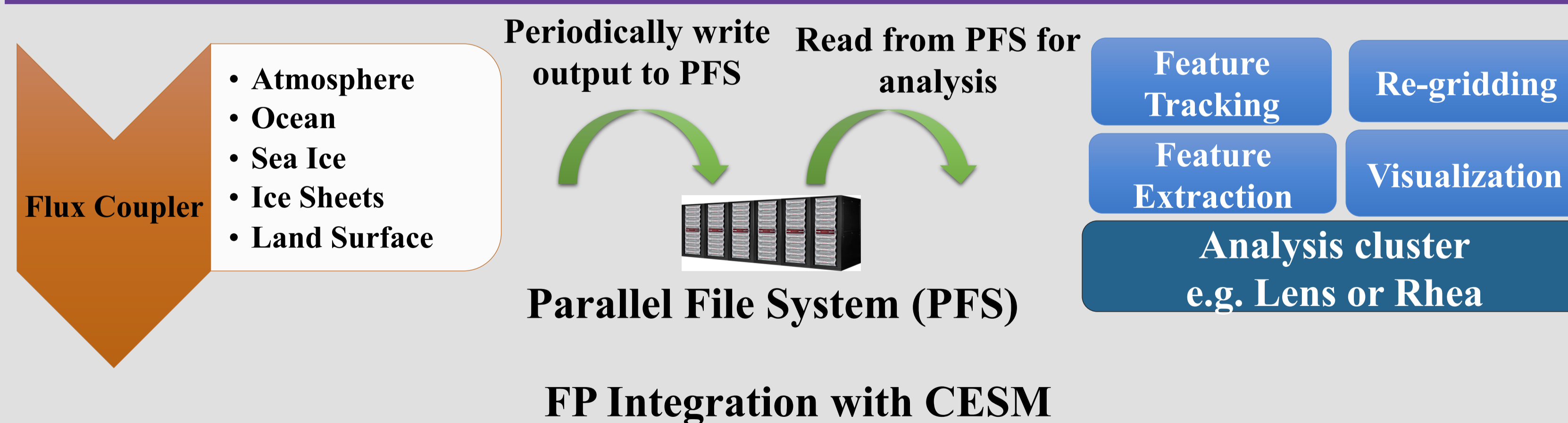
//FP daemon creates Pthreads
FP_Post(<args>)
;User Code
..
;User Code

FP_Finalize() //Finish, Cleanup
```

Compute Node on Titan



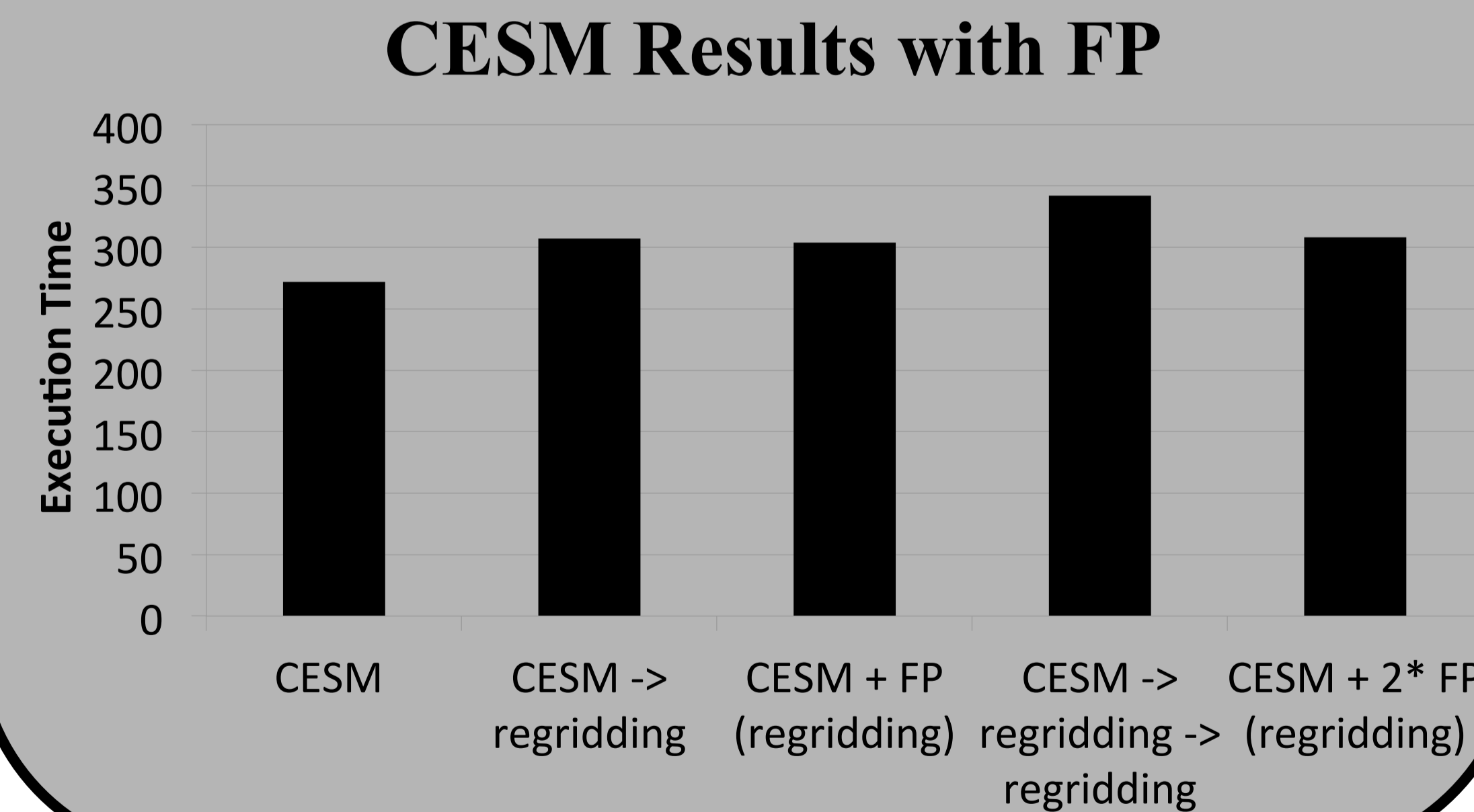
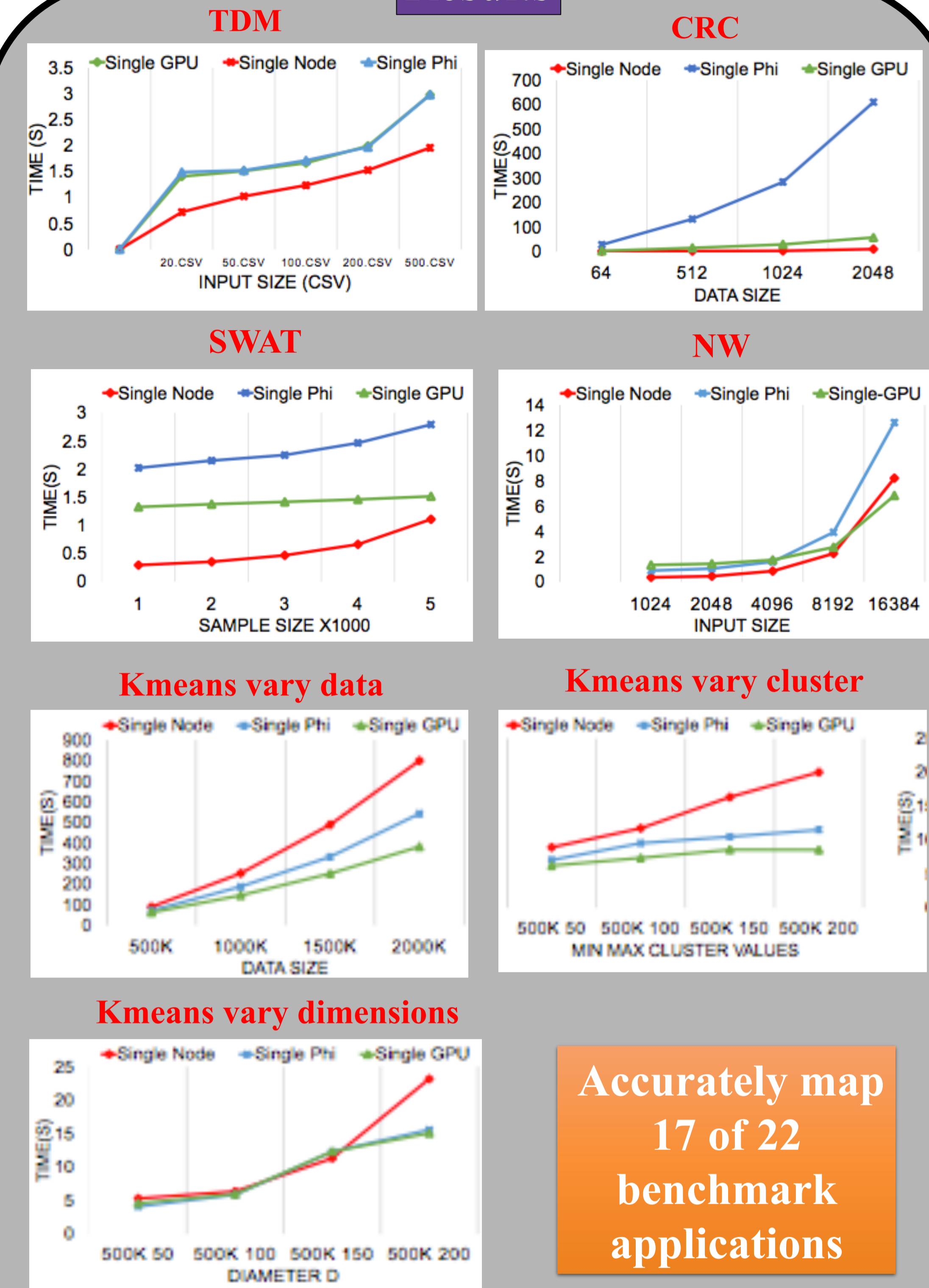
### Use case scenario Community Earth Science Model (CESM) Workflow



FP Integration with CESM

- FP task: Re-gridding of output and interpolation, for data analysis
- Modified the compilation macros to link to FP library during compilation
- Add fp\_init(), fp\_finalize() in driver module
- Add fp\_post() to call interpolation function after writing analysis output
- interpolation function: dynamic libraries to invoke at runtime

## Results



Accurately map  
17 of 22  
benchmark  
applications

## Contributions

- **Quantified A2A framework:** optimal architecture for a given application
- **Framework:** run-time maintenance of Application and Subtask in Heterogeneous Architecture
- **A2A:** optimal mapping of application task at runtime for optimal performance of overall application