State of the Union: Commission proposes new regulation for the European High Performance Computing Joint Undertaking – Questions and Answers

Brussels, 18 September 2020

What is High-Performance Computing (HPC)?

High-performance computing (HPC) or supercomputing refers to computing systems with extremely high computational power that are able to solve hugely complex and demanding problems.

World-class supercomputers can now perform over 10^{15} operations per second (petascale performance), with top-range systems exceeding 10^{17} operations per second (pre-exascale performance). From 2022, the next generation (exascale) will perform over a billion billion (10^{18}) operations per second, a computing power comparable to aggregating all computing capabilities of the mobile phones of the entire EU population.

Why is this proposed regulation needed two years after the creation of the EuroHPC Joint Undertaking?

The European High-Performance Computing Joint Undertaking (EuroHPC Joint Undertaking) was established in 2018, initially until 2026, to match the operational life of its first HPC systems procured in 2019-20. Its main funding comes from the current EU long-term budget - Multiannual Financial Framework (MFF) - and will end in 2020.

New funds from the Horizon Europe, Digital Europe and Connecting Europe Facility programmes for the next decade are essential to deploy new, ever more powerful HPC systems and (soon) quantum computing systems, and to support new research and innovation efforts beyond 2020. The proposed new regulation will reflect recent wide-ranging socio-economic as well as technological developments, and the evolution of end-user requirements affecting the development of HPC in the EU and worldwide, including the EU's political priorities for 2020-25. The revision provides an opportunity to update the mission of the EuroHPC Joint Undertaking, taking into consideration these developments and lessons learnt from its current activities.

What will the proposed new regulation change?

The objective of the proposed new regulation is to set out a new ambitious mission and budget of €8 billion for the EuroHPC Joint Undertaking to maintain the EU's leading role in supercomputing. This budget for the period 2021 – 2033 will come from an EU investment of €3.5 billion from the next MFF programmes, an equal investment from the participating Member States of the Joint Undertaking (Member States and any other associated countries) and €1 billion investments (in kind, but also in cash) from the private members of the EuroHPC Joint Undertaking.

The initial budget of the Joint Undertaking was around €1.1 billion for the period 2018-20, with an EU contribution of €536 million from the current MFF (2014-2020), and the remainder coming from participating states. Private members contributed an additional €422 million in in-kind contributions.

With the new, ambitious €8 billion budget, the EuroHPC Joint Undertaking will:

- develop, deploy, extend and maintain a world-class exascale and post-exascale HPC and data infrastructure, driven by key scientific, industrial and social applications;
- develop and deploy a quantum computing and quantum simulation infrastructure integrated with the HPC one;
- federate high-performance and quantum computing resources and make them accessible to users across Europe;

- extend and democratise the use of supercomputing to a wider range of scientific and industrial users, e.g. by helping SMEs develop innovative business cases using HPC and providing them with training opportunities and critical skills;
- provide secure cloud-based HPC services for a range of public and private users, including for the European public data space, as presented in the 2020 European Data Strategy;
- develop technologies and applications to underpin a competitive supercomputing ecosystem, develop greener computing and exploit the synergies of HPC with AI, big data and cloud technologies.

How will access be granted to all users across Europe?

The EuroHPC Joint Undertaking will make accessible existing European supercomputing and quantum computing resources to all users across the European Union, no matter where they are located. The primary users of the EuroHPC machines will be research and scientific users. The objective is also to ensure access to public sector and industrial users, in particular SMEs that do not have the in-house resources to profit from these new technologies.

The EuroHPC Joint Undertaking will manage the access time of its 8 new supercomputing centres, proportional to its funding level (50% for the pre-exascale systems up to 35% for the petascale systems).

User allocation of access time to the supercomputers of the Joint Undertaking should be free of charge for public users. It should also be free of charge for private users for their applications related to research and innovation activities funded by Horizon Europe or the Digital Europe Programme, as well as for private innovation activities of SMEs, where appropriate. Such allocation of access time should primarily be based on periodic, peer-reviewed, open calls in which all eligible European users may participate. Through these calls, the EuroHPC Joint Undertaking will ensure balanced and appropriate allocation of offered HPC resources between its whole community of users..

