



# Parallel Performance Optimization and Productivity

EU H2020 Centre of Excellence (CoE)

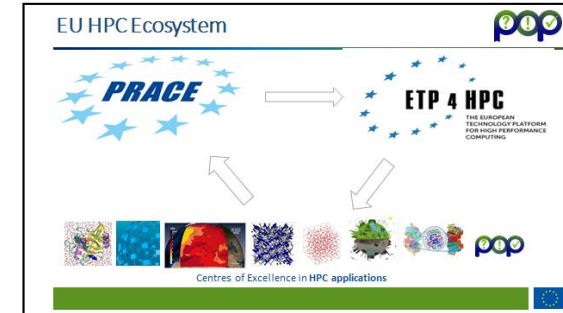


Grant Agreement No 824080

1 December 2018 – 30 November 2021



- A **Centre of Excellence**
  - On **Performance Optimisation and Productivity**
  - Promoting **best practices in parallel programming**
- Providing **FREE Services**
  - Precise understanding of application and system behaviour
  - Suggestion/support on how to refactor code in the most productive way
- **Horizontal**
  - Transversal across application areas, platforms, scales
- **For (EU) academic AND industrial codes and users !**



# Partners



## • Who?

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





## 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](mailto:pop@bsc.es)
- Selection/assignment process
- Install tools @ your production machine (local, PRACE, ...)
- Interactively: Gather data → Analysis → Report

The screenshot shows the 'Request Service Form' on the Performance Optimisation and Productivity (POP) website. The form is titled 'Request Service Form' and is part of a 'Request Service Form' page. It includes a sidebar with navigation links such as 'News', 'Blog', 'Newsletter', 'Partners', 'Tools', 'Services', 'Request Service Form', 'Target Customers', 'Success Stories', 'Customer Code List', 'Further Information', 'Learning Material', and 'Contact'. The main form area is divided into several sections: 'Contact Details' with fields for 'Applicant's Name', 'Institution', and 'e-mail'; 'Code' with fields for 'Name of the code', a dropdown for 'Scientific/technical area and class of problems it solves', and radio buttons for 'Contribution' (Core developer, Module developer, User) and 'Access to sources' (Yes, No); 'Programming languages' with checkboxes for C, C++, Java, Fortran, Python, and Others; 'Parallel programming models' with checkboxes for MPI, OpenMP, OpenMPs, Pthreads, CUDA, OpenCL, and Others; and 'Performance Service' with a dropdown for 'Service request' and a text area for 'Describe your perception of the performance problem'. A 'Log in' link is visible in the top right corner of the page.

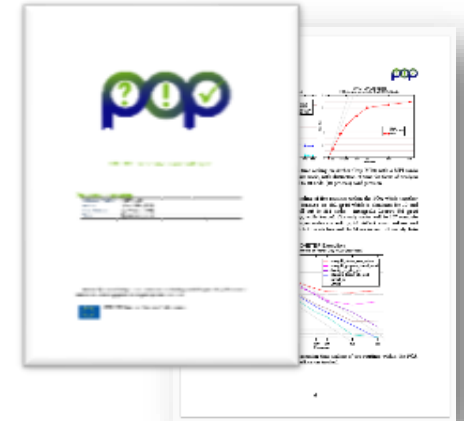


# FREE Services provided by the CoE



- **Parallel Application Performance Assessment**

- Primary service
- Identifies performance issues of customer code (at customer site)
- If needed, identifies the root causes of the issues found and qualifies and quantifies approaches to address them (recommendations)
- **Combines former Performance Audit (?) and Plan (!)**
- Medium effort (1-3 months)



- **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
- Larger effort (3-6 months)

```
<!DOCTYPE html>
<html id="home-layout">
  <head>
    <meta http-equiv="content-type" conte
    <title>Source Code Pro</title>
    <!-- made with <3 and AFDKO -->
    <meta name="keywords" content="sans,
    monospace, open source, coding, for
    <link rel="stylesheet" type="text/css
  </head>
  <body>
    <div id="main">
```

Note: Effort shared between our experts and customer!



# Target customers



- **Code developers**

- Assessment of detailed actual behaviour
- Suggestion of most productive directions to refactor code

- **Users**

- Assessment of achieved performance in specific production conditions
- Possible improvements modifying environment setup
- Evidence to interact with code provider

- **Infrastructure operators**

- Assessment of achieved performance in production conditions
- Possible improvements from modifying environment setup
- Information for time computer time allocation processes
- Training of support staff

- **Vendors**

- Benchmarking
- Customer support
- System dimensioning/design



- **Install and use already available monitoring and analysis technology**
  - Analysis and predictive capabilities
  - Delivering insight
    - With extreme detail
    - Up to extreme scale
- **Open-source toolsets**
  - Extrae + Paraver
  - Score-P + Cube + Scalasca/TAU/Vampir
  - Dimemas, Extra-P
  - MAQAO
- **Commercial toolsets**  
(if available at customer site)
  - Intel tools
  - Cray tools
  - ARM tools





# Performance Optimisation and Productivity

A Centre of Excellence in HPC

Contact:

<https://www.pop-coe.eu>

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 @POP\_HPC

