

EUROPEAN TECHNOLOGY
PLATFORM FOR HIGH
PERFORMANCE COMPUTING



ANNUAL REPORT 2019

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- New members:
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DLR, EOFS, Fabriscale, M3E, Maguay, Sicos,
University of Padova
- Article on CEF scheme:
UCit, NEOVIA Innovation, CSC

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ANNUAL REPORT 2019



Editorial

Jean-Pierre Panziera
ETP4HPC Chair

Dear ETP4HPC Members and Partners,

This year 2019 saw the actual debut of the EuroHPC Joint Undertaking: the first EuroHPC machines are about to be procured, and the first calls for Research & Innovation projects have been launched under the EuroHPC banner. The Research and Innovation Advisory Group (RIAG), and particularly its 4 members and 3 observers from ETP4HPC, actively contributed to the first EuroHPC research programme.

For ETP4HPC, 2019 was also marked by the preparation of the fourth edition of our major work, the Strategic Research Agenda for European HPC, prepared with the support of the EXDCI-2 project. Over 80 experts delegated by our members participated in this huge collaborative work. Our SRA comes out completely renewed, with a new structure, and more complete than ever. It is also more collaborative than ever: we have extended our collaborations beyond our long-time friends from BDVA (Big Data Value Association), to organisations representing the related technologies that HPC must synchronise with: Internet of Things (IoT), Artificial Intelligence (AI) and Cyber Physical Systems (CPS).

The SRA draws a complete picture of the state of the art and the challenges for the next 3-4 years rather than focus on specific technologies, implementations or solutions. It expresses in the most objective way possible the views of the European HPC value chain. We hope you find it interesting reading!

The EuroHPC R&I programmes are based on the input from our Strategic Research Agenda. Our Association is therefore in a unique position to provide recommendations for the best benefit of the European HPC value chain and its stakeholders, i.e. the members of ETP4HPC. Also, we have emerged from this exercise as the leaders of the entire European effort. By monitoring trends and introducing new paradigms such as the Digital Continuum and the Transcontinuum, we are at the core of the constant change, networking together with other organisations and areas.

At the same time, EuroHPC is expanding. With its growth, the role of our Association in the governance and operation of this Joint Undertaking is expected to increase. Just like in the case of the SRA, this provides our Association with a unique opportunity as the most important partner of the EC and the Participating States within EuroHPC.

We have also conducted many other activities as part of the EXDCI-2 project. For example: we have analysed the results of the first FETHPC projects, we have engaged with the photonics and micro-electronics communities to understand how HPC can benefit from their technological advances and we have developed support mechanisms for SMEs.

The evolution of European HPC will most certainly result in exciting work and projects that will keep all of us busy throughout 2020, our common goal being the strengthening of our ecosystem. We are honoured to be able to pursue this objective with your support.

Our association



Jean Gonnord (CEA) is retiring from his role in the Steering Board. Jean is one of the founding fathers of ETP4HPC. We would like to thank him warmly for his heart-felt commitment to European HPC and European technologies. Jean will be replaced by Jean-Philippe Nominé as representative of the CEA.

ETP4HPC – the European Technology Platform (ETP) for High-Performance Computing (HPC) - is a private, industry-led and non-profit association. Our main mission is to promote European HPC research and innovation in order to maximise the economic and societal benefit of HPC for European science, industry and citizens. Our main task is to propose research priorities and programme contents in the area of HPC technology and usage, by issuing a Strategic Research Agenda (SRA). This SRA

is used by the EuroHPC Joint Undertaking (JU) to define the contents of the HPC Technology Work Programmes.

We are a private member of the EuroHPC JU that provides mechanisms and resources to develop globally competitive European HPC systems, technology and application expertise. We have several representatives in EuroHPC's Research and Innovation Advisory Group (RIAG).

The ETP4HPC Steering board

The current Steering Board was elected at the Annual General Assembly on 13 March 2018, for 2 years. Its members represent:

- **European Research centres** (5 seats):
BSC, CEA, Cineca, Fraunhofer, Forschungszentrum Jülich (FZJ)
- **European SMEs** (4 seats):
E4 Computer Engineering, ParTec, Megware
- **European-controlled corporations** (4 seats):
Atos, ESI Group, Infineon, Seagate
- **International companies with R&D in Europe** (2 seats):
Fujitsu, Intel

The Steering Board appointed the following Steering Committee:

- **Chairman:**
Atos - Jean-Pierre Panziera
- **Vice-chair for Research:**
CEA - Jean Gonnord
- **Vice-chair for Industry:**
Seagate - Sai Narasimhamurthy
- **Secretary:**
ParTec - Hugo Falter
- **Treasurer:**
Fraunhofer - Guy Lonsdale

The Office is in charge of day-to-day operations, under the supervision of the Steering Board. We have a distributed Office team, composed of professionals contributed by several of our members:

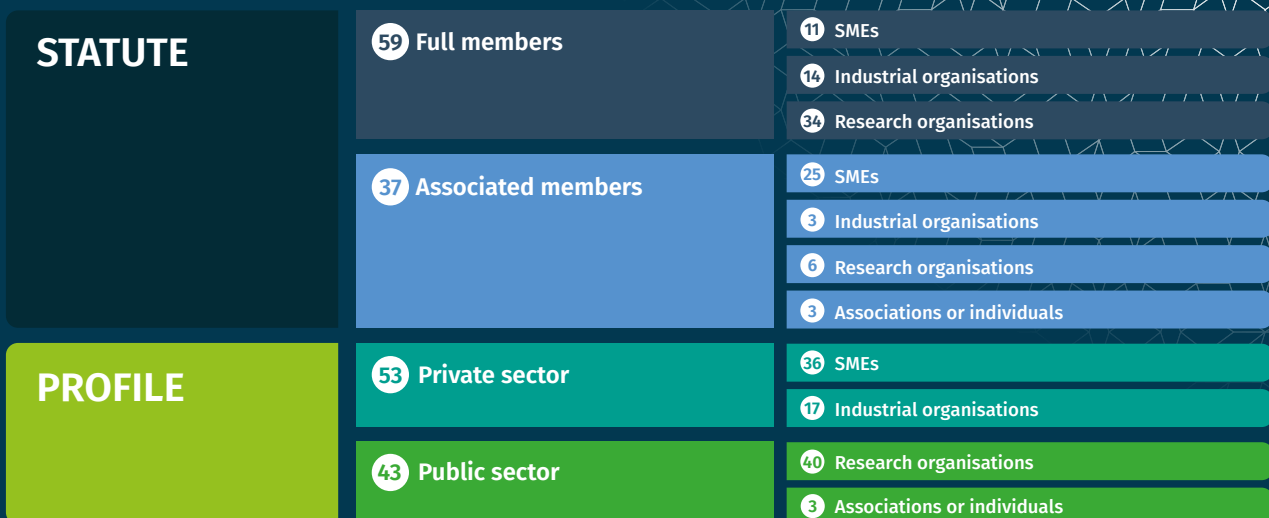
The ETP4HPC office



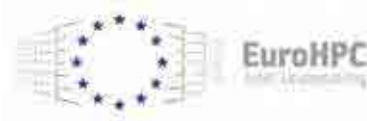
Jean-Philippe Nominé leaves his Office duties as of January 2020, when he takes over as representative of CEA in the Steering Board. We'll miss you JPN!

