Advanced pilots towards the European supercomputers

Proposals are expected to address the European research, technology building blocks integration, system co-design, validation and experimentation of advanced supercomputing pilot systems aiming at exascale performance, driven by a set of ambitious extreme data and HPC application and power-efficiency requirements.

The approaches should ensure that they contribute to the realisation of future exascale system architectures based on European low-power processing technologies, such as those developed for example in the EPI initiative. Each proposal should aim at realising one supercomputing pilot system. Pilot systems should maximise the integration of European hardware and software technologies, and foster, to the extent possible, the development of solutions based on European open hardware and open-source software.

Two complementary pilot supercomputing systems are expected to be supported, based on the European Processor Initiative (EPI) and/or other previously funded EU R&I actions:

- One leveraging the efforts on European low power general purpose processing technologies
- A complementary one leveraging the efforts on European open hardware solutions (e.g. an agnostic HPC system able to embed, cool and manage existing components and future ones, such as accelerator technologies based on RISC-V or other components that can simulate the behaviour of future European components)

The proposals should address all the following points:

- Description of the supercomputing pilot system, with architectural features and measurable objectives that demonstrate the relevance and potential of the pilot system as a meaningful step towards the realisation of future operational European exascale systems. The description of the pilot should address amongst other: targeted number of computing elements, interconnects and network topologies for exascale, cooling, I/O, etc.

- Definition of clear and measurable intermediate and final targets to demonstrate the suitability of the pilot system, for example in terms of system performance, performance improvements for the selected applications, power budget and efficiency, scalability, resilience, etc. The proposal should clearly describe the approach to measure and verify each of these targets and should demonstrate that the pilot system would offer a clear approach towards overall reduced power consumption.
- Description of software issues, including software stack, software scaling and adaptation for heterogeneous systems, software reliability, optimisation, and inclusion of a set of software programming tools and environments, compiler technologies for basic instruction sets and for higher level support of applications at scale with various programming models, etc. Pilot systems should aim to offer a pluralism in European solutions and maximise their integration inside the software stack.
- The integration of different European cooling systems, including prototype systems for their further testing and development.
- Clear identification of the European technology hardware and building blocks and how they are integrated and leveraged in the pilot systems. In particular, proposals have to demonstrate how the pilot system aligns with the efforts of European low power processing technologies, by describing the mechanisms that will be used for that purpose.
- Identification of a set of ambitious and relevant applications for the system co-design, describing how and when application developers and users will be involved in the co-design process, and what measures will be taken to attract and motivate users and developers to adopt the technologies proposed in the pilot system, in view of maximising their use and acceptance.
- Clear timed description of the engineering approach for the pilot systems, indicating for example the timing to development and release of the proposed hardware and software solutions, evaluation, testing, and the validation and deployment of the pilot systems in close-to-operation environments. The approach should also describe the involvement of users and developers (with the eventual re-writing, porting, re-factoring etc. of codes) in a co-design approach.
- Description of the use of the pilot systems in the operational environment during the life of the project and once the project is completed, including targeted services, communities and applications, etc...
- Description of mechanisms for cooperation between the pilot systems that would be supported by the action: the successful proposals are expected to establish a close collaboration in order to ensure to the extent possible the convergence and compatibility of the different results and solutions developed in the pilot systems, e.g. hardware/software stacks, components, common or fully interoperable software environments, common or fully interoperable application development platforms, common architectural views, etc. These mechanisms will be formalised in a cooperation framework gathering the selected pilot systems.

Wherever appropriate, actions should seek synergies and co-financing from relevant national or regional research and innovation programmes.

The EuroHPC JU considers that proposals requesting a contribution from the JU of up to EUR 22 million for the first pilot above and up to 15 million for the second pilot above, matched by the Participating States with a similar amount, and a duration of between 3 and 4 years would allow this specific challenge to be addressed appropriately. Nevertheless this does not preclude submission and selection of proposals with another duration or requesting other amounts.

Considering the specific objectives of the calls for proposals and the fact that these calls concern areas of critical importance for the security of the Union and the Digital Single Market and may pose potential risk to ensuring European technological autonomy in line with Article 9(5) of the Rules for Participation[[https://ec.europa.eu/research/participants/data/ref/h2020/legal_basis/rules_participation/h2020-rules participation_en.pdf]], the EuroHPC JU may limit the participation of legal entities established in associated countries and legal entities established in the EU but controlled from third countries.

To demonstrate in pre-operational environments the successful integration of European technology building blocks developed for example in the European Processor Initiative (EPI) and in previously funded EU R&I actions into fully integrated pilot supercomputing systems commensurate with exascale performance objectives along with other European IP such as software tools and application libraries, interconnects, rack design, cooling systems, advanced fabric management, etc... The goal of these pilot supercomputing systems will be to produce a prototype system which can be used in a pre-operational environment, able to execute jobs and run software components designed as part of the pilot programme.

Two such pilot supercomputing systems will be supported whose work will be closely inter-coordinated. They will have to demonstrate how the challenges of power efficiency, usability, resiliency and scalability can be met, by considering in particular a strong co-design approach driven by ambitious application requirements. The involved stakeholders should include technology component suppliers, system integrators, supercomputing infrastructure providers and user communities.

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Proposals should describe how the proposed work will contribute to the impacts listed below and include a baseline, targets and metrics to measure impact:

- Contribution to the realisation of the EuroHPC JU's overall and specific objectives[[Council Regulation 2018/1488 of 28 September 2018 establishing the European High Performance Computing Joint Undertaking (EuroHPC) https://eurohpc-ju.europa.eu/documents/Regulation.pdf]]
- Strengthening scientific leadership as well as the competitiveness and innovation potential of the European industry through the further development and use of European technologies
- Contributing to a sustainable exascale HPC supply ecosystem in Europe and ensuring European technological autonomy in this field
- Leveraging the efforts on the European low power processing (in particular the European Processor Initiative) or in open hardware technologies and contributing to the realisation of future exascale system architectures based on such technologies
- Maximising the use of European technologies in users and developers of relevant applications for European scientific and industrial leadership
- Creation, promotion and exploitation potential of European IP

Maturity of solutions and potential for exploitation in future European exascale HPC components and systems

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