Parallel Performance Optimization and Productivity

EU H2020 Centre of Excellence (CoE)

1 December 2018 – 30 November 2021

Grant Agreement No 824080

The POP CoE

- One of ten Centres of Excellence in HPC Applications
  - POP is a CoE in **Performance Optimisation and Productivity**
    - Promoting **best practices in parallel programming**
  - Another is ESiWACE, the **Centre of Excellence in Simulation of Weather and Climate in Europe**
- POP provides **FREE** services
  - for (EU) academic and industrial codes and users
  - across all application areas, platforms, scales
- giving users
  - a precise understanding of application and system behaviour
  - suggestions/support on how to refactor code in the most productive way.

The POP Partners

- **Who?**
  - BSC, ES (coordinator)
  - HLRS, DE
  - IT4I, CZ
  - JSC, DE
  - NAG, UK
  - RWTH Aachen, IT Center, DE
  - TERATEC, FR
  - UVSQ, FR

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

HLRS

VSB TECHNICAL UNIVERSITY OF OSTRAVA | IT4INNOVATIONS NATIONAL SUPERCOMPUTING CENTER

JÜLICH Forschungszentrum | JÜLICH SUPERCOMPUTING CENTRE

nag®

RWTH AACHEN UNIVERSITY

Teratec

UNIVERSITÉ DE VERSAILLES ST-QUENTIN-EN-YVELINES

A team with

- Excellence in performance tools and tuning
- Excellence in programming models and practices
- A research and development background and a proven commitment to real academic and industrial applications

Motivation

Why?

- Complexity of machines and codes
  - ⇨ Frequent lack of quantified understanding of actual behaviour
  - ⇨ Not clear most productive direction of code refactoring
- Important to maximize efficiency (performance, power) of compute intensive applications and productivity of the development efforts

What?

- Parallel programs, mainly MPI/OpenMP
  - Although also CUDA, OpenCL, OpenACC, Python, …

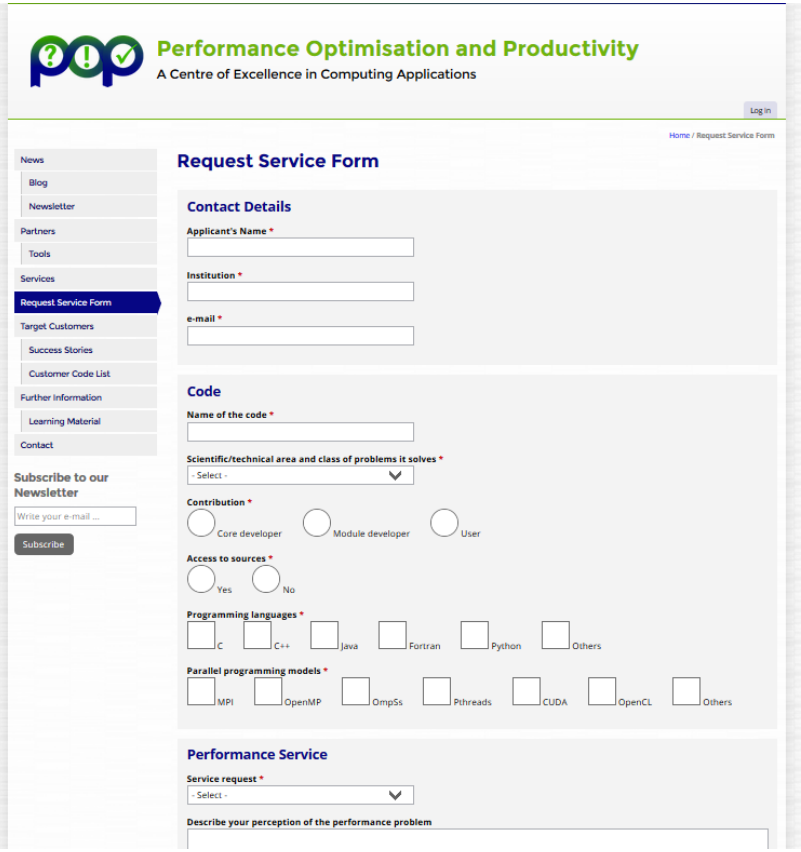
The Process …

When?

December 2018 – November 2021

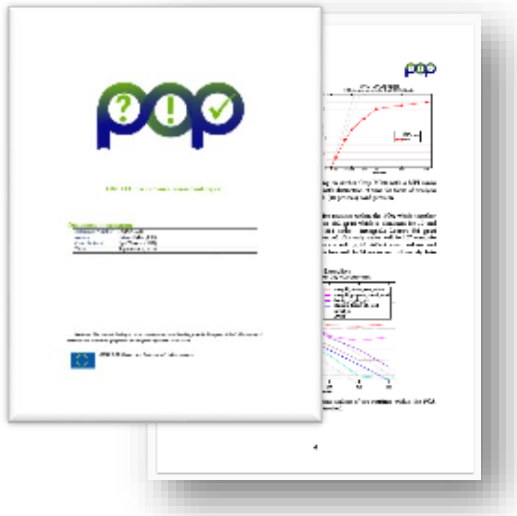
How?