- **Pascale Bernier-Bruna (Atos):**
communication, website, social media
- **Carolien Deklerk:**
accounting
- **Chris Ebell (Partec):**
ad hoc support
- **Maike Gilliot (Teratec):**
office coordination, EXDCI-2, HPC-GIG, workshops...
- **Michael Malms (IBM):**
SRA
- **Jean-Philippe Nominé (CEA):**
office coordination, support to Chairman
- **Marcin Ostasz:**
roadmap, industrial relations, member relations, back office

BREAKDOWN OF OUR MEMBERS BY STATUTE AND PROFILE



EuroHPC RIAG



Axel Auweter (Megware), member of the ETP4HPC Steering Board and of the EuroHPC RIAG, and Pascale Bernier-Bruna (ETP4HPC office)

The EuroHPC Joint Undertaking (JU) brings together the European Commission, 31 European states (EU members and countries associated to the Horizon 2020 work program), and the two private members ETP4HPC and BDVA. The Euro HPC JU is a legal and funding entity which enables the pooling of EU and national resources in High-Performance Computing.

More information: <https://eurohpc-ju.europa.eu>

The Research and Innovation Advisory Group (RIAG) is one of the two advisory groups that compose the EuroHPC JU's Industrial and Scientific Advisory Board, which provides independent advice to the EuroHPC Governing Board on the strategic research and innovation agenda and on the acquisition and operation of the supercomputers owned by the Joint Undertaking.

The RIAG draws up and regularly updates the EuroHPC's draft multiannual strategic research and innovation agenda. This draft multiannual strategic research and innovation agenda identifies research and innovation priorities for the

development and adoption of technologies and key competences for High-Performance Computing across different application areas, in order to support the development of an integrated High-Performance Computing ecosystem in the EU, strengthen competitiveness and help create new markets and societal applications.

The RIAG is composed of 12 members, six of which are appointed by the Private Members (i.e. ETP4HPC and BDVA), and the other six by the Governing Board. The RIAG also includes 10 observers, who attend and contribute to the RIAG work, but have no voting rights.



The RIAG members and observers

ETP4HPC in the RIAG

ETP4HPC has four members as well as three observers in the RIAG. Together, they represent the interests of our association – independently from their respective affiliations. They regularly report to the ETP4HPC Steering Board on their RIAG activities.

The strong presence of ETP4HPC representatives in the RIAG demonstrates that our association is a preferred partner for the EuroHPC JU in seeking guidance on the technological roadmap for European HPC.

Conversely, our presence in the RIAG is the best vehicle for ETP4HPC to advise the EuroHPC JU and the EU Commission, and to promote the priorities defined in our Strategic Research Agenda (SRA). Indeed, the key mission of our representatives is to work towards the implementation of ETP4HPC's SRA within the EuroHPC JU RIAG.

The RIAG first met in March 2019, and very quickly went to work on the adoption of a first version of the strategic research and innovation agenda, with a close deadline so as to be in a position to rapidly resume the HPC funding programme under EuroHPC. Based on the RIAG's guidance, the EuroHPC JU has already begun to award close to 100 million euros in research and innovation funding through the first two EuroHPC calls issued on 25 July 2019.

The RIAG also interfaces regularly with the other EuroHPC advisory group, the INFRAg, which provides advice on the acquisition and operation of the supercomputers owned by the Joint Undertaking. In the new context enabled by EuroHPC, the two groups must engage in a constructive dialogue and collaborate closely to ensure that European research and development for HPC addresses the needs of the European HPC user community and that the European technologies born from funded research will be integrated into European operational HPC machines. Only in this way will the expected benefits for the European HPC ecosystem materialize to the benefit of the European society as a whole.

Our RIAG team

Our representatives in the RIAG were nominated for two years by the ETP4HPC Steering Board through a formal vote.

MEMBERS

- **Jean-Pierre Panziera (Atos)**, chairman of ETP4HPC, was elected Chairman of the RIAG on 5 April, 2019
- **Axel Auweter (Megware)**, member of the ETP4HPC Steering Board
- **D' Carlo Cavazzoni (Cineca)**, member of the ETP4HPC Steering Board
- **Jean Gonnord (CEA)**, Vice-Chair for Research in the ETP4HPC Steering Board

OBSERVERS

- **Hugo Falter (Partec)**, member of the ETP4HPC Steering Board
- **D' Katerina Slaninová (IT4Innovations)**
- **Isabella Weger (ECMWF)**

AGENIUM SCALE



CONSTELCOM LTD



DLR



SME/ASSOCIATED MEMBER

Agenium Scale is an innovative company located at the Plateau de Saclay in France (European Silicone Valley) that provides software solutions for high performance computing and complex systems.

Agenium Scale also offers its expertise in the form of services related to various sectors such as automotive sector, space, rail, finance, telecoms, aeronautics, defence...

Agenium Scale assists its clients in the design, feasibility study, development, optimisation and industrialisation of their software. Its expertise lies in various business areas as well as in the entire software development chain and includes knowledge of processors and computation architectures.

<https://www.agenium-scale.com>

SME/FULL MEMBER

Constelcom, already an associated member of ETP4HPC, upgraded to Full member in 2019.

Constelcom's mission is to provide easy, secure and private access to on-premises HPC resources to anyone regardless of size and skills and for any application from its web-accessible Constellation™ platform. Constellation™ empowers HPC Centres and users by providing a collaborative environment to manage and access supercomputing resources when and where they are needed.