For emergency and crisis management situations and initiatives of strategic importance for the EU, including Destination Earth, the Human Brain Project Flagship, the "1+ Million Genomes" initiative, the common European data spaces operating in domains of public interest, access time will be granted without a call for expressions of interest.

How can HPC be used to fight the coronavirus?

HPC is one of the key technologies helping to fight the global coronavirus pandemic. It helps to forecast the trajectory of the spread of infection, support decision-making on containment measures with scenario buildings and simulations, and dramatically accelerate the development of treatments and evaluate post-epidemic scenarios.

One example is the Exscalate4CoV project. With massive HPC resources and support from biological institutes, research centres and pharmaceutical companies, the project is analysing the effectiveness of over 500 billion drug molecules against COVID-19 viral proteins. Using classical computing, analysing each molecule would take months, while the HPC simulation can do so in 50 milliseconds. In June, the EU-funded consortium Exscalate4CoV announced that an already registered generic drug used to treat osteoporosis, Raloxifene, could be an effective treatment for COVID-19 patients with mildly symptomatic infection. This drug is now ready to enter clinical trials, and the project is continuing to work on other promising molecules.

The Commission is collaborating with members of PRACE (Partnership for Advanced Computing in Europe) and mobilising world-class European supercomputers in an urgent/priority access scheme for computational research targeting COVID-19, providing researchers with access to HPC and data resources. Other initiatives (e.g. BioExcel and CompBioMed) are using HPC to analyse the origin and structure of the SARS-CoV-2 genome, study the spread of the virus within communities and how it interacts with human cells, and accelerate vaccine development by identifying virus proteins that stimulate immunity.

How can HPC help our society, industry and science?

HPC is essential in supporting the digital transformation of our society and economy, and is contributing to the digitisation of industrial sectors that account for a total of around 53% of the EU's GDP. It is the engine bringing the benefits of digitisation to EU citizens and businesses. Today, HPC powers more than 800 scientific, industrial and public sector applications that play a role in improving quality of life, boosting industrial competitiveness, and advancing science.

Society: HPC applications are a strategic resource to understand our ever-changing world, and transform global challenges into innovation opportunities for growth and jobs. HPC can be used to simulate chemical reactions, to understand neurological disorders and develop precision treatments,

to monitor the behaviour of the oceans, to forecast weather with much greater precision, and for earth resource evolution. HPC is also critical to developing autonomous vehicles, which generate and use large amounts of data to constantly analyse their geographical position, road conditions, state of the vehicle, passenger comfort, and safety. HPC is essential to ensuring sustainable agriculture, for enabling simulations of plant growth that help achieve more robust and productive crop varieties. It is also vital for national security, defence and sovereignty, as supercomputers are used to increase cybersecurity and in the fight against cyber-criminality, in particular in the protection of critical infrastructures.

Industry: HPC enables the automotive, aerospace, renewable energy and health industries and other industrial sectors to innovate. This allows companies to move up into higher value products and services, paving the way to novel industrial applications, from safer and greener vehicles to personalised medicine. In particular, the use of HPC applications over the cloud will make it easier for SMEs without the financial means to invest in in-house skills to develop and produce better products and services.

Science: HPC applications and infrastructures are essential for a deeper understanding of a wide range of scientific fields, and HPC applications in science are countless. Many recent breakthroughs would not be possible without access to the most advanced supercomputers, e.g. Nobel Prizes for Chemistry in 2013 (where supercomputers were used to develop powerful computing programmes and software, to understand and predict complex chemical processes) and Physics in 2017 (where supercomputers helped to make complex calculations to detect hitherto theoretical gravitational waves).

What is the link between HPC and quantum computing?

The proposed new regulation will enable the Commission to invest in the construction of hybrid computers that combine elements of quantum and classical computing.

