Performance Optimization and Productivity

EU H2020 Center of Excellence (CoE)

1 October 2015 – 31 March 2018 (30 months)
POP CoE

• **A Center of Excellence**
  - On **Performance Optimization and Productivity**
  - Promoting **best practices in parallel programming**

• **Providing Services**
  - Precise understanding of application and system behavior
  - Suggestion/support on how to refactor code in the most productive way

• **Horizontal**
  - Transversal across application areas, platforms, scales

• **For academic AND industrial code(s) !**
Motivation

Why?

• Complexity of machines and codes
  → Frequent lack of quantified understanding of actual behavior
  → Not clear most productive direction of code refactoring

• Important to maximize efficiency (performance, power) of compute intensive applications and the productivity of the development efforts
Partners

• Who?
  • BSC (coordinator), ES
  • HLRS, DE
  • JSC, DE
  • NAG, UK
  • RWTH Aachen, IT Center, DE
  • TERATEC, FR

A team with

• Excellence in performance tools and tuning
• Excellence in programming models and practices
• Research and development background AND proven commitment in application to real academic and industrial use cases
Tools used

- **Open-source toolsets**
  - Extrae + Paraver
  - Score-P + Scalasca/TAU/Vampir + Cube
  - Dimemas, Extra-P

- **Commercial toolsets** (if available at customer site)
  - Intel tools
  - Cray tools
  - Allinea tools
BSC Performance tools

- Advanced clustering algorithms

- Instantaneous metrics for ALL hardware counters at “no” cost

- Adaptive burst mode tracing

- Tracking performance evolution

- 26.7MB trace
  - Eff: 0.43; LB: 0.52; Comm: 0.81

- BSC-ES – EC-EARTH

- BSC Performance

- AMG2013
BSC Performance Tools

Models and Projection

Dimemas

eff_factors.py

eff.csv

extrapolation.py

Intel – BSC Exascale Lab

Data access patterns

Tareador

*Scalability prediction for fundamental performance factors.* J. Labarta et al. SuperFRI 2014
The process ...

When?
October 2015 – March 2018

How?
Apply: pop@bsc.es; http://www.pop-coe.eu
Small questionnaire describing application and needs
Selection/assignment process
Install tools @ your production machine (local, PRACE, ...)
Interactively: Gather data → Analysis → Report
3 levels of services

**Application Performance Audit**
- Primary service
- Identify performance issues of customer code (at customer site)
- Small Effort (< 1 month)

**Application Performance Plan**
- Follow-up on the service
- Identifies the root causes of the issues found and qualifies and quantifies approaches to address the issues
- Longer effort (1-3 months)

**Proof-of-Concept**
- Experiments and mock-up tests for customer codes
- Kernel extraction, parallelization, mini-apps experiments to show effect of proposed optimizations
- 6 months effort
Other activities

• **Customer advocacy**
  • Gather customers feedback, ensure satisfaction, steer activities

• **Training**
  • Best practices on the use of the tools and programming models (MPI + OpenMP)
• If you have the feeling you are not getting the performance you expected
• If you are not sure whether it is a problem of your application, the system, ...
• If you want an external view and recommendations on suggested refactoring efforts
• If you would like some help on how to best restructure your code

**POP Coordination**

Prof. Jesus Labarta, Judit Gimenez
Barcelona Supercomputing Center (BSC)
Email: pop@bsc.es
WWW: http://www.pop-coe.eu