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An Automated Component-Based Performance Experiment Environment

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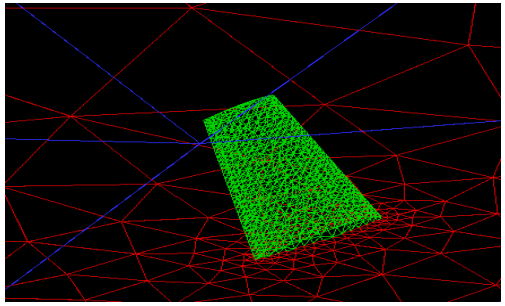
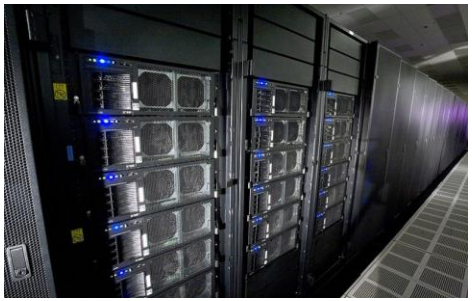
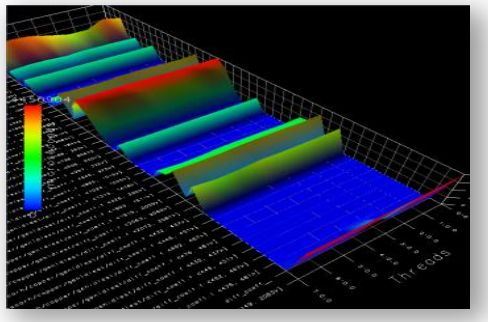
Computational Quality of Service (CQoS) Infrastructure

- Uses metadata for describing non-functional properties and requirements, e.g., quality "metrics"
- Supports automated performance instrumentation and monitoring
- Enables offline performance data analysis through machine learning, statistics, etc.







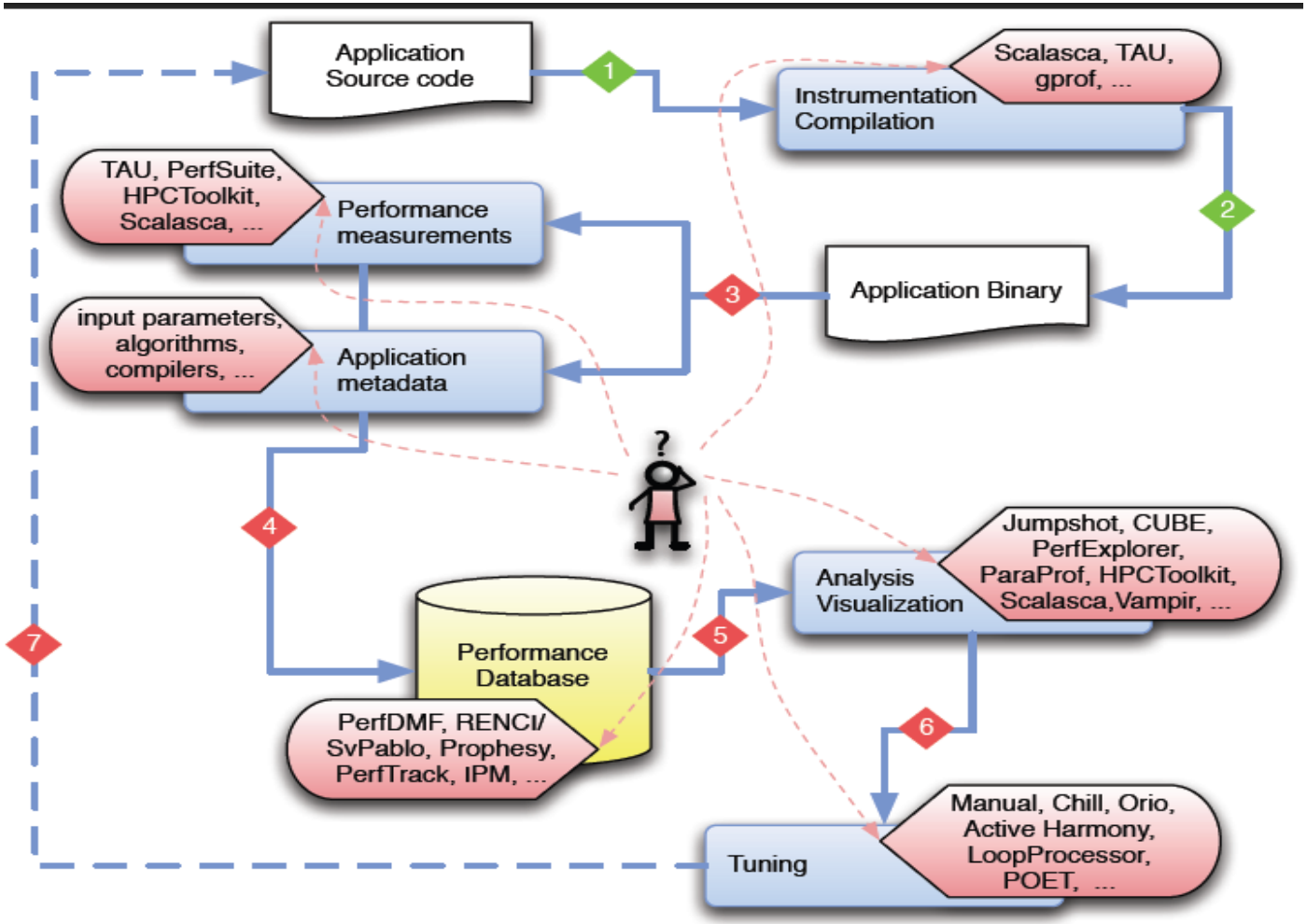
Motivation

- Computational Quality of Service (CQoS) requires support for
  - Performance measurement
  - Performance databases
  - Performance analysis
- Performance analysis can involve running thousands of experiments varying different parameters

Project Goals

- Automate performance experiments as much as possible using a component approach
- Design a uniform interface across platforms, tools, etc…
- Design a portable and extensible tool infrastructure to streamline performance experiments

