



Barcelona Supercomputing Center Centro Nacional de Supercomputación



## The Barcelona Supercomputing Center

Sergi Girona Operations Director

e-IRG workshop Dec 2019

04/12/2019

### Barcelona Supercomputing Center Centro Nacional de Supercomputación



Supercomputing services to Spanish and EU researchers

#### **BSC-CNS objectives**



R&D in Computer, Life, Earth and Engineering Sciences



PhD programme, technology transfer, public engagement

BSC-CNS is a consortium that includes



Supercomputing Center Centro Nacional de Supercomputación

Barcelona

Spanish Government	60%	
Catalan Government	30%	Generalitat de Catalunya Departament d'Empresa i Coneixement
Univ. Politècnica de Catalunya	10%	UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONATECH

### **People and Resources**



BSC Barcelona Supercomputing Center Centro Nacional de Supercomputación

UPC contributes, in terms of assigned staff and room space, the equivalent of 10% of regular income

### **Mission of BSC Scientific Departments**



To influence the way machines are built, programmed and used: programming models, performance tools, Big Data, Artificial Intelligence, computer architecture, energy efficiency



To understand living organisms by means of theoretical and computational methods (molecular modeling, genomics, proteomics)



Center Centro Nacional de Supercomputación



To develop and implement global and regional state-of-the-art models for shortterm air quality forecast and long-term climate applications



To develop scientific and engineering software to efficiently exploit super-computing capabilities (biomedical, geophysics, atmospheric, energy, social and economic simulations)

### MareNostrum 4

Total peak performance: 13,7 Pflops

General Purpose Cluster:	11.15 Pflops	(1.07.2017)
CTE1-P9+Volta:	1.57 Pflops	(1.03.2018)
CTE2-Arm V8:	0.65 Pflops	(12.2019)
CTE3-AMD Rome+MI500:	0.52 Pflops	(12.2019)

R-E-S

Access: bsc.es/res-intranet

Access: prace-ri.eu

RACE >

MareNostrum 1 2004 – 42,3 Tflops 1<sup>st</sup> Europe / 4<sup>th</sup> World New technologies MareNostrum 2 2006 – 94,2 Tflops 1<sup>st</sup> Europe / 5<sup>th</sup> World New technologies MareNostrum 3 2012 – 1,1 Pflops 12<sup>th</sup> Europe / 36<sup>th</sup> World MareNostrum 4 2017 – 11,1 Pflops 2<sup>nd</sup> Europe / 13<sup>th</sup> World New technologies

-Vecional de Supercomputeción

### MareNostrum 5. A European pre-exascale supercomputer

- **200 Petaflops** peak performance (200 x 10<sup>15</sup>)
- Experimental platform to create supercomputing technologies "made in Europe"
- 223 M€ of investment







Barcelona Supercomputing Center Centro Nacional de Supercomputación

The acquisition and operation of the EuroHPC supercomputer is funded jointly by the EuroHPC Joint Undertaking, through the European Union's Connecting Europe Facility and the Horizon 2020 research and innovation programme, as well as the Participating States Spain, Portugal, Croatia, and Turkey

### MEEP, MareNostrum Experimental Exascale Platform

- The MareNostrum Experimental Exascale Platform (MEEP) is a flexible FPGA-based emulation platform that will explore hardware/software co-designs for Exascale Supercomputers and other hardware targets, based on European-developed IP.
- MEEP provides two very important functions:
  - 1. An evaluation platform of pre-silicon IP and ideas, at speed and scale
  - 2. A software development and experimentation platform to enable software readiness for new hardware.
- MEEP enables software development, accelerating software maturity, compared to the limitations of software simulation.
- IP can be tested and validated before moving to silicon, saving time and money.
- The objectives of MEEP are to leverage and extend projects like EPI and the POP2 CoE in the following ways:
  - Define, develop, and deploy an FPGA-based emulation platform targeting European-based Exascale Supercomputer RISC-V-based IP development, especially hardware/software co-design.
  - Develop a base FPGA shell that provides memory and I/O connectivity to the host CPU and other FPGAs.
  - Build FPGA tools and support to map enhanced EPI and MEEP IP into the FPGA core, validating and demonstrating European IP.
  - Develop the software toolchain (compiler, debugger, profiler, OS, and drivers) for RISC-V based accelerators to enable application development and porting.



### **MEEP Research Stack**



#### FPGA Shell:

External Interfaces: I/O, DRAM, etc.

Emulation Region:





Profiling, Performance Monitors

### MareNostrum 5 Final budget approved (GB EuroHPC)

	Acquisition [€]	Operation[€]	TOTAL TCO [€]
MareNostrum 5 - overall budget	151.410.000	55.806.000	207.216.000
EuroHPC - contribution	75.705.000	25.700.000	101.405.000



### MareNostrum5 concept



Hosting Consortium: Spain Portugal Turkey

#### Applications:

- General purpose partition, open to all researchers with MPI, OpenMP codes, standard HPC codes. Scalable machine to run codes with high scalability, thousands of nodes.
- Accelerated partition: Any GPU application ready to scale to thousands of GPUs
- Any domain with workflows mixing General Purpose and GPU, e.g. Earth science, Life science, Engineering, AI and AI driven executions.

The acquisition and operation of the EuroHPC supercomputer is funded jointly by the EuroHPC Joint Undertaking, through the European Union's Connecting Europe Facility and the Horizon 2020 research and innovation programme, as well as the Participating States Spain, Portugal, Croatia, and Turkey

### **MareNostrum 5 facilities**















#### BSC Barcelou Superco Center Centro Nac

Barcelona Supercomputing Center Centro Nacional de Supercomputación



# Thank you

#### sergi.girona@bsc.es