About CERN

CERN openlab

Outline

CERN & its computing challenges

CERN openlab

R&D collaborations with Science and Industry

This talk will cover activities from the EC-funded project interTwin

Digital Twins

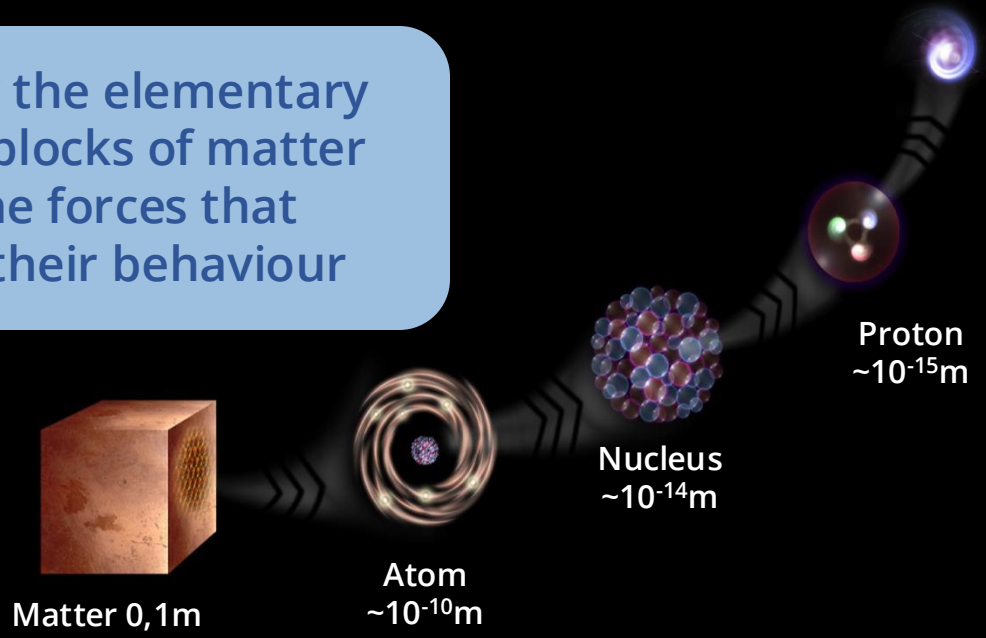
Diversity in Technology

CERN is the European Laboratory for particle physics

CERN is the world's biggest laboratory for particle physics

Our goal is to understand the most fundamental particles and laws of the universe

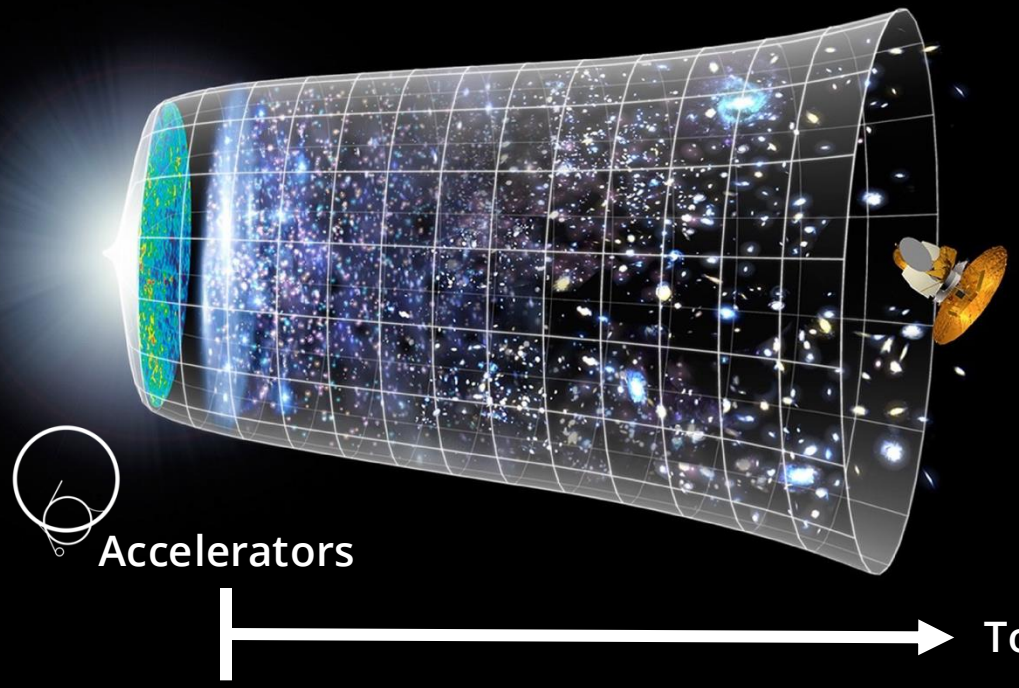
We study the elementary building blocks of matter and the forces that control their behaviour