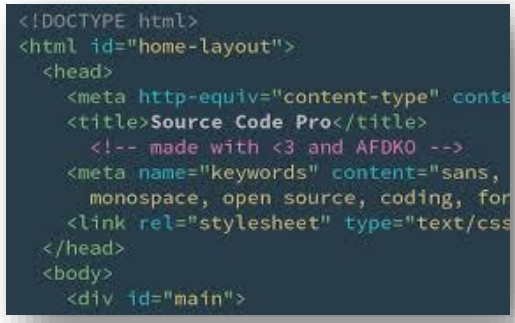
- Apply
  - Fill in small questionnaire describing application and needs https://pop-coe.eu/request-service-form
  - Questions? Ask pop@bsc.es
- Selection/assignment process
- Install tools @ your production machine (local, PRACE, …)
- Interactively: Gather data → Analysis → Report



FREE Services provided by the CoE

- **Parallel Application Performance Assessment**
  - Primary service
  - Identifies performance issues of customer code
  - If needed, identifies the root causes of the issues found and qualifies and quantifies approaches to address them (recommendations)
  - 1-3 months effort
- **Proof-of-Concept**
  - Follow-up service
  - Experiments and mock-up tests for customer codes
  - Kernel extraction, parallelisation, mini-apps experiments to show effect of proposed optimisations
  - 3-6 months effort

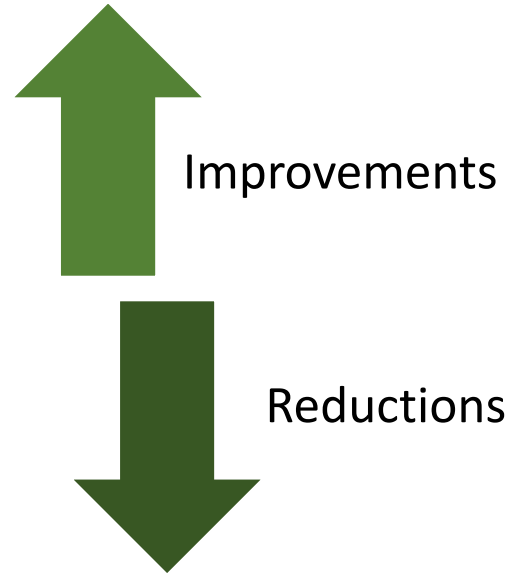




Note: Effort shared between our experts and customer!

