

SPACE HPC

ESA's new High Performance Computing

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Introducing ESA Space HPC – Webinar

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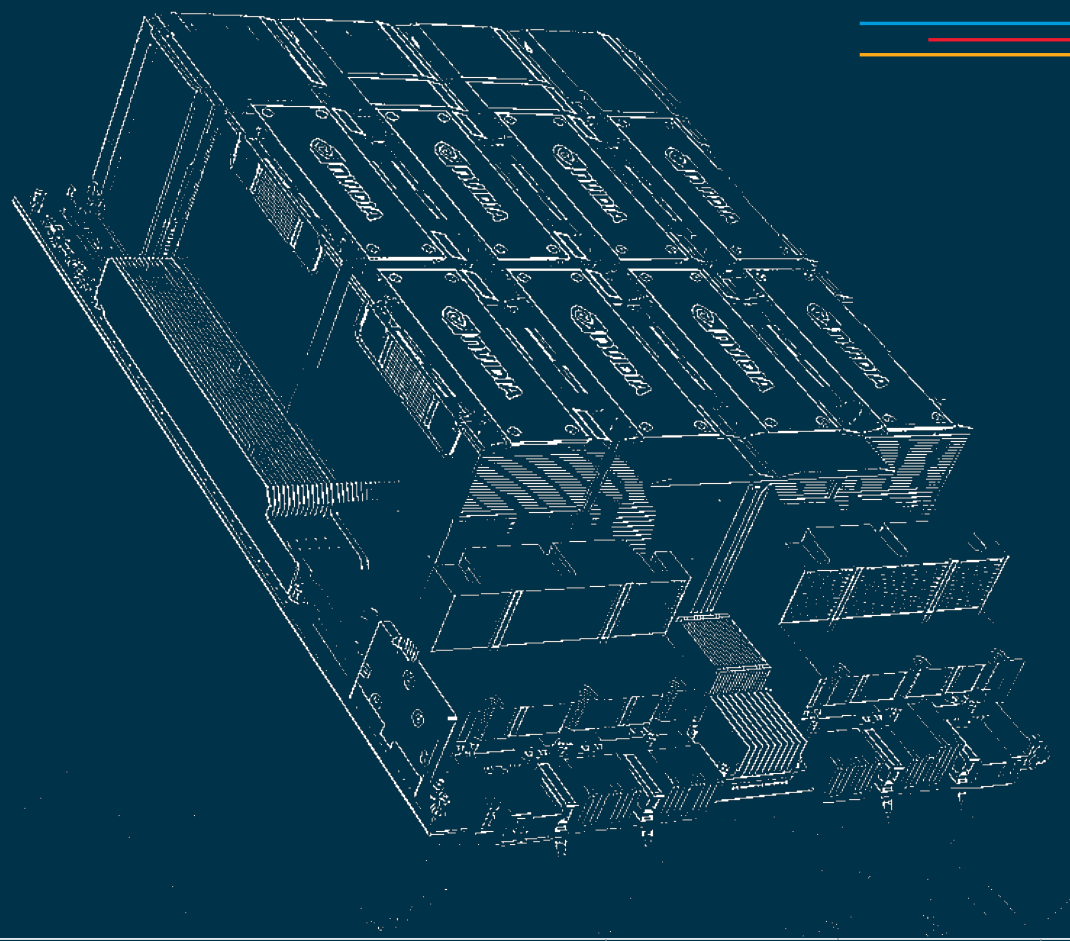
WHAT IS HPC?

High Performance Computing (HPC) uses powerful computer systems to solve complex problems that regular computers can't handle.

An HPC system, like a supercomputer or computer cluster, is made up of many individual computers working together. They're connected by a fast network, so they can share data quickly.

Instead of relying on one super-powerful computer, HPC systems use lots of computers at once. This teamwork lets them tackle big tasks that regular computers couldn't manage on their own.