What is the universe made of?

How did the universe begin?

We reproduce the conditions a fraction of a second after the Big Bang, to gain insight into the structure and evolution of the universe.



At CERN we develop technologies in three key areas

ACCELERATORS

DETECTORS

COMPUTING

The Large Hadron Collider (LHC)

- 27km in circumference
- About 100m underground
- Superconducting magnets steer the particles around the ring
- Particles are accelerated to close to the speed of light

Giant detectors record the particles collisions

ATLAS

ALICE

CMS

LHCb

About CERN openlab

CERN openlab

About CERN openlab

CERN openlab stands as a testament to **over two decades of pioneering history and expertise.**

Remains a **ground-breaking public-private partnership**, forging **collaborations between leading ICT companies and research centres worldwide**, uniting them at the forefront of scientific innovation at CERN.

These partnerships fuel CERN researchers with **invaluable opportunities and resources to push the boundaries of computing.**

CERN openlab mission

Since its inception, CERN openlab has fostered the development of big data scientific research through **four primary missions.**

1 | Establishing strategic industry collaborations

2 | Fuelling technological innovation

3 | Exposing technology to researchers

4 | Nurturing knowledge and growth in young STEM researchers

CERN openlab phase VIII

Structured three-year phase cycles:

- Systematically assess technological evolution
- Anticipate future needs
- Delineate overarching thematic priorities

INCEPTION
I-IV
2003-2014

CONSOLIDATION
V-VII
2015-2023

THE NEXT PHASES
VIII-X
2024-2034

OBJECTIVES

High-level: Accelerating Computing for Science

Pioneer sustainable and innovative computing and storage solutions

Leverage HPC infrastructures and AI techniques for sustainable science

Foster collaboration between industry and science in ICT technologies

R&D DIRECTIONS

Sustainable Infrastructures

- Heterogeneous computing, platforms and HPC systems
- Computing architectures and software engineering
- Advanced storage, data management and networks
- Infrastructures and techniques for artificial intelligence
- Applications for society and environment

Emerging Technologies

- New materials for long-term digital storage
- Digital twins

R&D ACTIVITIES

CERN openlab – Phase VIII (2024-2026)

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Established Industry and Research Members

intel, altera, SIEMENS, ORACLE, micron, cerabyte, SIM NS FOUNDATION, PURESTORAGE, E4 COMPUTER ENGINEERING, Johnson & Johnson, Pasqal, UNIVERSITÀ DEGLI STUDI DI TRIESTE, INFN

Industry And Research Members in Pre-agreement Stage

UCL, SURF, IMPERIAL, NVIDIA, Google

Prospective Industry/Research Members

cerebras, Hewlett Packard Enterprise, AMD XILINX, NOKIA

Structured Three-year Phase Cycles

- Systematically Assess Technological Evolution
- Anticipate future needs
- Delineate overarching thematic priorities

CERN openlab phase VIII
Implementation Model

The CERN openlab **implementation model relies on two main approaches:**

Establishing a managed portfolio of small to medium-size, agile projects with technology providers with clear impact on the CERN IT Technology Roadmap.

Identifying a few collaborations, especially at the level of the computing infrastructures, of high potential impact and act as an initial incubation step for longer-term collaborations.

- Foster strategic industry-science partnerships
- Maximise technical impact
- Harness the potential of innovative technologies
- Amplify CERN openlab core strengths

CERN openlab phase VIII

Stakeholders

CERN openlab's primary role is to act as conduit and facilitator for collaboration in computing science and technology between **two categories of stakeholders**:

The science communities
(CERN departments and groups; R&D teams at CERN; Research centres)

Technology providers
(industry)

CERN openlab phase VIII

How does it work?