Performance Experiment Workflow



Performance Components

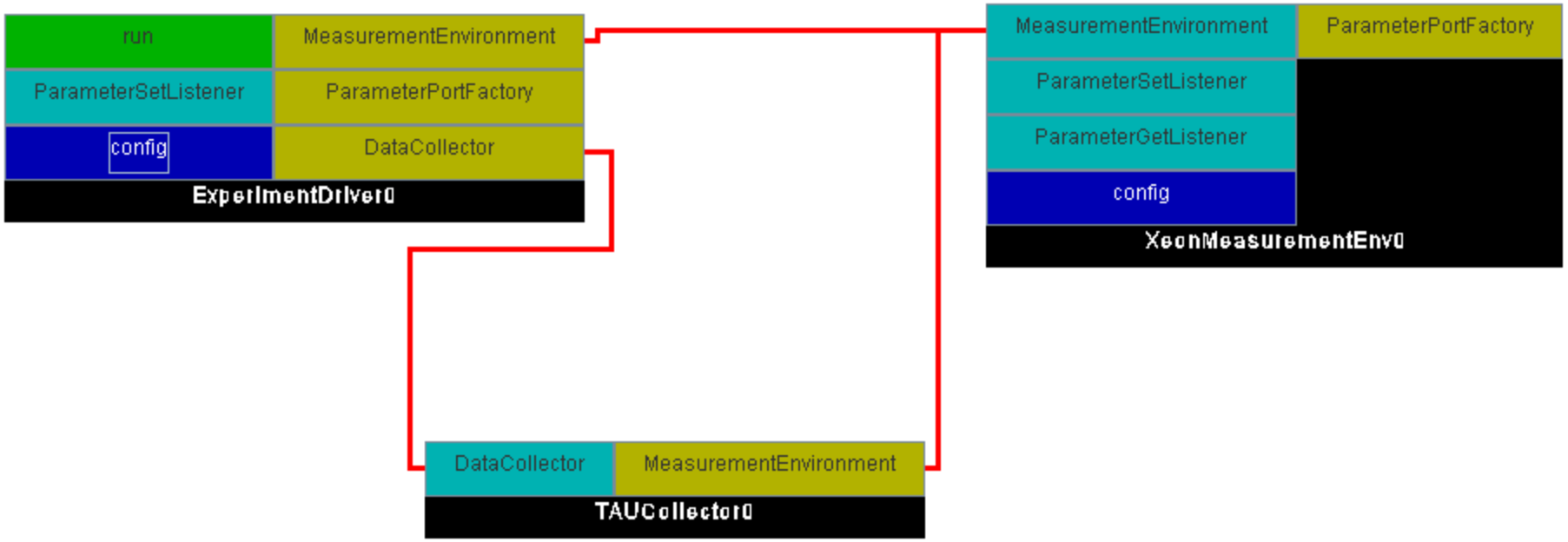
Experiment Setup and Collection

Data Management

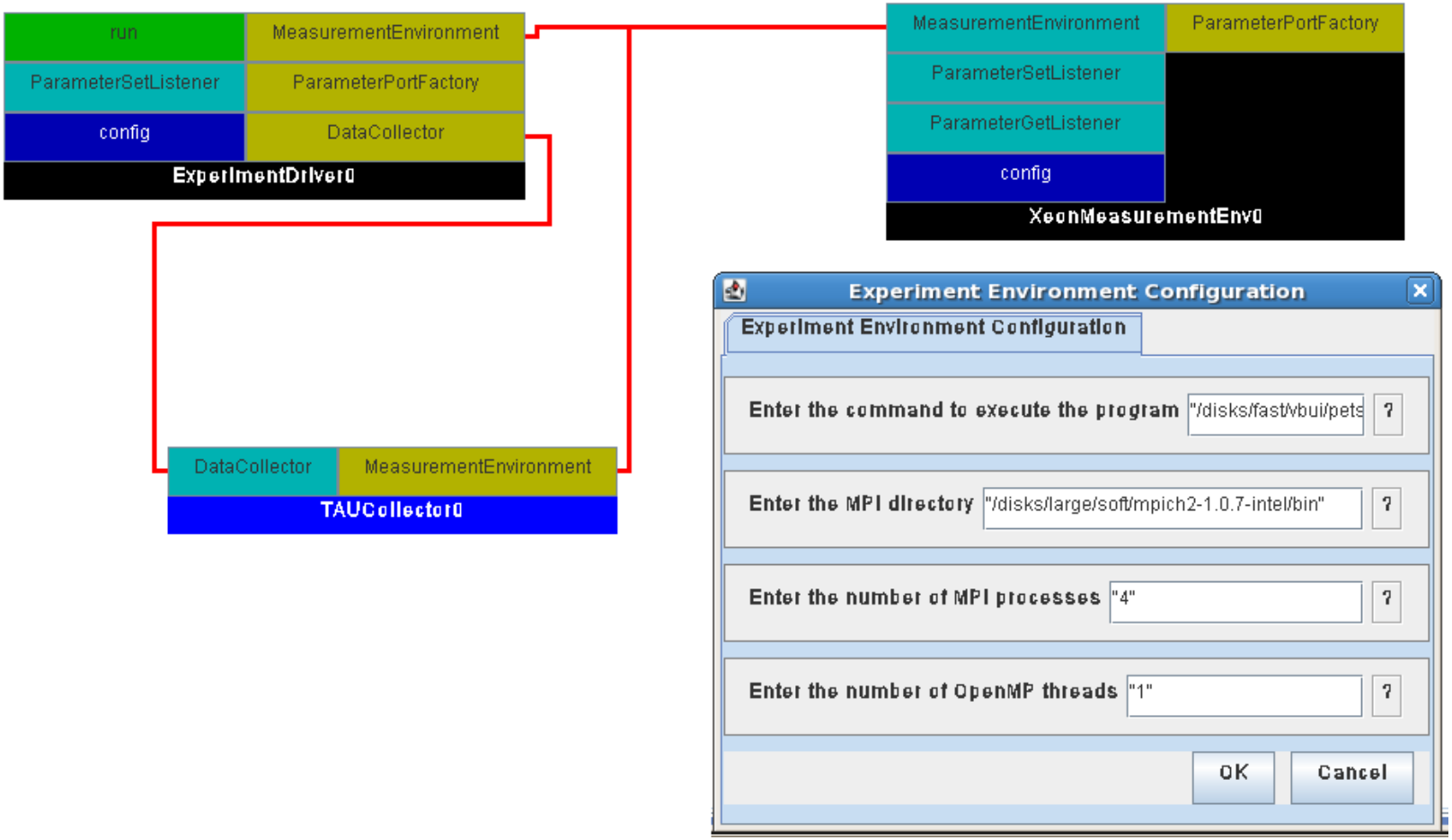
Analysis Phase

Experiment Set-up and Collection

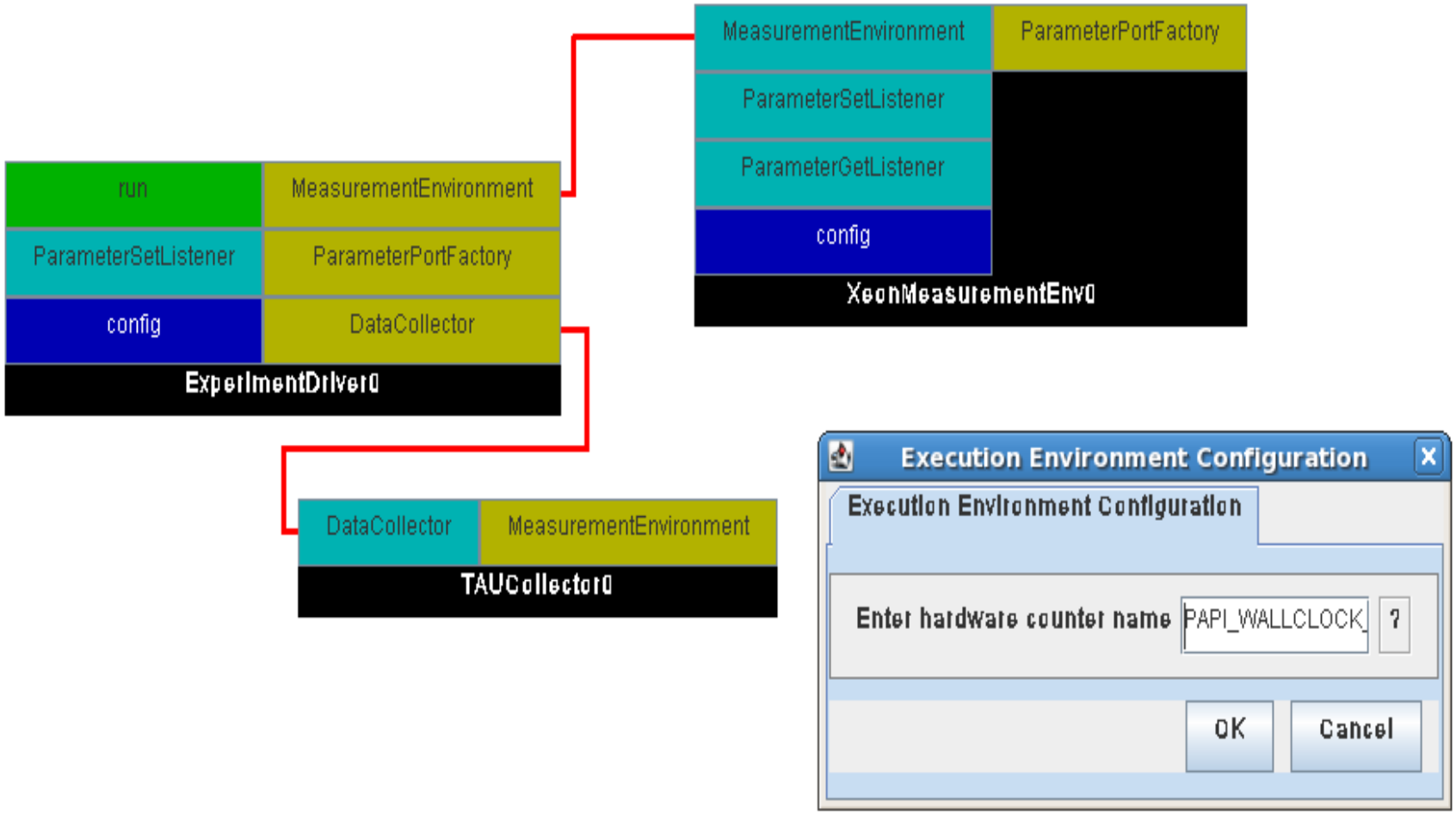
- Configure application, tools, and platform
- Select measurement approach
- Run the application and collect data