POWERING BREAKTHROUGHS

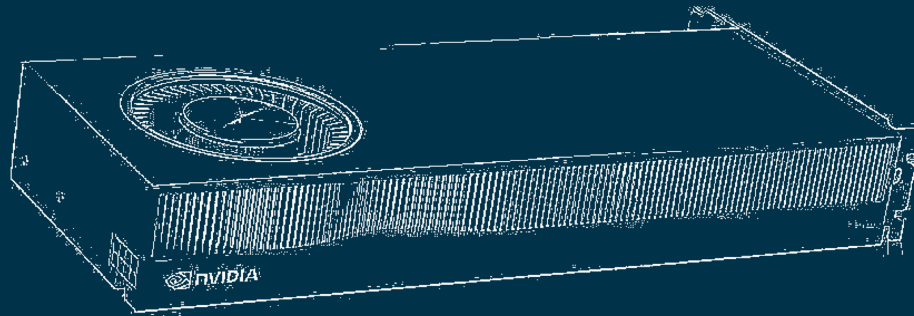


Parallel Processing: HPC systems split big problems into smaller parts and solve them simultaneously across many computers, speeding up calculations dramatically.

Specialized Hardware: HPC systems use advanced components like high-performance processors, Graphical/AI Processing Units, and fast storage to handle specific tasks more efficiently.

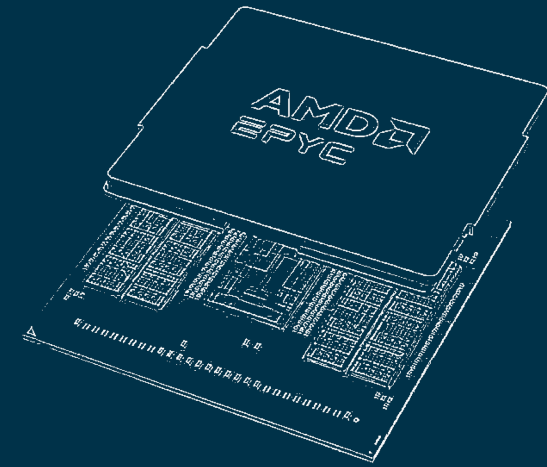
HPC is used across fields like scientific research, engineering, weather prediction, finance, and more. It enables quick solutions to complex problems that would take years on regular computers.

HPC compute: GPUs & CPUs



GPU

- High level of parallelism
- Tasks such as **AI/ML model training**, data mining operations, **high-res graphics rendering**, etc.
- **Less flexible than CPUs** in terms of tasks



CPU

- Can handle a **variety of general tasks**
- **More precise** than GPUs in FLOP
- Used for a wider range of tasks such as **simulations, I/O, etc.**

What is the Space HPC?

Space HPC is ESA's new High Performance Computing system.

The **ESA Space HPC** is a technology demonstrator and first HPC system dedicated to European space industry.

It was built as a modular system at **ESA ESRIN, Italy**, with the best available hardware at that time.

The use cases for Space HPC range from running complex simulations, processing large amounts of data to training machine learning models, artificial intelligence (AI) and much more.

This system aims to serve as an **incubator for upskilling** the ESA workforce, startups and SMEs in space sector in the use of HPC systems.



Space HPC at ESA ESRIN



What is the Space HPC?

Space HPC was ranked **261st in the TOP500 supercomputers** and **59th in the GREEN500**. (www.top500.org)

Rank	TOP500 Rank	System	Cores	Rmax (PFlop/s)	Power (kW)	Energy Efficiency (GFlops/watts)
59	261	Space HPC - HPE Cray XD670/XD665, EPYC 9454 / Xeon 8480L, NVIDIA H100 SXM5 80GB, Infiniband NDR200, RHEL 8.10, HPE European Space Agency (ESRIN) Italy	16,368	4.47	106	42.163



What are the benefits for ESA and industry?

Space HPC will accelerate innovation for European space industry.

For industry (with focus on startups and SMEs), the Space HPC is offering its computational power **at no cost (at least) until end of 2025**, with flexible scalability to meet evolving needs and de-risk their activities, making cutting-edge R&D accessible, efficient, and affordable.

For ESA workforce, we offer a simple registration process. The resources are allocated on first-come first-serve basis, based on the project's readiness and availability of the resources.

For all Space HPC users, we will announce **free trainings** from experienced trainers.