	PARTNERS	ASSOCIATES
In-kind contributions & annual funded effort	≥300 000CHF	<300 000CHF
Annual membership	30 000CHF	30 000CHF
Scope of collaboration	Longer-term co-development programmes	Shorter tactical projects

For CERN openlab Phase VIII (2024-2026), a **simplified membership structure is being implemented with two levels**:

Strategic Members (Partners) and **Associate Members** (Associates).

Projects are required to **include overhead costs for activities such as system administration, dedicated communication and support activities**. The appropriate level of overhead to be charged depends on the type of project and will be explicitly negotiated.

Research centres with complementary expertise, aligned scientific goals, and innovation objectives may become research members of CERN openlab with or without direct financial contributions.

Team

Head of CERN openlab

Coordinates the overall programme and manages the negotiation of contracts between CERN and members with the assistance of the CERN Legal Services.

Maria Girone
Head of CERN openlab

Communication office

Manages CERN openlab's communication needs, especially agreements with industrial partners about communication, including organising the summer student programme and events.

Mariana Velho
Communication Manager

Administrative & Financial office

Handles administrative and financial tasks.

Killian Verder
CTO Office Administration

Valentina Clavel
Finance Manager

CTO office

Contributions from experts in CERN IT technical groups. Assesses technology for projects. It functions as a central hub for proposals evaluation and project coordination and maintains close ties with CERN technical groups and other CERN departments.

Luca Atzori
CTO for Computing

Thomas Owen James
CTO for AI and Edge Devices

Luca Mascetti
CTO for Storage

Antonio Nappi
CTO for Platforms and Workflows

Eric Wulff
Deputy CTO

CERN openlab

How to contact us

Get in touch

Send us a message ↓

Email | openlab-communications@cern.ch

Website | openlab.cern → check our projects!

Phase VIII Brochure

X

LinkedIn

Thank you!

CERN openlab

Collaborations and R&D on HPC

New Techniques and Technologies

Enables Machine Learning and AI algorithms and processing techniques

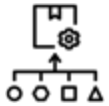
Opens the possibility for real-time interactive simulations (Digital Twins)

A path to optimize energy usage

ODISSEE

Online Data Intensive Solutions for Science in the Exabyte Era

New Challenges and Opportunities



New resources for processing

Requires technology migration and redesigning of applications

Encourages stronger engagement with industry, other science communities and the computing community

Requires strategic planning and communication with the existing distributed computing community