Constelcom was founded after our founding team had experienced first-hand the barriers to investigation that a shortfall in compute power can mean to any ground-breaking research. As users of HPC ourselves, we understand deeply the impact of hassle-free and self-managed access to HPC, strong collaboration amongst multi-skilled teams, and what that can mean for discovery and in turn, economics. Empowering engineers, scientists and innovators to run projects and remain in control of HPC is at the heart of Constellation™. As close collaborators to HPC Centres, we also understand the challenges of managing clients, allocations, accounts and systems. For HPC Centres, licensing Constellation™ means freedom and visibility both to manage internal resource and to optimise usage for external clients. Our team of expert scientists and engineers provide assistance to HPC Centres with their management and support industrial users with software acceleration and adaptation to HPC, simulations and workflows.

<https://www.constelcom.com/>

RESEARCH ORGANISATION/FULL MEMBER

The German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) is the national aeronautics and space research center of the Federal Republic of Germany. Its extensive research and development work in aeronautics, space, energy, transport, security and digitalisation is integrated into national and international cooperative ventures. DLR is also responsible for the planning and implementation of Germany's space activities on behalf of the federal government. DLR is also the umbrella organisation for one of Germany's largest project management agencies. DLR's mission comprises the exploration of Earth and the Solar System and research for protecting the environment. This includes the development of environment-friendly technologies for energy supply and future mobility, as well as for communications and security. DLR's research portfolio ranges from fundamental research to the development of products for tomorrow. In this way, DLR contributes the scientific and technical expertise that it has acquired to the enhancement of Germany as a location for industry and technology. DLR operates major research facilities for its own projects and as a service for clients and partners. It also fosters the development of the next generation of researchers, provides expert advisory services to government and is a driving force in the regions where its facilities are located.

<https://www.dlr.de>

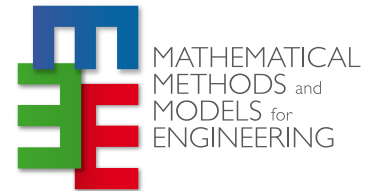
EOFS- EUROPEAN OPEN FILE SYSTEM



FABRISCALE



M3E



ASSOCIATION/ASSOCIATED MEMBER

EOFS (European Open File Systems) was founded in 2010 as a Societas Cooperativa Europaea (SCE Ltd) to foster the establishment and adoption of open source parallel file systems, sustain and enhance its quality, capabilities and functionality and to ensure that specific requirements of European organizations, institutions and companies are upheld. EOFS's initial focus was clearly to secure future support and development of the open-source parallel file systems LUSTRE® as its fate and future ownership was unclear at that time. EOFS considers parallel file systems and related technologies as critical components of large HPC systems from entry level through Exascale. Its founding members included companies and institutions from France, Germany, Italy, Switzerland, Russia, United Kingdom and the US. In close collaboration with OpenSFS, EOFS reached an agreement with the company Seagate that on Nov. 2nd 2019 EOFS and OpenSFS jointly became the owners of all assets related to the URL "lustre.org" as well as the word LUSTRE® and its design marks. EOFS also has started to collaborate with EU-SMEs, EU research institutions and large EU government organizations to establish joint projects and foster knowledge transfer for their mutual benefits. Looking ahead, EOFS plans to significantly enhance its membership with a clear focus on European institutions, companies and SMEs with the goal to ensure that EU-developed technologies and features are competitive, cover the specific needs of the EU and become visible beyond Europe. This is what the "E" in EOFS stands for!

<https://www.eofs.eu/>

SME/ASSOCIATED MEMBERMEMBER

Fabriscale specializes in fabric management and monitoring software with an emphasis on smart algorithms that simplify network configuration, management, monitoring and routing. Wingman, our fabric manager for InfiniBand provides superior performance and fast fault-tolerance. Our user-friendly network monitoring software, Hawk.eye, simplifies InfiniBand network monitoring with alerts, topology visualisation and flexible integration with resource management.

<http://fabriscale.com/>

SME/FULL MEMBERMEMBER

M3E is the acronym for Mathematical Methods and Models for Engineering. The company, born as a spin-off of the University of Padua, focuses on numerical modelling and algorithms development for the solution of challenging problems in several engineering sectors. M3E combines high competences in mathematics and computer science together with an extensive knowledge in engineering, to provide support and consultancy to top engineering firms.

<https://www.m3eweb.it/>

MAGUAY

MAGUAY
KNOWLEDGE AS A SERVICE

SICOS

SICOS
Wir vermitteln Höchstleistung.

UNIVERSITY OF PADOVA



**UNIVERSITÀ
DEGLI STUDI
DI PADOVA**

SME/ASSOCIATED MEMBER

Maguay is one of the leading Romanian IT companies, with a background of 26 years of successful experience on the market.

- Maguay is one of the leading Romanian system builder of computer systems: servers, storage, notebooks, PCs, marketed under its own brand;
- As a software developer, Maguay provides its own software applications;

Maguay is also a leading integrator of complex IT projects - able to implement and deliver hardware and software "turnkey" solutions by ensuring quality of service and support.

Maguay clusters are designed together with Intel solution architects based on Intel HPC Data Center Specialty in order to ensure hardware allows appropriate workload balance such as CPU, memory, storage, and network bottleneck analysis.

Maguay integrates the latest Intel architectures and technologies to provide optimal performance and power consumption for the lowest cost. Maguay has 5 IT engineers involved in HPC Business located in Bucharest.

<http://www.maguay.ro/>

SME/FULL MEMBER

Sicos, already an associated member of ETP4HPC, upgraded to Full member in 2019.

SICOS BW GmbH, based in Stuttgart, was founded in 2011 by the Karlsruhe Institute of Technology (KIT) and the University of Stuttgart in order to make it easier for small and medium-sized enterprises (SMEs) in particular to access simulation and high-performance computing, as well as big data and smart data topics.

Many SMEs still think that supercomputing, artificial intelligence (AI), Industry 4.0, Industry of Things (IoT), etc. are reserved for large companies. However they can also benefit from the advantages of these innovative technologies and strengthen their competitiveness.

We are part of a powerful and goal-oriented network of competences in Baden-Württemberg. Members from research and industry cover all relevant aspects relating to high performance computing (supercomputing) and data intensive computing. SICOS BW is financially supported by its shareholders and the Ministry of Science, Research and Art Baden-Württemberg. This enables us to support you neutrally and free of charge - across all industries. We work with specialized solution centres in the areas of automotive, energy and media as well as smart data.