Experiment Driver Configuration



Measurement Env. Configuration



Performance Components

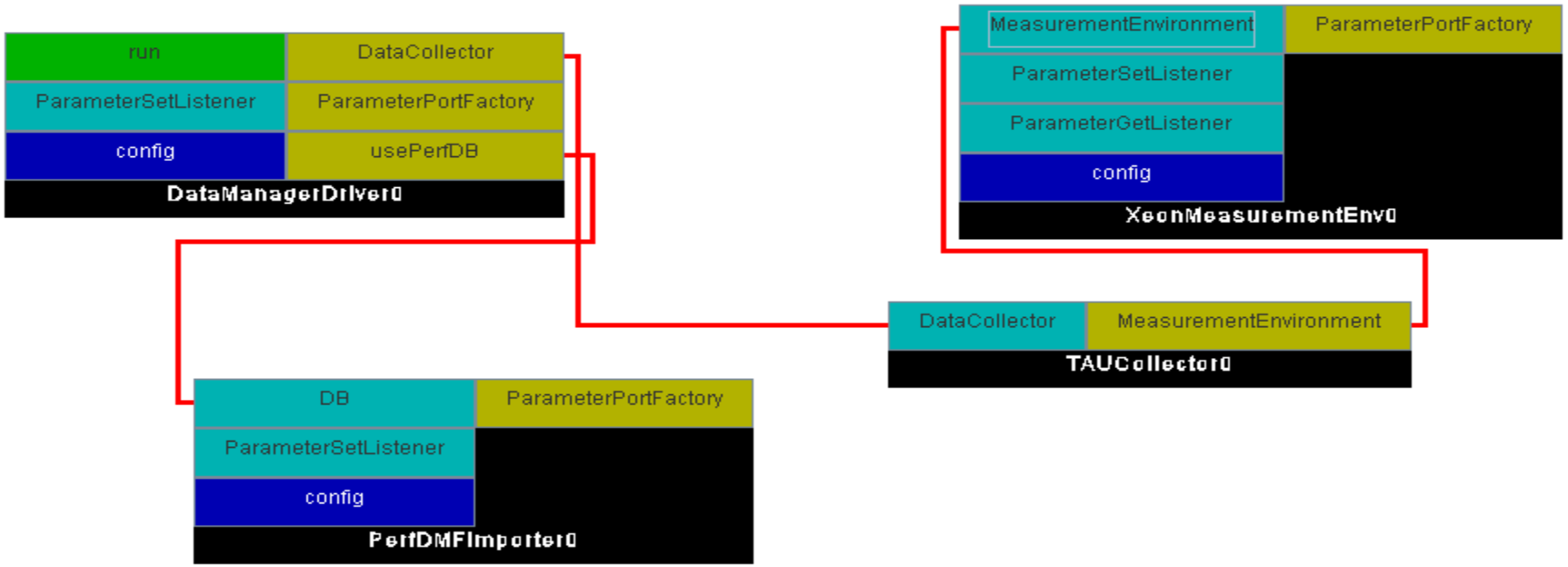
Experiment Setup and Collection

Data Management