Some Success Stories

- See ⇨ https://pop-coe.eu/blog/tags/success-stories



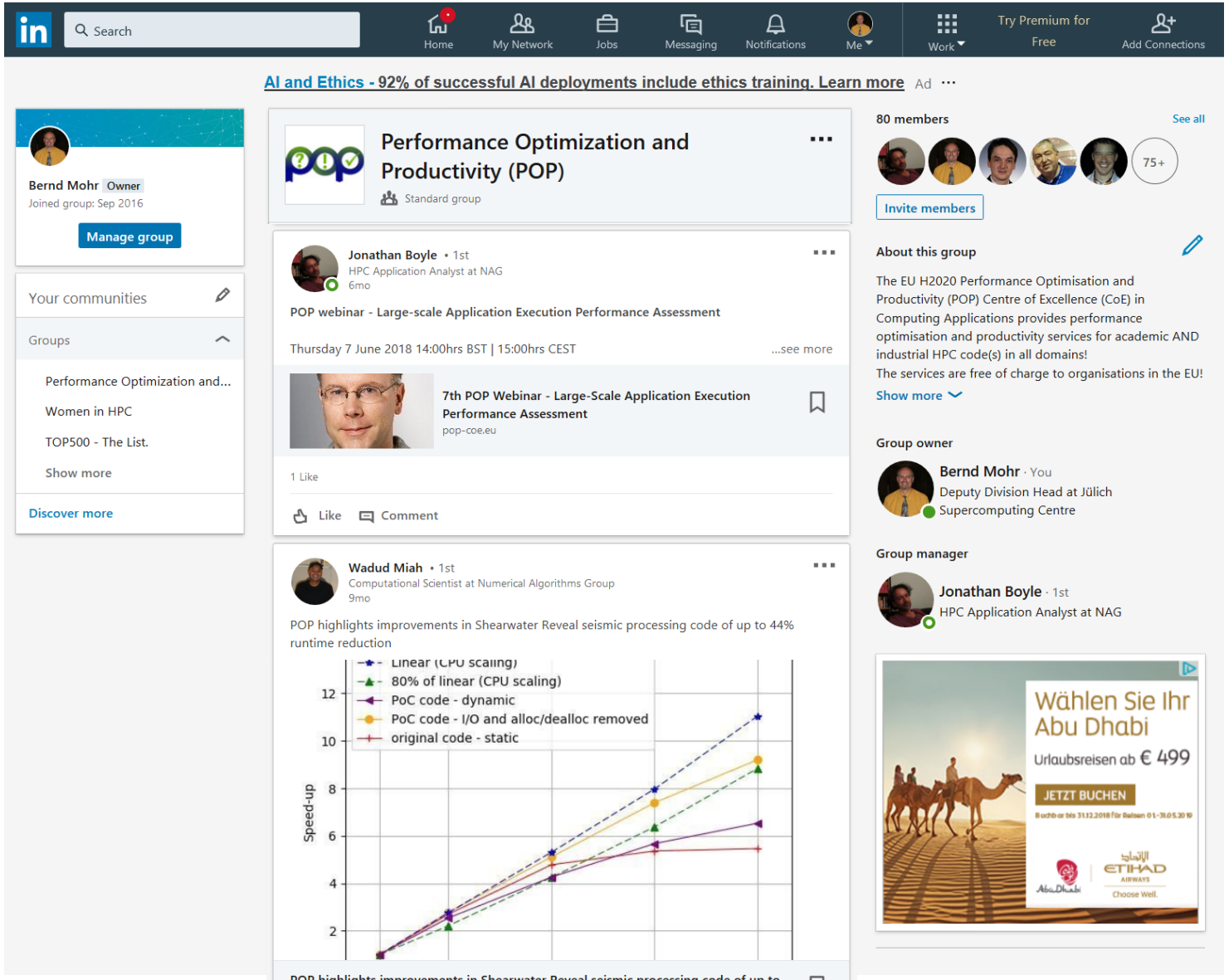
- Performance Improvements for SCM's ADF Modeling Suite
- **3x Speed Improvement** for zCFD Computational Fluid Dynamics Solver
- **25% Faster time-to-solution** for Urban Microclimate Simulations
- **2x performance improvement** for SCM ADF code
- Proof of Concept for BPMF leads to around **40% runtime reduction**
- POP audit helps developers **double their code performance**
- **10-fold scalability improvement** from POP services
- POP performance study improves performance **up to a factor 6**
- POP Proof-of-Concept study leads to **nearly 50% higher performance**
- POP Proof-of-Concept study leads to **10X performance improvement** for customer