<https://www.sicos-bw.de/>

RESEARCH ORGANISATION/FULL MEMBER

The University of Padua is one of Europe's oldest and most prestigious seats of learning; it is a multi-disciplinary university that aims to provide its students with both professional training and a solid cultural background. A qualification from the University of Padua is a symbol of having achieved an ambitious objective, one that is recognised and coveted by both students and employers alike.

<https://www.dicea.unipd.it/>

The CEF Funding Scheme: Bringing public open data to life with HPC

Maïke Gilliot, ETP4HPC Office

More information on CEF:
<https://ec.europa.eu/inea/en/connecting-europe-facility>

We have asked two CEF projects directly related to HPC to tell their stories on the next pages. Some of you may find inspiration from them!

The Connecting Europe Facility (CEF) is a key EU funding instrument to promote growth, jobs and competitiveness through targeted infrastructure investment at European level. It supports the development of high performing, sustainable and efficiently interconnected trans-European networks in the fields of transport, energy and digital services. One part of the CEF instrument is dedicated to Public Open Data: The objective here is to help boost the development of information products and services based on the re-use and the combination of data held by public and commercial actors across the EU along two axes:

● A CORE SERVICE PLATFORM:

The initial part of the Core Service Platform has been deployed through the development of the European Data Portal. Operational since November 2015, the portal has been harvesting the metadata of Public Sector Information made available by public data portals across Europe. Currently the portal contains references to almost 900.000 datasets contained in 78 catalogues from 34 countries. It is also harvesting the metadata of European Union Institutions and bodies disseminated via the EU Open Data Portal as well as EUMETSAT and ESA data collections (<http://data.europa.eu/europeandataportal>).

● DEVELOPMENT OF SERVICES AS BUILDING BLOCKS

Since 2016, calls have funded projects that address the generation of cross-border and/or cross-domain services re-using public open data. The funded projects support in particular the development and the sustainable deployment of new innovative services, integrating public open data into existing (or new) ecosystem platforms. These services are based on cross-border use of HPC and data capacities for public interest: collecting, storing and managing large (public or private) data sets of cross-European interest, and developing and offering HPC-based services. The full list of funded projects is available here:

<https://ec.europa.eu/inea/en/connecting-europe-facility/cef-telecom/projects-by-dsi/public-open-data>

AQMO project

By our members UCit and NEOVIA Innovation

Many metropolises are struggling to reduce air pollution. At the core of this issue are two important requirements: getting a better temporal and spatial measurement coverage, and having the ability to use simulations to answer "what-if" questions. The AQMO project provides an end-to-end urban platform based on an edge-to HPC and cloud hybrid computing model fuelled by Open Data.

The AQMO platform is deployed in the Rennes metropolitan area (Brittany, France) which consists of 43 cities and is the 12th largest metropolis in France in terms of population.

A transversal approach was chosen for the design, that spans from sensors to supercomputers in order to deliver day-to-day data as well as capabilities to help catastrophic event handling, denoted as "urgent computing". The AQMO project explores the use of High-Performance Computing (HPC) both centrally in supercomputing centres and distributed on enhanced sensors (Edge computing) or cloud resources. HPC capabilities are necessary to perform accurate numerical simulations of pollution dispersion, including sensors data-assimilation.

The dissemination of the platform and its use by other cities will be eased by its modular design: transferable and replicable systems, and additional data and capabilities can be added thanks to open Application Program Interfaces.

To achieve, in a cost-effective manner, rigorous air quality measurements in a wide area, the local transportation bus network is enhanced with mobile sensors. In the case of measurements for catastrophic events, the use of drones is explored, in connection with the UAV-Retina project supported by the EIT-Digital. AQMO is implementing HPC-as-a-service as a means to provide both routinely and also on-demand air quality simulations. The resulting data will be made available to citizens thanks to the Open-Data Metropolitan Service that is being developed by Rennes Métropole. Metadata will be published on the French national Open Data Portal and the European Data Portal.

The project consortium gathers the University of Rennes 1 (coordinator of the project), GENCI, the Rennes Metropolis, the organization in charge of air quality monitoring in Brittany (AIR BREIZH), a bus operator (KEOLIS), a supercomputing centre (CNRS-IDRIS) and four SMEs (AmpliSIM, UCit, NEOVIA Innovation and RYAX Technologies).

Two ETP4HPC members are involved in this action: UCit and NEOVIA Innovation. UCit is responsible for the design of new business models for HPC-as-a-Service, to which NEOVIA also contributes. Moreover, UCit brings its technical expertise in HPC Analysis and Prediction for the AQMO platform, while NEOVIA also supports the consortium both for project management and technical coordination.

The AQMO platform has been under test for a year now in one of the Rennes Metropolis bus and has remained stable during the full experiment. The design choices have been proven to fit the project needs, with new sensors needed to get a measurement context. For instance, the team would like to be able to explain the detection of peaks of particles.

The partners have implemented a smart camera that will be added to the platform to help with these detections

The year 2020 will be dedicated to deploying the platform in 20 buses to start air quality monitoring (based on AlphaSense OPC-N3 sensors) in the whole Rennes metropolis.



Twitter: [@aqmo-project](https://twitter.com/aqmo-project)
 Website: <http://aqmo.irisa.fr/>

Phidias project

By our members NEOVIA Innovation and CSC

High-Performance Computing technology is becoming increasingly important as a key-driver to push European economic growth and Scientific Research. A comprehensive tool that can support the development of a wide array of scientific domains and impact societal challenges as well. PHIDIAS is creating access services to increase the HPC and data capacities of the European Data Infrastructure in the context of the Connecting Europe Facility on Open Data. Running from September 2019 to September 2022, this research and innovation action will build a prototype for Data/HPC services based on Earth sciences cases.

Use case 1 – Intelligent screening of satellite data: Improve efficiency and genericity of the intelligent screening of environmental satellite data.

Use case 2 – Big data earth observation: Enhance the EO data processing chains scalability for environmental monitoring from the end-users needs of THEIA land data centre network.

Use case 3 – Ocean: Improve the use of cloud services for marine data management, service and processing, with the EOSC challenge and DIAS top of mind.