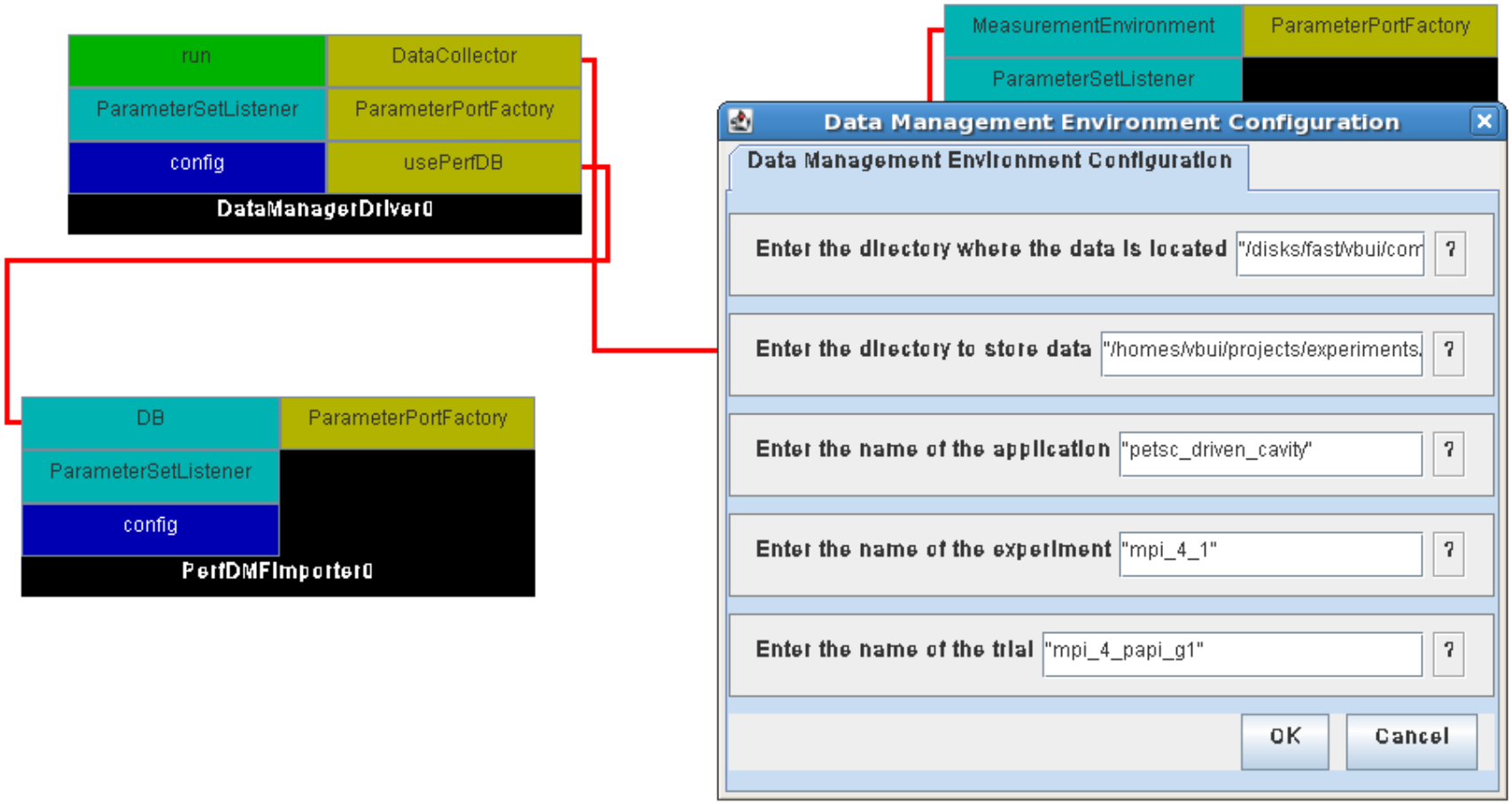
Analysis Phase

Data Management

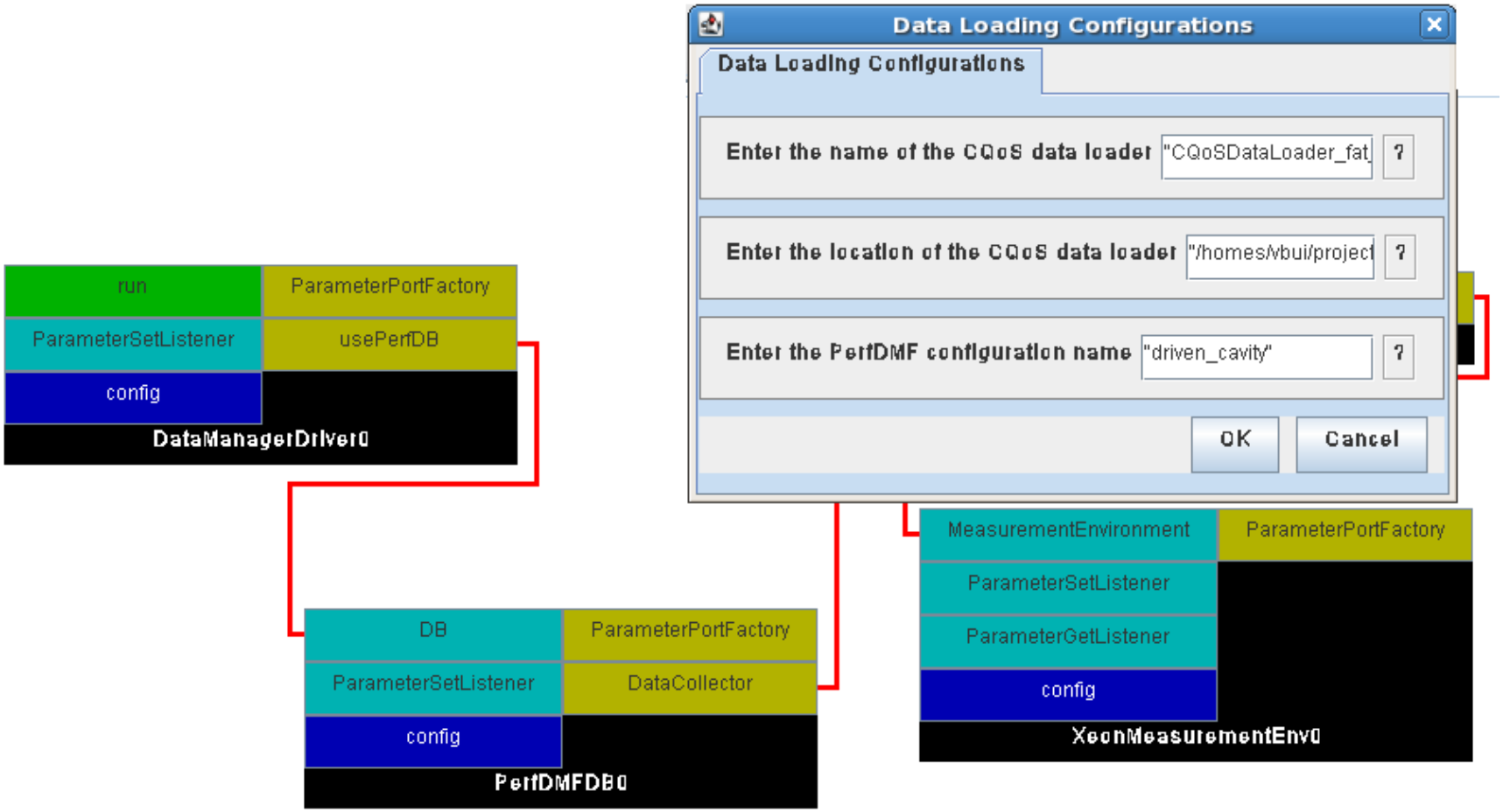
- Prepare performance data for storage
- Store metadata and performance data to database