Website – www.pop-coe.eu

- POP User Portal
- Access to all public information and services

Follow us on Twitter @POP_HPC

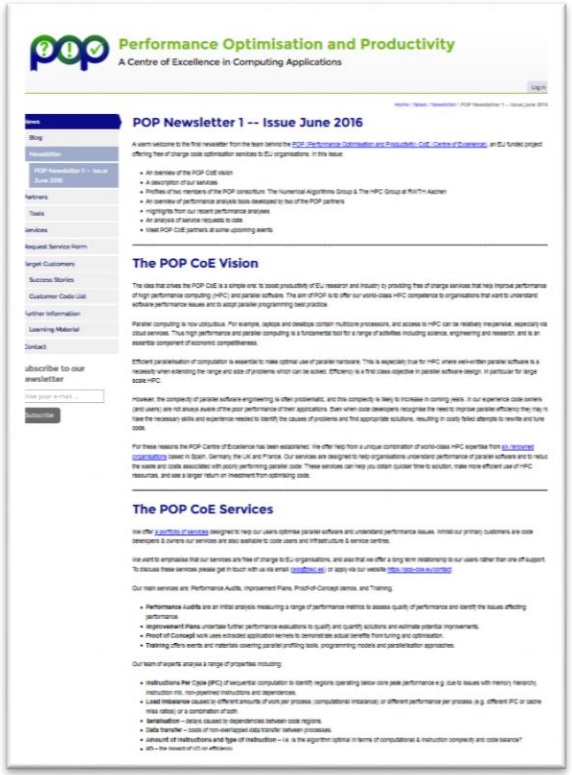
LinkedIn Group

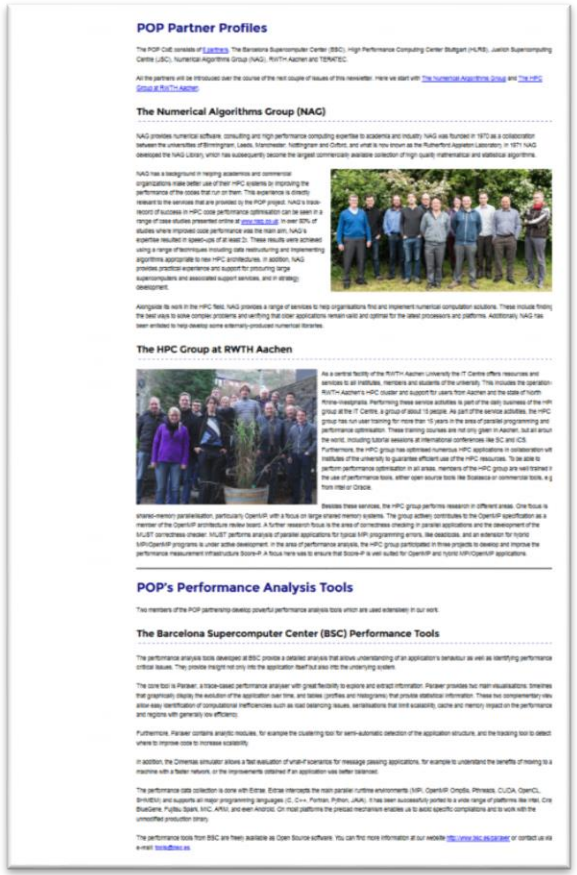


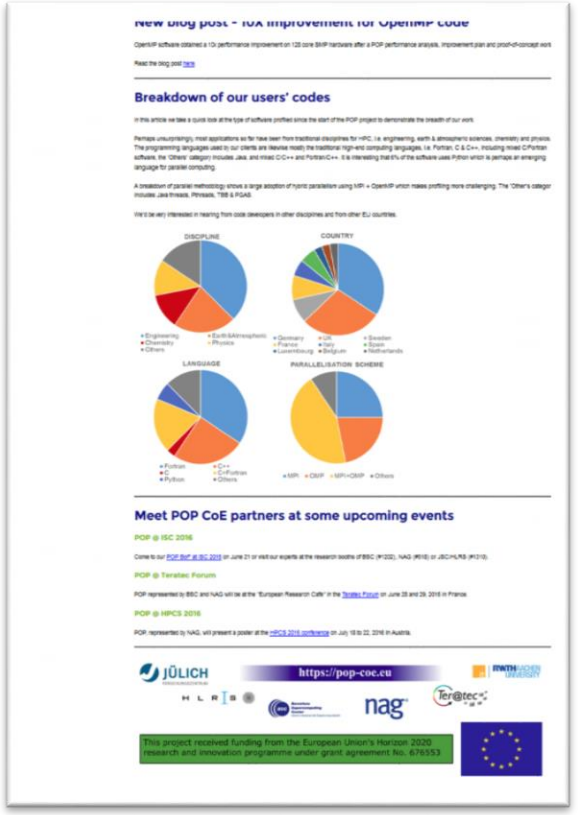
- Important announcements
- Also serves as a user forum

Quarterly Email Newsletter

- Subscribe on the POP website
- Newsletter archive: https://pop-coe.eu/news/newsletter

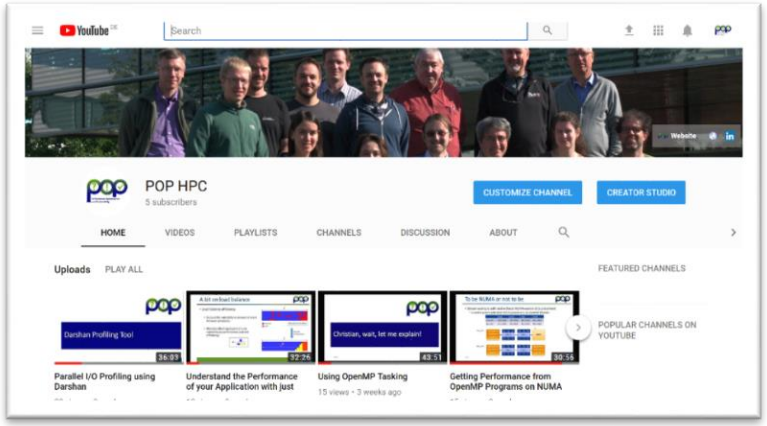






Webinars / YouTube

- See ⇨ https://pop-coe.eu/blog/tags/webinar
- Or our YouTube Channel



- Already available:
  - How to Improve the Performance of Parallel Codes
  - Getting Performance from OpenMP Programs on NUMA Architectures
  - Understand the Performance of your Application with just Three Numbers
  - Using OpenMP Tasking
  - Parallel I/O Profiling Using Darshan
  - The Impact of Sequential Performance on Parallel Codes
  - Large-scale Application Execution Performance Assessment
  - POP Case Study: 3x Speed Improvement for Zenotech's zCFD Solver

Performance Optimisation and Productivity

A Centre of Excellence in HPC

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