The project is paving the way to increase the HPC and Data capacities of the European Data Infrastructure by pursuing the following objectives:

- Develop a catalogue allowing users to discover and access data, open-source software, public APIs and interactive processing services. This catalogue will implement interoperable services for the discovery, access and processing of the data, and be connected to other major data repositories such as the European Data Portal, GEOSS, NextGEOSS, and EOSC.
- Optimise and industrialise workflows to allow extensive re-usability of data
- Implement an end-user web common interactive processing service based on notebook and data cube technologies allowing new users to easily have access to HPC capacities and develop new algorithms
- Improve the FAIRisation of satellite and environmental datasets and preserve FAIR (Findable Accessible Interoperable Reusable) datasets into a Remote Data Access certified repositior.
- Contribute to the development of the EOSC by industrialising its HPC/HPDA/AI processes and algorithms, as well as making its services available and accessible through the EOSC portal



The expected outcome of PHIDIAS is thus to:

- Create sustainable HPC data-powered services for the earth, atmospheric and marine data towards researchers, industry and public sectors
- Leverage networking infrastructures such as GEANT, RENATER, FUNET to ensure end-to-end scientific workflows
- Federate infrastructure to infrastructure services, including authentication, access to resources (pre- and post-processing, management and preservation of large volumes of digital information over time)
- Define and create a FAIR portal for the scientific community and data providers

PHIDIAS is carried out by a committed, competent and complementary consortium of 13 partners from 5 European countries, led by CINES (France) and involves ETP4HPC members CSC and Neovia Innovation.

Twitter: @PhidiasHpc
 LinkedIn: company/PHIDIAS-HPC
 Website: <https://www.phidias-hpc.eu/>
phidias-contact@cines.fr

What's new in the fourth edition of ETP4HPC's Strategic Research Agenda?

Michael Malms, ETP4HPC Office

This Strategic Research Agenda (SRA) is the fourth High Performance Computing (HPC) technology roadmap developed and maintained by ETP4HPC, with the support of the EXDCI-2 project. It continues the tradition of a structured approach to the identification of key research objectives. The main objective of this SRA is to identify the European technology research priorities in the area of HPC and High-Performance Data Analytics (HPDA), which should be used by EuroHPC to build its 2021 – 2024 Work Programme.

Over eighty HPC experts associated with member organisations of ETP4HPC created this document in collaboration with external technical leaders representing those areas of technology that together with HPC form what we have come to call **"The Digital Continuum"**. This new concept well reflects the main trend of this SRA – it is not only about developing HPC technology in order to build competitive European HPC systems but also about making our HPC solutions work together with other related technologies - the material included in this SRA is also a result of our interactions with Big Data, Internet of Things (IoT), Artificial Intelligence (AI) and Cyber Physical Systems (CPS).

Major trends in the deployment of HPC and HPDA methods and systems are described, driven by economic and societal needs in Europe, taking into account the changes expected in the technologies and architectures of the expanding underlying IT infrastructure. The goal is to draw a complete picture of the state of the art and the challenges for the next 3-4 years rather than to focus on specific technologies, implementations or solutions. Any reference to products or solutions is intended as a reference to better explain the context, not as an implied promotion. The SRA thus remains completely agnostic in relation to brands with the intent to preserve the diversity of implementation options. In this regard, it differs from planning documents issued by EuroHPC and its RIAG, which delineate the implementation of research priorities in the form of work programmes and calls. These documents are driven by two factors:

- 1/ the political strategy agreed upon by the EC and the Participating States within EuroHPC and
- 2/ the relevant technical directions.



EXDCI 2 (European Extreme Data & Computing Initiative) supports the development and implementation of a common strategy for the European HPC ecosystem. PRACE and ETP4HPC are both involved in this transversal project.

More information:

<https://exdci.eu/>

EXDCI on Twitter: @exdci_eu

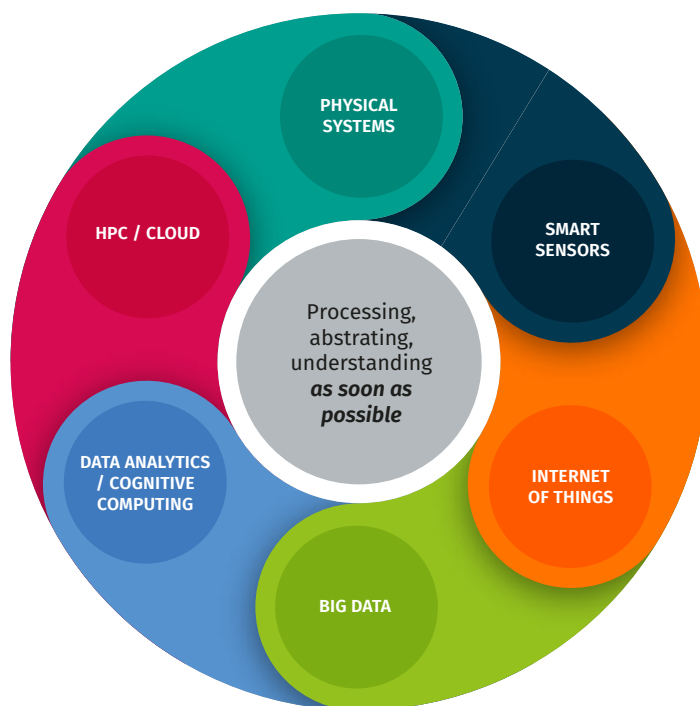
The SRA in numbers

- 80+ recognised experts involved
- 8 working groups
- 4 face-to-face workshops
- 40+ teleconferences
- More complete than ever with 128 pages!

The new paradigm: HPC in the Digital Continuum

The rapid proliferation of digital data generators, the unprecedented growth in the volume and diversity of the data they generate, and the intense evolution of the methods for analysing and using that data are radically reshaping the landscape of scientific computing. The most critical problems involve the logistics of wide-area, multistage workflows that move back and forth across the computing continuum, between the multitude of distributed sensors, instruments and other devices at the network's Edge and the centralised resources of commercial clouds and HPC centres. The objective of this SRA is to process this **new paradigm of 'The Digital Continuum'**.