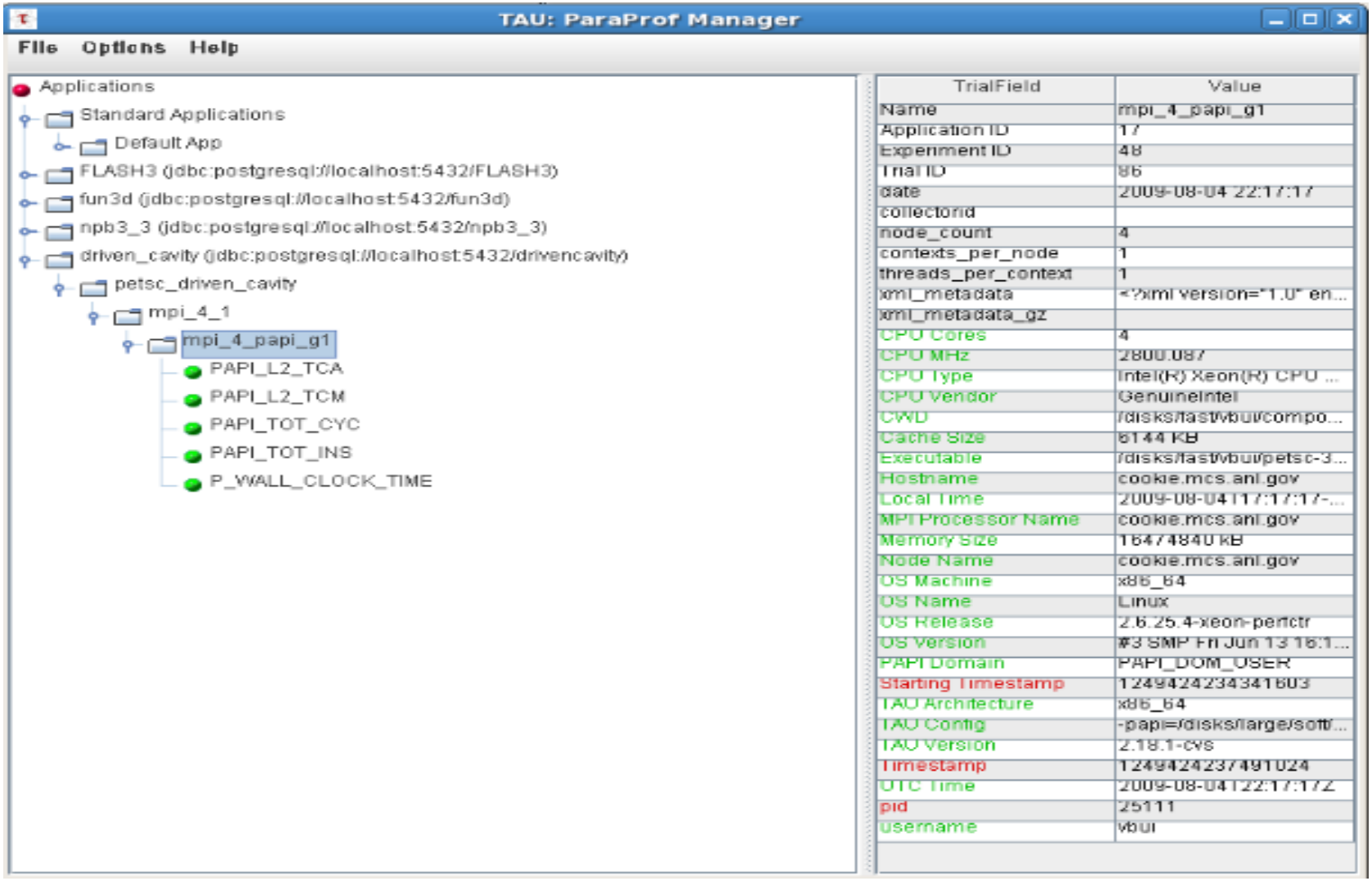
Data Manager Configuration



Database Configuration



Visualize Data Imported



Performance Components

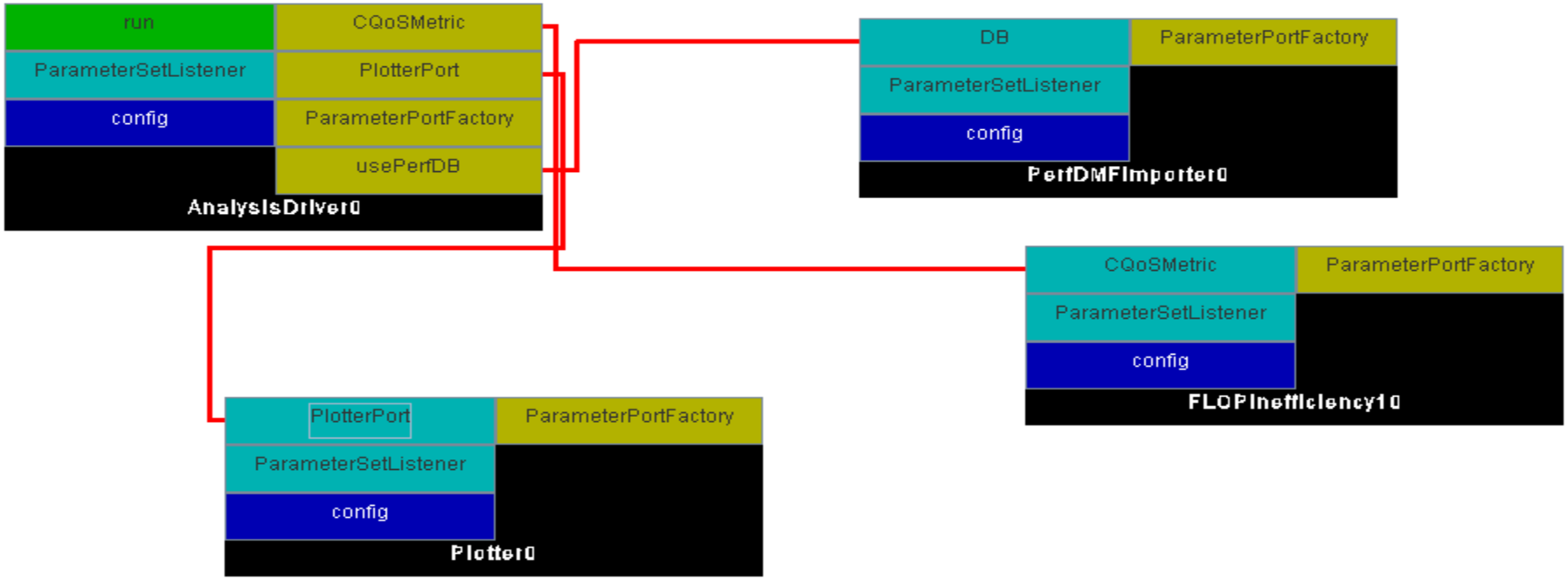
Experiment Setup and Collection