Examples of Projects in HPC Areas

Unified programming models and portability

Expandable Memory and AI on edge devices

Accelerators and RISC-V

Accelerators, digital twins and AI

AI/HPC Convergence, AI tuning

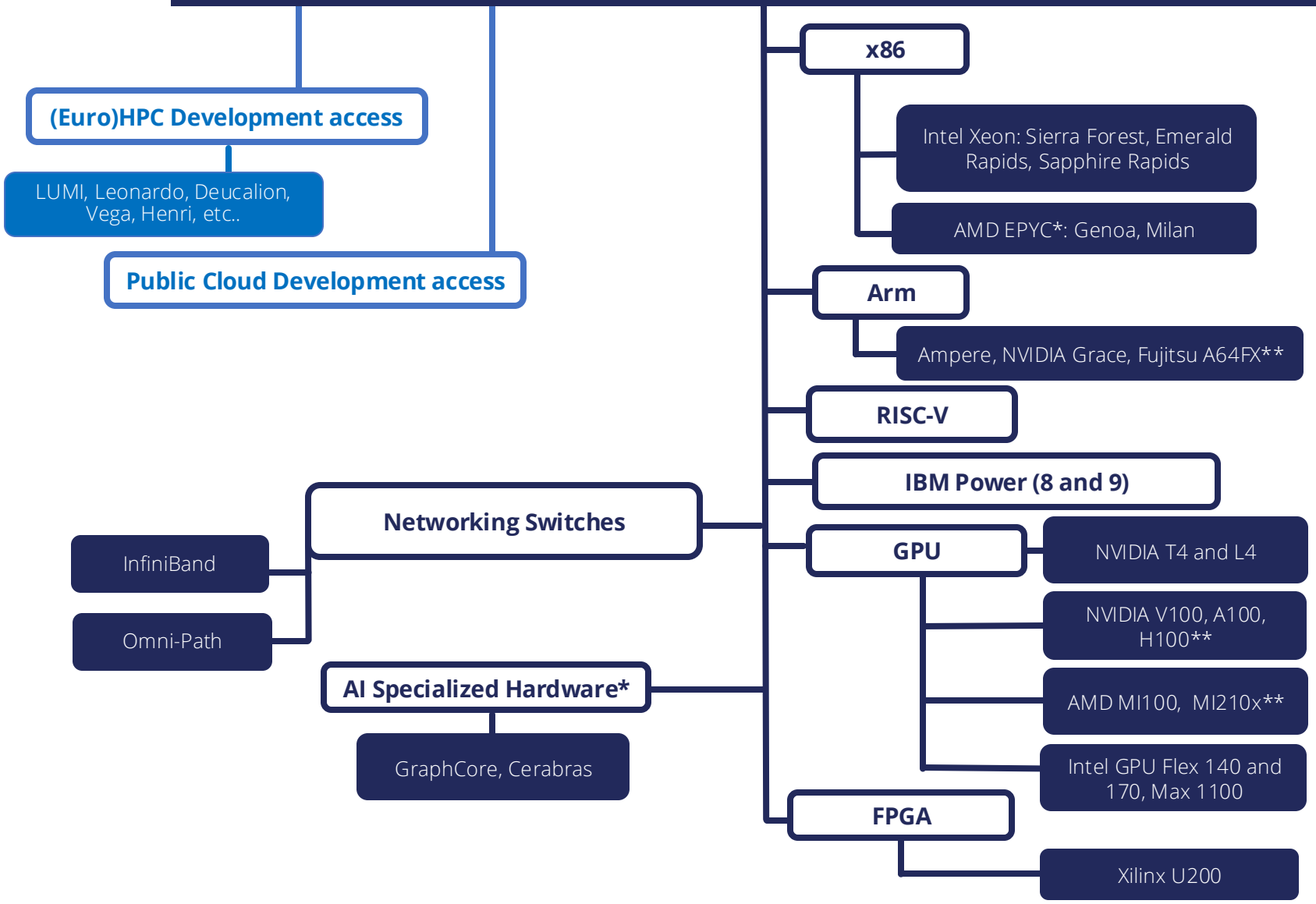
Advanced Archival Storage & Digital Preservation

High Performance Scalable Storage

Low latency networking

FPGA Acceleration

Heterogeneous Architecture Testbed: Hardware



- 100+ users & 290+ accounts
- ~95 systems, mostly bare-metal
- Used by ATLAS, CMS, LHCb, QTI, openlab, CERN EP, IT, ATS
- ~200 tickets handled p/a

*Remote access via E4

**Remote access via Simons Foundation

Heterogeneous Architecture Testbed: Hardware

Euro HPC Supercomputer development access

LUMI, Leonardo, Deucalion, Vega, etc

Networking Switches

- InfiniBand
- Intel Omni-Path

Memory

- Intel Optane

CPU

- Intel Xeon Gen 6, 5, 4 ...
  - Sierra Forest
  - Emerald & Sapphire Rapids
- IBM Power 8 & 9
- AMD EPYC*: Genoa, Milan
- ARM CPUs
  - Fujitsu A64FX**
  - Ampere ALTRA MAX*
  - NVIDIA GRACE

- RISC-V

Accelerators

- NVIDIA Tesla GPUs
  - L4, T4, A2*
  - A100(X*), V100(S), P100, H100*
- NVIDIA Bluefield 2 DPU
- Intel GPUs
  - Max 1100 (Ponte Vecchio)
  - Flex 140 & 170
- AMD
  - MI100*, MI210x**
  - ALVEO U200 (FPGA)

AI specialised hardware

- Cerebras*, Graphcore*

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- ~95 systems, mostly bare-metal
- Used by ATLAS, CMS, LHCb, QTI, ML research in IT department
- ~200 tickets handled p/a

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Communication, Education & Outreach

As a part of the education and training programme, CERN openlab **runs various initiatives that support participation of young scientists and other research organisations**

CERN openlab relies on Communication, Education & Outreach actions

Summer Student Programme

Provides undergraduate and master's level students with an opportunity to work on one of the R&D projects for nine weeks under experts' supervision

This year there was a record of more than 6600 applicants!