HPC IN THE LOOP



Enabling Intelligent data processing at the edge:

- Edge computing
- Fog computing
- Stream analytics

Transforming data into information as soon as possible

Collaboration between edge devices and the HPC/cloud ensuring:

- Data security and Privacy
 - Lower bandwidth
 - Better use of HPC/Cloud
- > creating a continuous flow

The Figure above illustrates High-Performance Computing as one element of a complex workflow ("HPC in the loop"), starting with data generated at smart sensors in an IoT environment. Data is being locally pre-processed at the Edge and relevant parts are forwarded to decentralised "Fog nodes" close to the Edge. A subset of data is then transferred for centralised Data Analytics or simulation and modelling in centralised HPC centres or clouds. In an increasing number of use scenarios based on the concept of the "Digital Twin", a "twin-copy" of a physical entity, is maintained and

continuously updated on these central compute infrastructures. It should be noted that in reality the dependencies between the segments of the loop shown in the figure are not sequential in nature. The loop is not strictly repeating actions in a circular mode; the elements are cross-connected in rather complex, often fast changing event-driven flows. The final outcome of the loop is a set of optimised actions in the "Cyber Physical Entanglement" representing physical systems (e.g. robots, vehicles, industrial processes) interconnected in complex intelligent networks.

New in SRA – 4: the concept of Research Clusters and Research Domains

What is new in this SRA is the way technical priorities are selected, described and grouped. In our model, the research areas identified are grouped according to two overlapping layer dimensions: “**Research Domains**” and “**Research Clusters**”, as presented in the Figure below. The priorities to be addressed by the future Work Programme are also to be found on the intersection of the Research Clusters and Research Domains – each of the Research Domain chapters highlights those common elements.

SRA4 RESEARCH DOMAINS AND RESEARCH CLUSTERS

RESEARCH CLUSTERS

Development methods and standards	Energy efficiency	AI everywhere	Data everywhere	HPC and the digital continuum	Resilience	Trustworthy computing	
●	●	●	●	●	●	●	RESEARCH DOMAINS
●	●	●	●	●	●	●	System Architecture
●	●	●	●	●	●	●	System Hardware Components
●	●	●	●	●	●	●	System Software & Management
●	●	●	●	●	●	●	Programming Environment
●	●	●	●	●	●	●	IO & Storage
●	●	●	●	●	●	●	Mathematical methods & Algorithms
●	●	●	●	●	●	●	Application co-design
●	●	●	●	●	●	●	Centre-to-edge framework

The concepts of “Research Domains” and “Research Clusters” is an evolution of models used in previous SRAs.

- **Research Clusters** represent cross-cutting “themes”, which capture the research priorities for the next generation of HPC infrastructure. They are shown as vertical elements in the Figure as the impact of most of them cuts through the majority or all of the research domains. Under the heading of each “Cluster”, several aspects with a high degree of similarity are grouped (or ‘clustered’) together. Some of them are traditional themes such as “Energy efficiency” or “Resilience” (already present in the previous SRAs) and some others are new and originate from outside traditional HPC e.g. “Data everywhere” or “AI everywhere”.
- **Research Domains** are needed to describe the essential layers and elements of an HPC functional stack. While “System Architecture” applies a holistic view of all elements of

the stack, “System Hardware Components” covers the lowest hardware level. “System Software and Management” focusses on all aspects of operating and managing the underlying hardware facilities. “Programming Environment” adds a user’s (programmers) view to using the HPC hardware and system software infrastructure. “I/O and Storage” covers the space of feeding the compute nodes with data and storing data. “Mathematical Methods and Algorithms” look at the backbone of any level of software used in HPC systems (not to be confused with the algorithms used in the application layer). “Application Co-design” offers an application writer’s input into the needs for the implementation of next generation HPC infrastructure all together. Finally, given the new trends of associating HPC with the other parts of the Digital Continuum, the “Centre-to-Edge Framework” Domain covers all aspects of HPC functionalities used in complex multi-tiered workflows.

The team effort behind this document

The process of preparing and writing the SRA started about a year ago. As in the case of previous SRAs, working groups were formed, led by two or three recognised experts. In each area, one of the leaders has an industrial background while the other has an academic one (some of them being active in partner associations such as BDVA), so that each group can benefit from the different professional engagements of its leaders and co-leaders. It is important to highlight that **all contributions were made on a strict voluntary basis without any payment**. Besides this core group of working group leaders, we received support and contributions from experts in various HPC deployment and application domains.



BDVA (Big Data Value Association) is the other private member of the EuroHPC JU, and also have representatives in the RIAG. We have been collaborating with BDVA since 2015 in order to align the roadmaps of our organisations.

The initial step of the team was to develop a new structure for the technical chapters of the SRA. Given the overarching paradigm of “HPC in the Digital Continuum”, new areas had to be analysed in terms of their relationship with HPC systems technology and deployment, e.g.: data analytics, Machine Learning, Cyber Security and the Internet of Things (IoT). The creation of clustered themes, called “Research Clusters” in the document, seemed to be an appropriate approach to capture these new influences. Also, two new “research domains” were introduced to reflect the importance of HPC applications and the influence of technology outside the datacentre on future workflows which include simulation and modelling. As the next step, besides writing the individual technical sections, we searched for use cases exemplifying the role HPC played in the Digital Continuum. Thus, interesting contributions, partially from outside the HPC ecosystem, are included in this SRA.

In addition, non-technical topics were identified to extend the scope of the SRA beyond a pure technical document, such as: the discussion of open source technology and software, recommendations for the future work programmes and an overview of the HPC programmes outside of Europe.

An example of a Research Cluster: AI everywhere

This article shows an example for one of the new research clusters identified in the SRA. The concept of “Research Clusters” and “Research Domains” is laid out in the previous article.

WHAT TOPICS ARE COVERED BY THIS CLUSTER?

Artificial Intelligence (AI) is living a second youth and is here to stay. Unlike in the past, the AI models and techniques are now feasible due to (I) the existence of a large amount of data that represents a high-potential source of valuable insights and (II) advances in the underlying hardware and software ecosystem, which provide the computational performance to train the models associated to these AI systems.

The high computational demand of fields such as Deep Learning (DL), have contributed to emphasise the need of high-performance hardware and software (e.g. GPGPUs) and therefore put HPC technologies in the foreground.

Nowadays, many scientific and industrial applications generate and use huge volumes of different kind of data (static data, real-time data, etc) and combine data analytics techniques with simulations. As a paradigmatic example, the autonomous car requires dealing with simulations of hypothetical situations as well as analysing extremely high volumes of data, coming from sensors, databases, etc. This type of applications benefits from architectures with thousands of cores and distributed storage systems but they also need tailored solutions in order to be able to run Machine Learning (ML) algorithms in order to organise and cluster data and to speed up the queries and the algorithms that use this input data.