Data Management

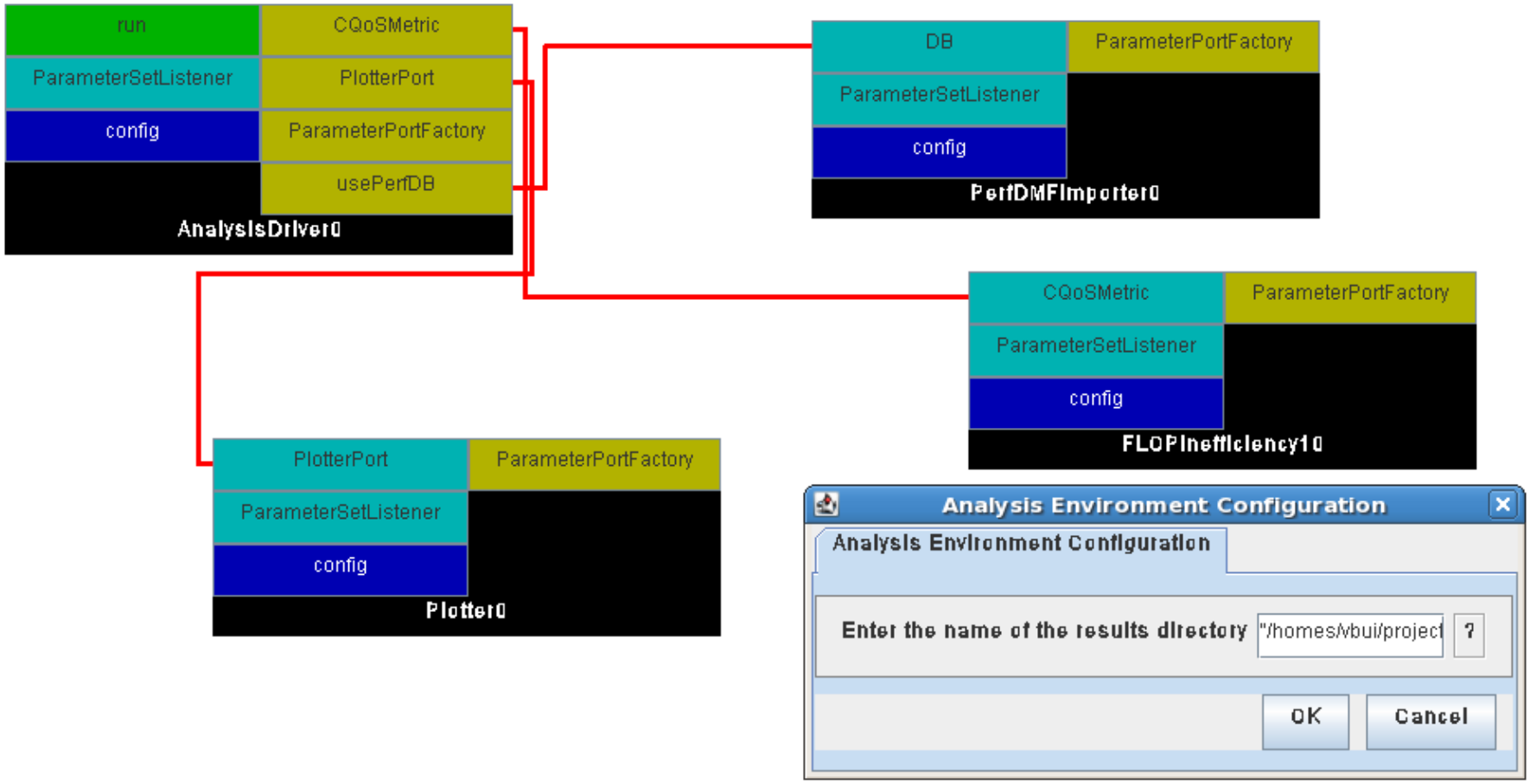
Analysis Phase

Analysis Phase

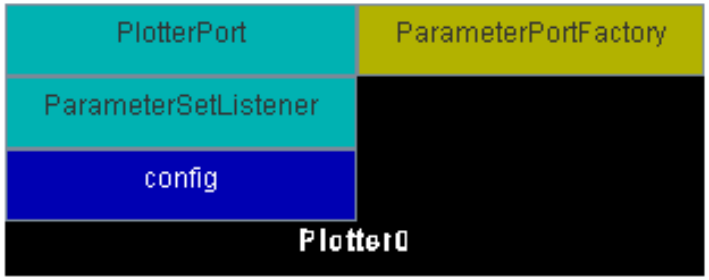
- Specify analysis for a given set of trials
- Determine type of analysis to perform