KEY BENEFITS

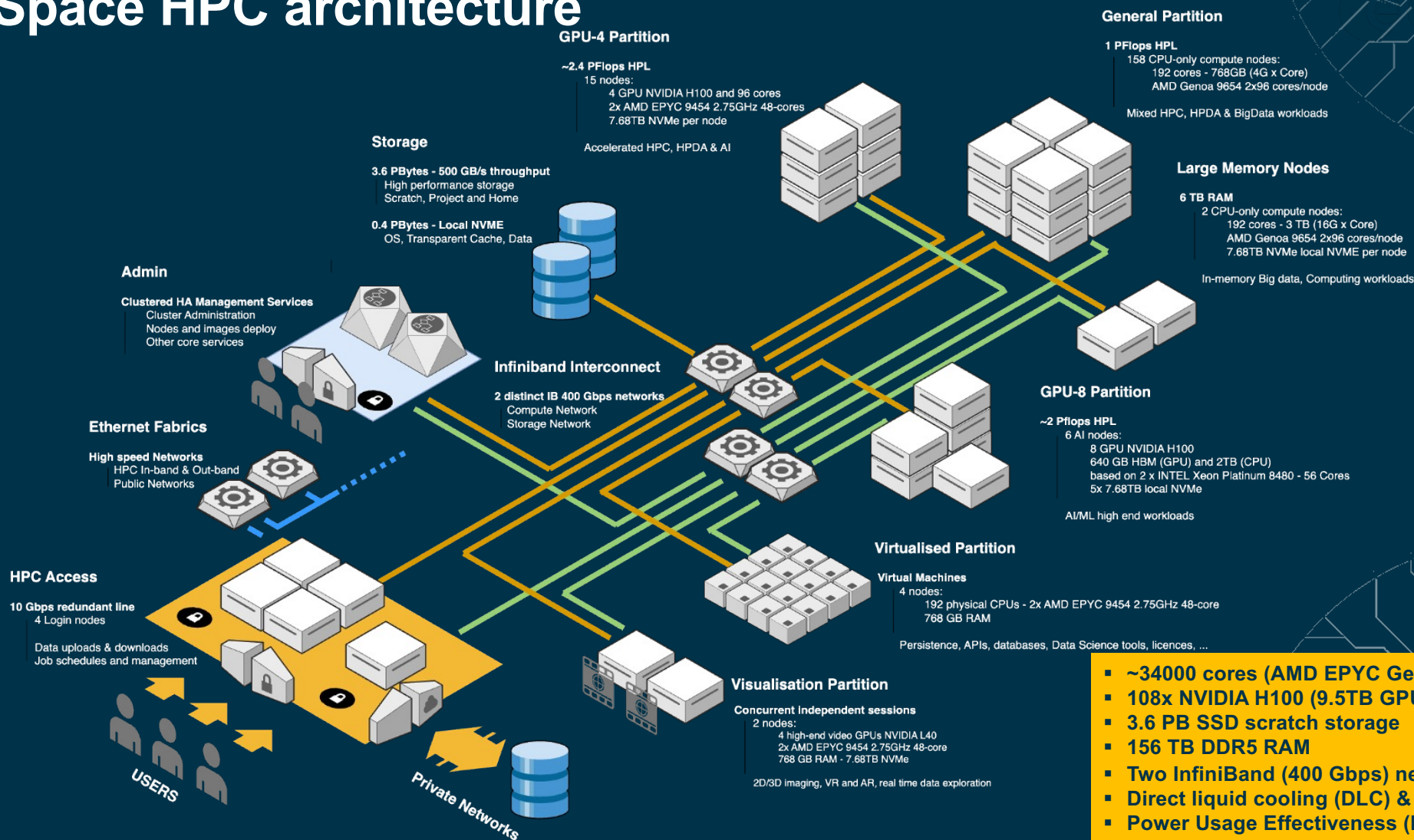
- **Free (no-cost) access at least until end of 2025**
- Light application process (Entity with contract with ESA)
- Fair & transparent resource allocation
- Secured sensitive data & IPR (Pending PL2 certification)
- Access to ESA resources and skills to support the use cases
- Regular free professional trainings (HPE, NVIDIA...)

TECHNOLOGY

- State-of-the art, flexible architecture:
 - **CPU partition** (With General & FAT nodes)
 - **GPU partitions** (GPU-4 & GPU-8)
 - Plus, other **dedicated/specialized nodes**
- High-speed compute & storage networks
- Guaranteed location & local data storage



Space HPC architecture



- ~34000 cores (AMD EPYC Genoa)
- 108x NVIDIA H100 (9.5TB GPU memory)
- 3.6 PB SSD scratch storage
- 156 TB DDR5 RAM
- Two InfiniBand (400 Gbps) networks
- Direct liquid cooling (DLC) & Air cooled
- Power Usage Effectiveness (PUE) < 1.09



How will the resource request & assignment work?