Quantum computing is based on quantum bits, allowing us to compute millions of possibilities in parallel, instead of one at a time as standard computers do. These new hybrid machines will use the best of the two complementary technologies, with quantum processors acting as accelerators to some of the EuroHPC Joint Undertaking's supercomputers. Even before the full potential of quantum computers is realised, it will be possible to perform operations (e.g. optimisation problems in logistics and scheduling) which no supercomputer is currently capable of doing.

What is the link between HPC and artificial intelligence?

Simulations running on HPC machines generate huge amounts of data, and AI techniques can help to process, organise and make sense of it. AI can be used to drive complex HPC simulations, making them faster, more accurate and self-improving. Equally, HPC can be used to explain, understand and improve the decisions made by AI.

Is HPC consistent with the Green Deal's objectives?

The EuroHPC Joint Undertaking is already setting the pace worldwide in the development of low-power technologies for HPC that can be applied more broadly, helping to reduce the carbon footprint of ICT solutions, e.g. low-power processors and accelerators. Greener computing should be prioritised with energy-efficient supercomputers and energy-efficient data centres, e.g. using dynamic power-saving and re-use techniques like advanced cooling and recycling of heat produced.

At a larger scale, HPC is a strategic resource for policymakers to advance towards the Green Deal's objectives, thanks to HPC-powered simulations and applications that provide the means to design efficient solutions, transforming environmental challenges into opportunities for social innovation and economic growth.

What is the link between HPC and the common European data spaces?

The volume of data produced in the world is growing rapidly, from 33 zettabytes (1 zettabyte = 1 trillion gigabytes) in 2018 to an expected 175 zettabytes in 2025. Data is the lifeblood of economic development: it is the basis for many new products and services, driving productivity and resource efficiency gains across all sectors of the economy, allowing for more personalised products and services, and enabling better policymaking and upgrading government services.

Appropriate computing power is therefore key to processing and analysing the growing volume of data, and to making the most of it to benefit citizens, businesses, researchers and public administrations.

HPC will be essential to supporting the establishment of the nine sectoral common European data spaces, underpinning a single market for data and driving public, industrial and scientific applications for the benefit of citizens and businesses.

Who are the current members of the EuroHPC Joint Undertaking?

The current EuroHPC Joint Undertaking members are the EU (represented by the Commission), 32 participating states (26 Member States and 6 countries associated with Horizon 2020),[1] and two private members: the European Technology Platform for High Performance Computing Association (ETP4HPC) and the Big Data Value Association (BDVA). The Joint Undertaking also relies on collaboration with key European actors such as PRACE (Partnership for Advanced Computing in Europe) and GEANT (the pan-European high-speed network for research and education).

What are the main activities of the present EuroHPC Joint Undertaking?

The EuroHPC Joint Undertaking currently supports two main activities:

- **Acquisition of eight new world-class HPC systems** through a joint investment of €830 million between the EU and participating states: three pre-exascale systems and five other petascale systems. Operational by early 2021, these supercomputers will multiply by eight the available computing power at European levelland benefit scientific, industrial and public users.
- **Funding research and innovation actions** to develop a highly competitive and innovative HPC ecosystem in the EU, covering the entire value chain from low-power processors, algorithms, applications and services to skills for the next-generation HPC era. The Joint Undertaking has committed €185 million, which should be matched by a similar amount from participating states during 2019-20 to support these actions and boost the EU's leadership, technological autonomy and innovation potential.

For more information

Press release: Commission sets out new ambitious mission to lead on supercomputing

Factsheet on the European Joint Undertaking on High Performance Computing

Proposed Regulation

EuroHPC Joint Undertaking website

State of the Union Address

Press release on the main initiatives of the State of the Union 2020

Dedicated webpage on the State of the Union 2020

[1] 26 Member States (Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden) plus 6 Associated Countries (Iceland, Montenegro, North Macedonia, Norway, Switzerland and Turkey).

QANDA/20/1593

Press contacts:

Johannes BAHRKE (+32 2 295 86 15)
Marietta GRAMMENOU (+32 2 298 35 83)

General public inquiries: Europe Direct by phone 00 800 67 89 10 11 or by email