The convergence between Big Data, data-driven AI and HPC demands a new software and hardware ecosystem, which, at the same time, should fulfil the requirements of the Exascale era. In relation to this, it is important to cover two different angles: “HPC for AI”, i.e. HPC supporting the efficient execution of AI approaches, and “AI for HPC”, i.e. AI improving and enabling new HPC solutions.

In the context of this cluster, the following topics will be addressed:

- Use of AI in the context of HPC hardware, such as neuromorphic architectures, which mimic the human brain.
- Scalable and high-performance AI solutions. Heterogeneous HPC architectures can contribute

to increase the scalability of these solutions, as well as the application of emerging technologies such as quantum or neuromorphic computing. All these alternatives have to be researched in depth.

- Distributed DL Networking Acceleration - DL model training time becomes a critical piece in the overall productivity and adoption of DL in the field. Training times are becoming shorter due to various optimisations in ASICs and software but there is a constant need to improve them. Fast training time can improve data scientists’ work dramatically by reducing DL model training time from days to minutes. This fundamentally changes the way data scientists operate.
- Learning across the Digital Continuum by means of the emergence of Distributed AI and Edge Analytics and its integration with HPC-based approaches. In particular, to run inference models at the Edge will contribute to reduce the energy consumption, avoiding some data movement (saving bandwidth) and enabling the use of low energy HPC devices.
- AI software should be easy to deploy, be customisable, run anywhere (across the continuum) and be able to include human in the loop, if needed. In this sense, explainable models will contribute to their acceptance. ML techniques can also be applied to software engineering, enhancing and accelerating the process of creating software.
- Application of AI and HPC not only to scientific scenarios but also to industrial applications, especially driven by the impact of AI in industry today. HPC tools and infrastructure should fulfil the needs of these industrial use cases.

RELEVANCE & IMPACT (WHY CHOSEN?)

AI is one of the significant pillars of the upcoming fourth industrial revolution. AI will proliferate into ALL aspects of the technology stacks and across the whole Digital Continuum: from Edge devices, cell phones and IoT devices all the way to data centres. This presents a great opportunity as a significant

inflection point in technology. AI will disrupt not only the IT space but most of other industries (practically across most of the domains and verticals: manufacturing, automotive, finance, communication) and will probably create new ones.

AI will also change the way software and hardware developments are done today, by employing AI techniques to create SW algorithms (that is, software writing software) and build new hardware. Finally, AI workloads will also increase the network bandwidth demands for Edge to data centre and inside the data centre.

MATURITY (TIME TO MARKET)

Although AI is a reality, many aspects of AI are not yet solved. For instance, there are many ethical aspects that have to be solved in the making-decision process. The liability of the AI system has to be clearly defined. On the other hand, at technical level, it is necessary to find a trade-off between two parameters essential in AI scenarios: time-to-model and the model accuracy. HPC can contribute to improve these technical issues (e.g. by improving the scalability of AI algorithms and systems). The interoperability and compatibility of existing tools in AI and HPC have also to be improved.

HURDLES TO OVERCOME

- Scalability of AI systems and algorithms: in many current applications, AI has to be applied to a huge amount of data, and often Big Data. Therefore, scalable data management techniques and scalable AI techniques are needed. Furthermore, the underlying infrastructures and frameworks should also exhibit this behaviour. Otherwise, these demanding applications will not be able to take advantage of the advances in AI.
- Performance and energy efficiency of AI methods: there is a huge ground of collaboration between the HPC and the AI community for optimising, scaling out and reducing the memory/energy footprint of AI applications.
- Interoperability of tools and software stack: Although there have been many efforts to make

the convergence between HPC and Big Data possible, the software stack of both disciplines is completely different, and the interoperability is still an issue. In the case of AI, the scenario is similar. The interoperability of tools and frameworks will make easier the appropriate combination of HPC and AI approaches.

- Ethical aspects: AI systems should follow a human-centric design, i.e. oriented at improving human welfare and freedom. This design has to exhibit three main characteristics: lawful (compliant with laws and regulations), ethical (ensuring ethical values) and robust (with good intentions).
- Liability of AI systems: If certain decisions are made by AI engines instead of humans, it is necessary to set up the liability of these decisions. This is difficult to do, particularly when the decision-making process is complex and involves different parties.
- Explainable AI: The omnipresence of AI in our lives, and particularly in critical or sensitive aspects of them, will demand the use of explainable AI techniques, which increase and guarantee the trust in the different applications as well as their acceptance.

DRIVING COMPETENCE IN EUROPE

AI technology usually will be combination of AI acceleration hardware (dedicated AI accelerators, GPUs, CPU), significant software stack that runs on top of this and the data that feeds the AI process. The SW stack is a place where competence can be gained in Europe, from developing new AI algorithms to tuning, customising and optimising existing ones. Thus, Europe should invest largely and primarily in the development of software solutions. At hardware level, the competition with other giants from USA, Japan or China is harder. However, Europe is also contributing to this race, mainly through the EPI project and in industries such as car manufacturing. Finally, Europe is strong in industrial data, due to the production happening in Europe.

ETP4HPC and the Digital Continuum: Next actions

ETP4HPC plans to engage with key technology stakeholders in a horizontal collaborative effort to drive towards synchronised research calls in 2021+ (the term “synchronised calls” means that each stakeholder funds its contributions separately from the other stakeholders and there is no merged (joint) overall funding mechanism). The stakeholders of this engagement are the providers of key co-technologies required to implement complete end-to-end solutions in the Digital Continuum. Among the players should be:

- BDVA, Big Data Value Association
- AIOTI, the Alliance for Internet-of-Things
- EU Robotics, the association of all European robotics stakeholders
- ECSO, the European Cyber Security Organisation
- 5G IA, the 5G Infrastructure Association

An important aspect of such a large horizontal action is the definition of the set of problems to be solved. Horizon Europe missions offer a wealth of options for connecting societal needs to such a collaborative effort.

In addition, the new European Commission has recently announced its guidelines for 2019 to 2024, in which a key priority is the “European Green Deal”. Among others, this includes a broad range of technical challenges, which could well be addressed by a collaborative R&D effort as described in the next section. The EC communication on “The Green Deal” states: “Accessible and interoperable data are at the heart of data-driven innovation. This data, combined

with digital infrastructure (e.g. supercomputers, cloud, ultra-fast networks) and artificial intelligence solutions, facilitate evidence-based decisions and expand the capacity to understand and tackle environmental challenges. The Commission will support work to unlock the full benefits of the digital transformation to support the ecological transition. An immediate priority will be to boost the EU’s ability to predict and manage environmental disasters. To do this, the Commission will bring together European scientific and industrial excellence to develop a very high precision digital model of the Earth.»