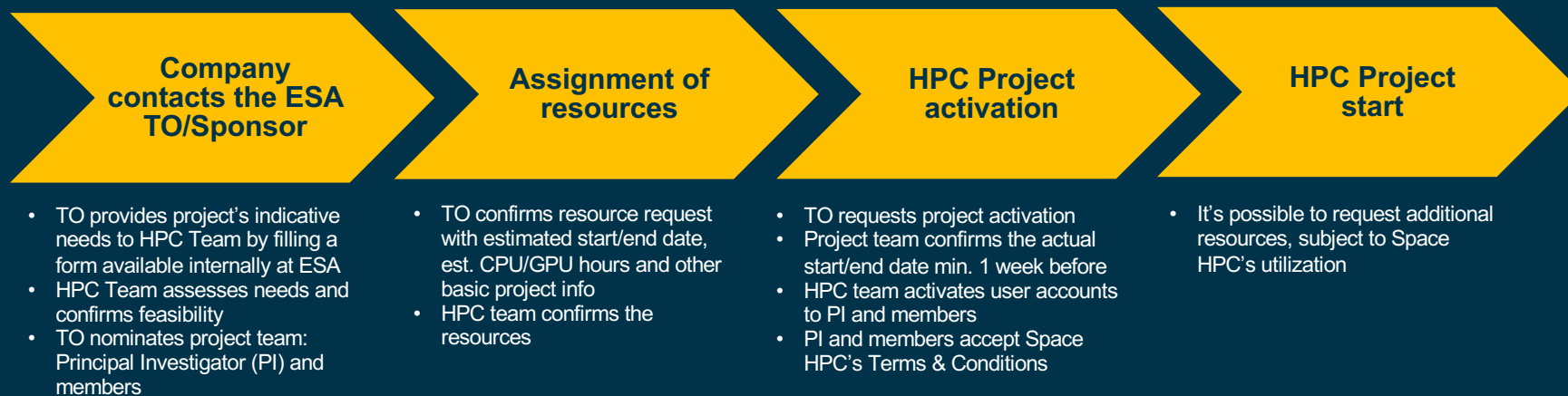
In short, the only requirement to request Space HPC resources is to have a contract with ESA.

Space HPC is there for any start-ups & SMEs that have a space-related use-case and are in line with the Space HPC Terms of Use & Policy.

The resources are fee* – at least this year (currently pending programme / budget decisions for 2026).

*with a limit on maximum use to assure a fair distribution

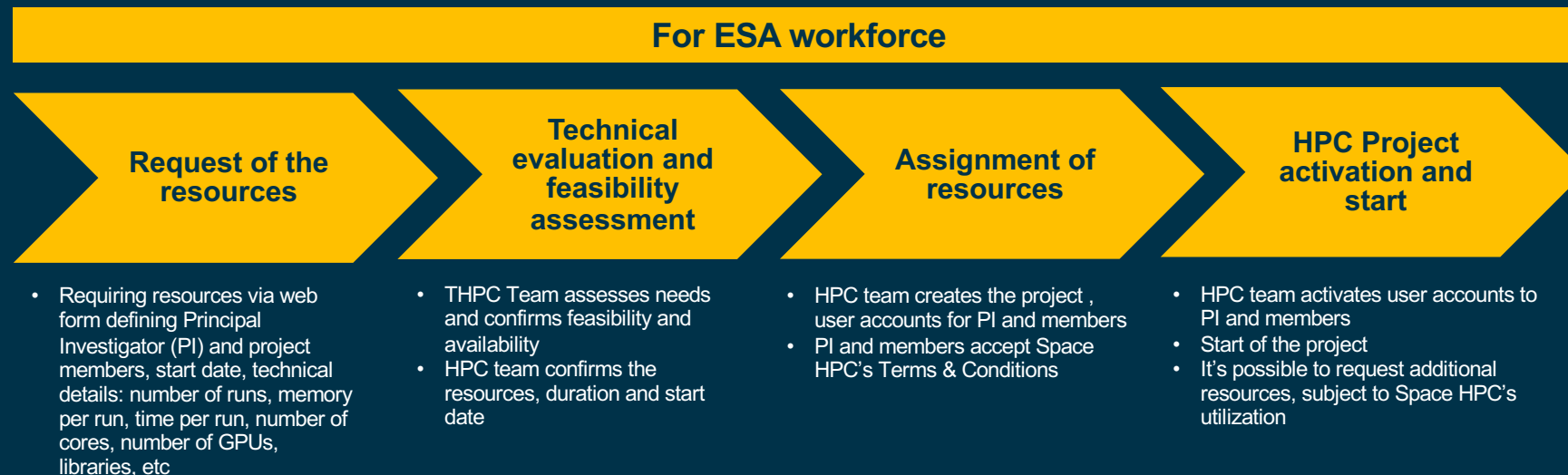
For external projects (industry/SMEs)



How will the resource request & assignment work?