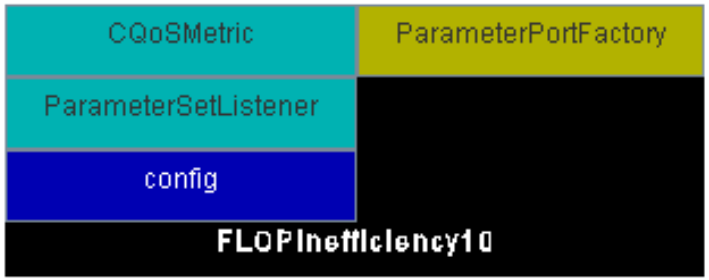


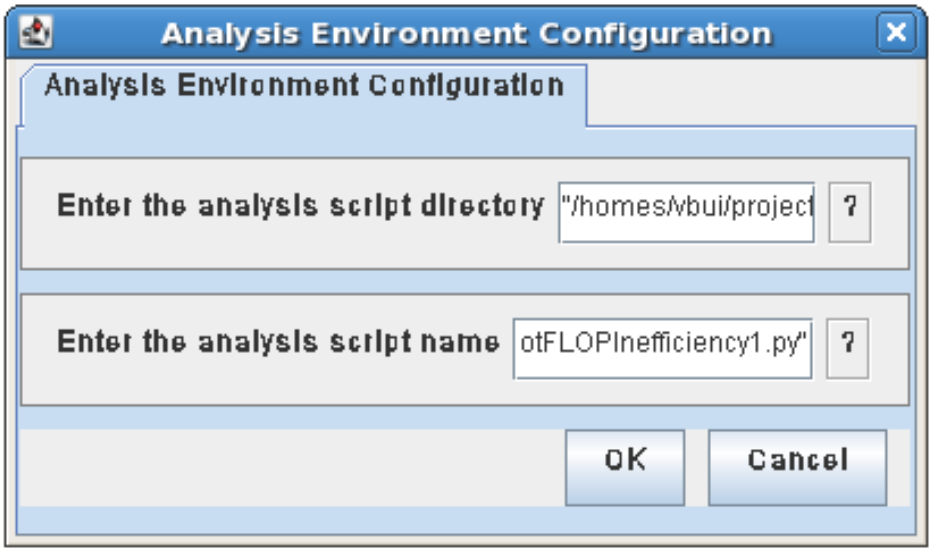
Analysis Driver Configuration



Analysis Configuration



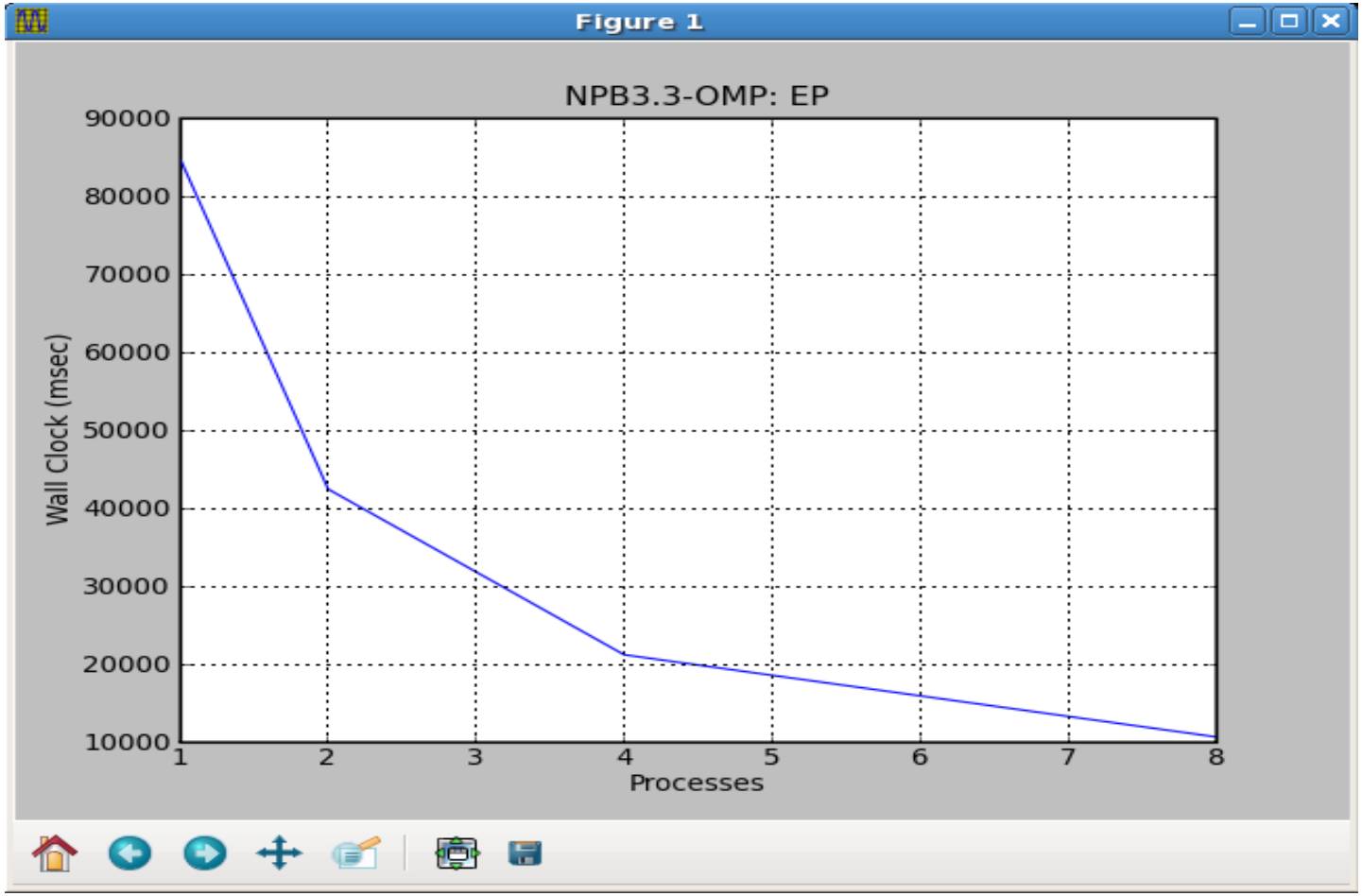




Sample Code for Plotting Wall Clock

```
for exp in experiments:                          # retrieve experiments
    ……..
    for tr in trials:                            # retrieive trials
        ……
            for event in trial.getEvents():      # retrieve events
                wallSum = 0
                if event == '@PROGRAM_EVENT@':
                    for p in range(node_count):
                        wallClock = trial.getInclusive(p, event,
  "PAPI_TOT_CYC")/@MHZ@                  # retrieve event value
                        wallSum += wallClock
                    data[node_count] = wallSum / (node_count)
generatePlot(data)                               # generate plot
```

Plotter: Wall Clock Time



Ccaffeine Script

- Instantiate component

```
instantiate cqos.perf.AnalysisDriver cqos_perf_AnalysisDriver
```

- Parameter configuration

```
parameter cqos_perf_AnalysisDriver config resultsdir