Lectures & Training

Open access to CERN openlab **lectures that cover a wide range of computing topics**, from AI to exascale computing and quantum technologies. **Regular specialised technical training** to members of the scientific community

Technical Worksho

Annual workshop to review the R&D projects carried out during the last year and discuss future plans. The event features technical talks, a poster session and a technology track dedicated to our industrial partners

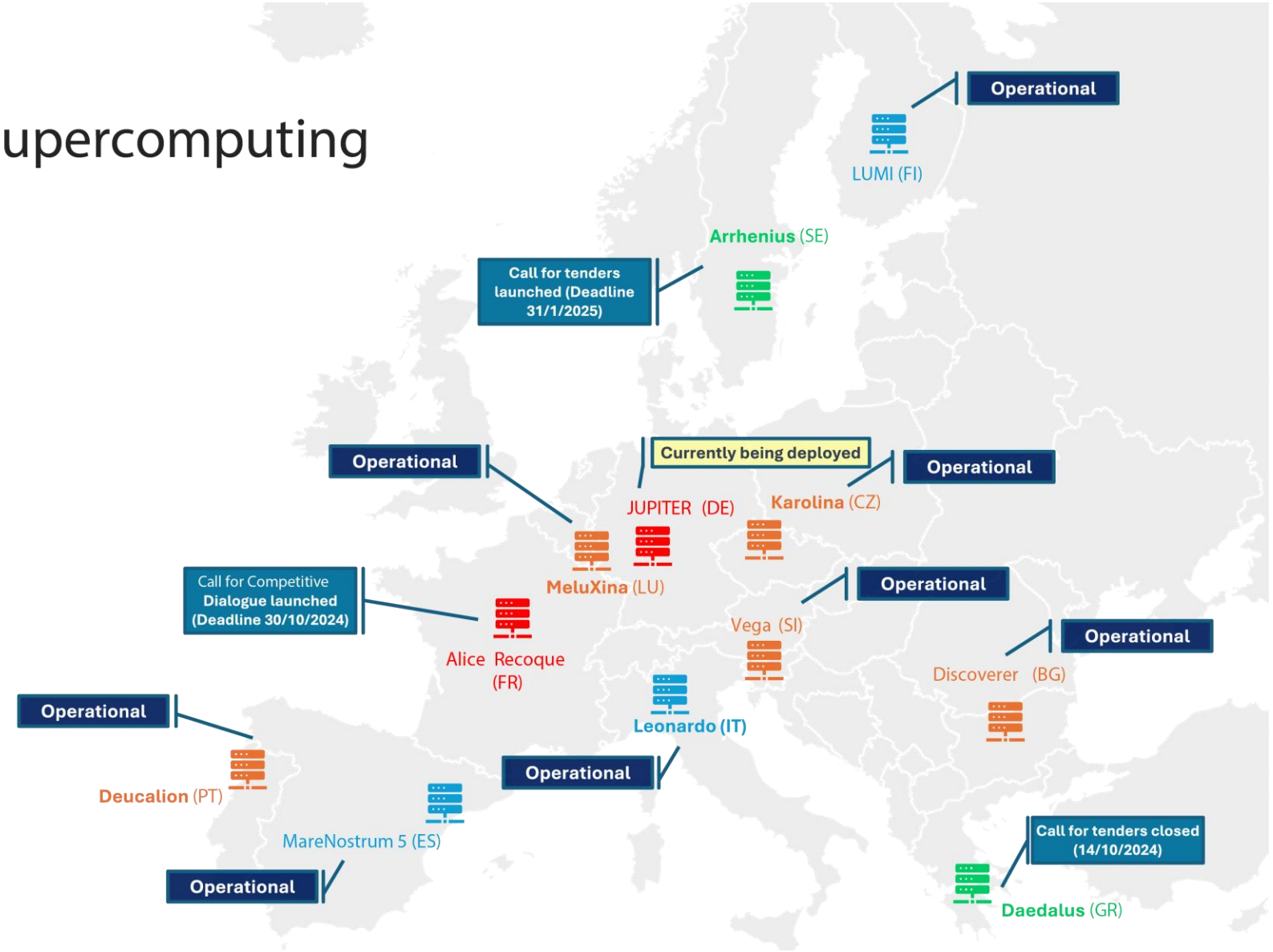
The EuroHPC Supercomputing Ecosystem

EXASCALE

PRE -EXASCALE

PETASCALE

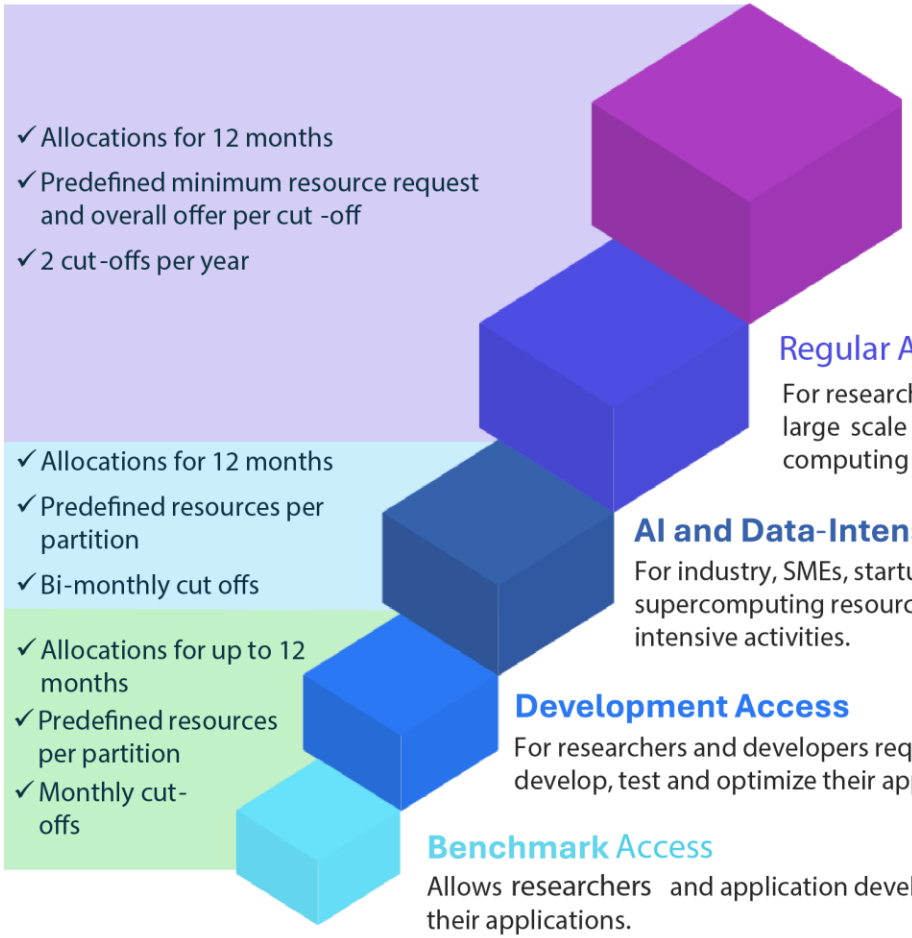
MID-RANGE



EuroHPC Joint Undertaking

Access modes

OVERVIEW



Extreme -Scale Access

For high impact and high gain innovative research applications, with very large compute time, data storage and support needs.

Regular Access

For research and public sector applications requiring large scale resources or frequent access to substantial computing and storage resources.

AI and Data-Intensive Applications Access

For industry, SMEs, startups, and public sector entities requiring access to supercomputing resources to perform artificial intelligence and data - intensive activities.

Development Access

For researchers and developers requiring a small number of node hours to develop, test and optimize their applications prior to applying for access.

Benchmark Access

Allows researchers and application developers to test or benchmark their applications.

WHO IS ELIGIBLE?

Principal Investigators and Team Members affiliated with organizations located in countries associated to Horizon 2020