For **ESA workforce**, we offer a simple registration process. The resources are allocated on a first-come first-serve basis, based on the project's readiness and availability of the resources

- 1. Project Duration:**
 1. Projects will typically follow a **proposal-based process**.
 2. The initial duration of each project is typically **6 months**, can be **renewed** based on resource availability.
- 2. Resource Allocation:** The Space HPC system provides significant computational power, with allocations ranging from:
 1. **10,000 to 100,000 core hours** (CPU resources).
 2. **10,000 to 50,000 GPU hours** (GPU resources).
- 3. GPU Resources:** Due to the high demand and limited availability of **GPU resources**, especially for intensive AI workloads, the access to these resources is only for a **few large-scale projects**.



How will the Space HPC operate?

Space HPC operating model aims to balance simplicity, fairness and flexibility.

The Space HPC will operate on a **simple first-come-first served rule with fair distribution** – all users will have the same priority (except for emergency priority).

- Resources are assigned for a project and are tracked for the duration of the project
- It's possible to request more resources (based on overall system utilization)
- Unused resources will be released to ensure fair access for all users

Fairshare job execution principle:

Jobs are scheduled and executed by the HPC scheduler algorithm (PBS) according to the **Fairshare principle**.

The system tracks each user's resource consumption over time and the dynamic prioritization adjusts user priorities based on recent resource usage. In short, users who recently used significantly more resources than requested will have decreased priority, and vice versa.



How does Space HPC fit into the wider ecosystem?

Space HPC complements existing National and EuroHPC ecosystem.

ESA Space HPC

- Fully dedicated to space
- Accelerating the development of the European space sector
- Building in-house knowledge of HPC technologies

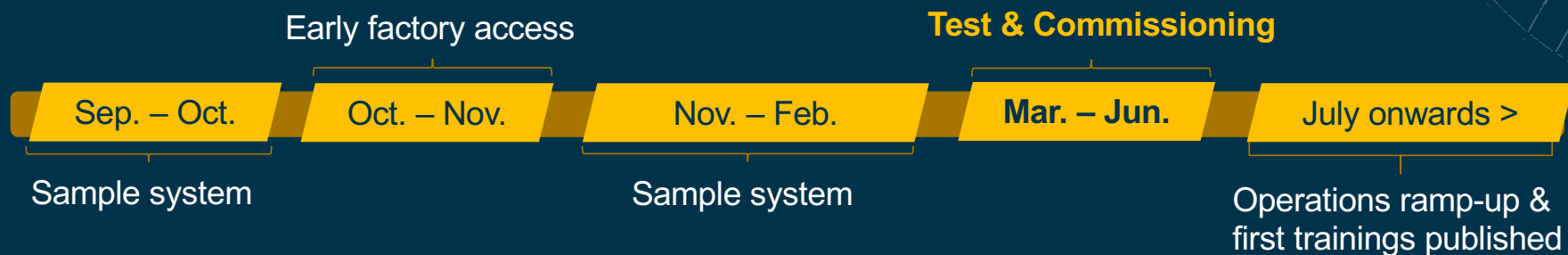
Mature projects
needing more
resources

National HPC / EuroHPC



Next steps and timeline of the project:

Timeline of the Space HPC project:



Currently, we are in **pre-operations phase** and collecting use-cases from internals & externals.

Sign up your interest at: commercialisation.esa.int/space-hpc/

We will start contacting you once the system is fully operational (est. July).

Contact & Questions

General info & sign up your interest at:
commercialisation.esa.int/space-hpc/

We will start contacting you once the system is fully operational.

Next webinar and trainings will be published at the ESA Learning Hub (learninghub.esa.int).

You can **meet us in person** at these events:

- Le Bourget Air Show (Paris): 16-18 June
- Living Planet Symposium (Vienna): 23-27 June (with hands-on workshop on the 22nd)

In case of other questions: spacehpc@esa.int



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Thank you for your attention!