"/homes/vbui/projects/experiments/driven_cavity"
```

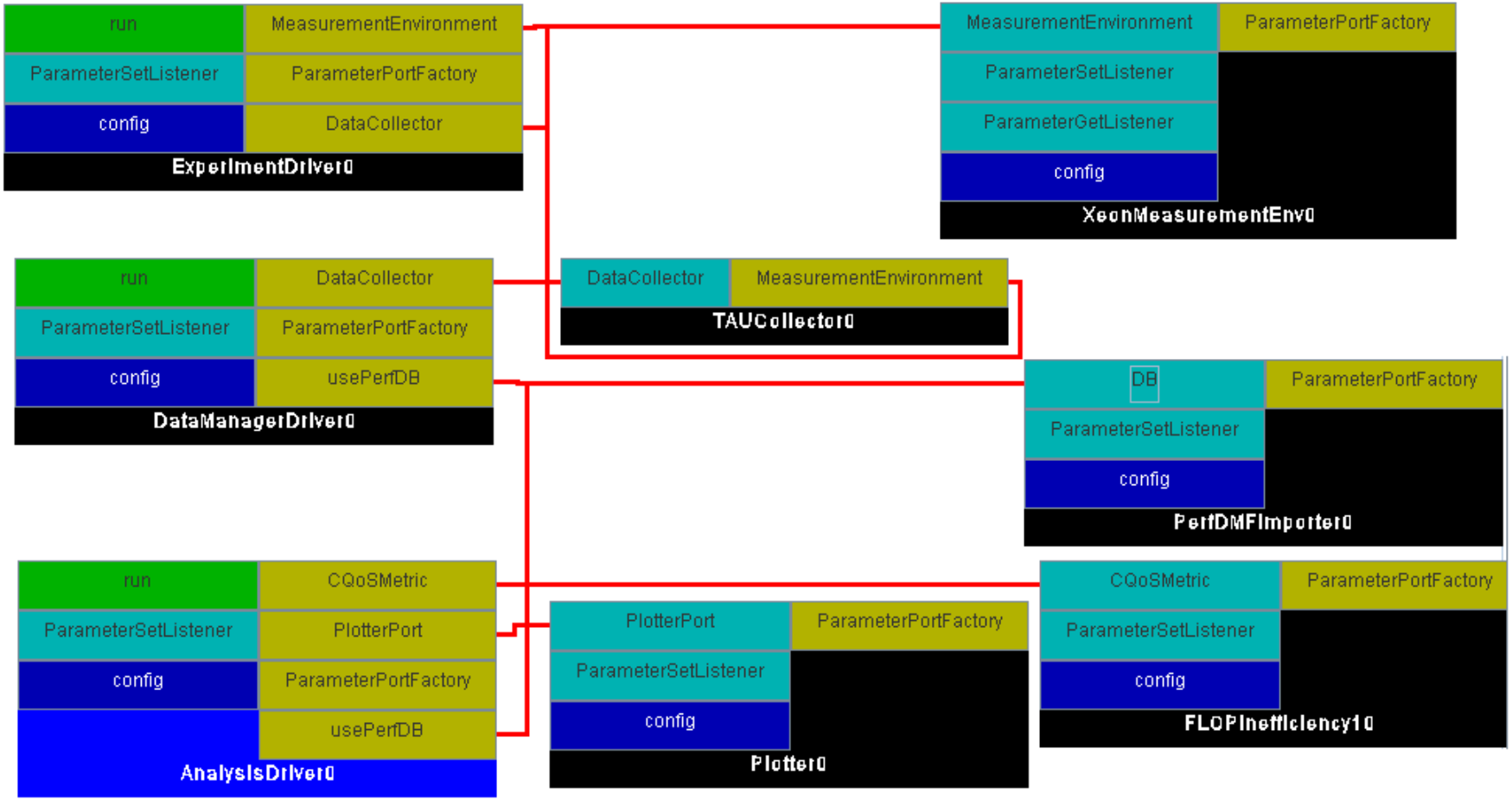
- Connect ports

```
connect cqos_perf_AnalysisDriver usePerfDB cqos_perf_PerfDMFImporter
DB
```

- Invoke driver go

```
go cqos_perf_AnalysisDriver run
```

Assembly of All Components



Summary

- Develop components to automate process of running multiple performance experiments
- Provide a uniform interface integrating support for multiple underlying tools and technology
- Raising the level of efficiency in performance tuning

Future Work

- Extensions to support multiple…
  - Platforms, application spaces, performance tools, database interfaces, and analysis techniques
- Python-based implementation layer of performance components
- Dynamic substitution and reconfiguration of component implementations
- Evaluating the tools with scientific apps and extending based on their needs

Additional Information

- Support from DOE SciDAC Institutions
  - Technology for Advanced Scientific Component Software (TASCS)
  - Performance Engineering Research Institute (PERI)

- Trac Website
  - https://trac.mcs.anl.gov/projects/cca/wiki/performance