A LARGE-SCALE COLLABORATIVE EFFORT: TRANSCONTINUUM EXTREME-SCALE IN-FRASTRUCTURES

Recent hardware and software advances have motivated the development of a transcontinuum digital infrastructures concept to account for the convergence of data and compute capabilities. This concept is not in a straight line from the past efforts and a paradigm change is needed: we will have to design systems encompassing hundreds of billions of cores distributed over scientific instruments, IoT, supercomputers and Cloud systems through LAN, WLAN and 5G networks.

Pushed by massive deployments of compute and storage capabilities at the Edge, we require new system design to accommodate the ecosystem change to be expected in the coming decades (environmental and

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technological) and horizontally integrate the different actors. The new demands and challenges that combine data and compute, distributed across the continuum, and the maintenance and resource efficiencies, are pushing for drastically increased software and hardware sustainability. Furthermore, the need to provide high-level cybersecurity is profoundly changing the game. Efficiency and resilience will have to reach levels never achieved so far, while taking into account the intrinsic distributed and heterogeneous nature of the continuum. In addition, the question of dealing with such high volumes of data needs to be faced, and quality versus quantity will become unavoidable. These considerations will spread over all components. Long-lifetime hardware devices will have to be reconfigurable, modular, and self-aware in order to be operational over extended periods. Algorithm efficiency will need to be drastically pushed up (e.g. more efficient AI). Management and deployment of large-scale application workflows will have to be adapted or invented. Network protocols will have to offer better control over the data logistics, etc.

Furthermore, it is widely recognised that AI will play a central role in these extreme-scale, continuum infrastructures. This will occur at three levels:

- AI for Digital Infrastructure,
- Digital Infrastructure for AI, and
- AI for Science, Industry and Societal Challenges.

The first addresses how AI can pilot and monitor the continuum and in so doing provide solutions to the points listed in the previous paragraph. The second

treats the question of re-designing the e-infrastructure to efficiently deal with data analysis and machine learning, which means tuning of data access, I/O, and low precision arithmetic. The last deals with the ever-increasing needs to exploit AI techniques for extreme-scale, combining Data and Compute through the interpretation and coupling of computing results, measurements and observations (e.g. Digital Twins in extreme earth modelling, combining climate models with satellite data and on-ground sensors).

The overall objective is to target high TRL solutions (7 and more), based on horizontal synergies between all the concerned digital infrastructure technologies: HPC, Big Data, Machine Learning, IoT, 5G, cybersecurity, processor technology (EPI) and robotics. All of these components of the digital infrastructure will together be able to address the critical societal challenges and sustainable development goals by mobilising their amazing potential all the way across the continuum.

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Our main events

Vision workshop at HiPEAC Conference



The Vision workshop co-organised by HiPEAC and ETP4HPC at the HiPEAC conference in Valencia on 22 January 2019 presented the highlights of different vision documents under preparation (HiPEAC, ECS-SRA, ETP4HPC, Eurolab4HPC ...). ETP4HPC was represented by our former Chairman Jean-François Lavignon. This workshop was a great opportunity for speakers and attendees to interactively confront their respective visions of the future of computing.

Many thanks to Marc Duranton (HiPEAC and CEA) for organising and moderating this event!

The issue of the HiPEAC magazine distributed at the conference included an article by Marcin Ostasz (ETP4HPC office) summarizing ETP4HPC's roadmapping activities.

9th General Assembly near Amsterdam



Our 9th GA was held in Sassenheim on 19 March 2019. All attendees were also invited to a networking dinner before the GA, where our new members were able to mingle in a relaxed atmosphere.

After the overview of the past year by our chairman Jean-Pierre Panziera, a large part of the GA was dedicated to the EuroHPC JU. Gustav Kalbe, Interim Executive Director of the EuroHPC JU, shared insights on the actual workings of EuroHPC. Axel Auweter (member of ETP4HPC Steering Board) detailed the composition and operation of the EuroHPC Research and Innovation Advisory Group (RIAG).

Michael Malms (our expert in charge of the Strategic Research Agenda - SRA) presented the roadmap for the production of our fourth SRA.

As we are increasingly working with the BDVA association, in particular within the RIAG and for the SRA, we had invited BDVA's Maria Perez (UPM) to present her association to our members.

Finally, Jean-François Lavignon (T&S) gave an overview of the results of the FETHPC 2015 projects that ended recently, as compiled by EXDCI.

EuroHPC Summit Week in Poznan



The EuroHPC Summit Week in Poznan was organised by PRACE, EXDCI-2 and ETP4HPC, and hosted by PRACE's Polish Member, the Poznan Supercomputing and Networking Centre, on 13-17 May 2019. More than 360 participants joined this week of intense networking, and attended the plenary sessions, parallel sessions, workshops and discussions.

ETP4HPC, besides being co-organiser of the complete event, was involved in many public sessions and private meetings organised around EHPCSW:

- EuroHPC RIAG meeting
- Our chairman Jean-Pierre Panziera chaired the second part of the Opening Plenary session
- HPC Ecosystem Summit, a meeting for all stakeholders in the HPC Ecosystem
- EuroHPC BoF, open to all to understand the EuroHPC Infrastructure and Research & Innovation pillars
- The HPC Ecosystem Workshop included a session on the SRA presented by our SRA expert Michael Malms
- An SRA 4 workshop took place just after the close of the conference

Teratec Forum 2019 in Palaiseau, France



The ETP4HPC team was present again at the Teratec Forum, held on 11-12 June 2019, with a booth hosting also EXDCI2. We inaugurated a brand-new look and feel for our booth at this occasion!

ETP4HPC was one of the 80 exhibitors at this conference gathering more than 1300 attendees representing both the academic community and the industry. The European HPC ecosystem was well represented at the Teratec Forum:

- the Café de la Recherche hosted several H2020 projects,
- for the first time, FocusCoE had a booth, and several CoEs presented their activities to attendees.

SME members on our booth at ISC 2019



The HPC community converged again to Frankfurt on 17-20 June 2019 for ISC High Performance! ETP4HPC had significantly increased its presence, with a much larger booth, adjacent to the PRACE booth. This made it possible to host 4 of our SME members. ETP4HPC members Asetek, ConstelCom, Iceotope and Maguay Computers each had their own little corner on our booth, providing an opportunity to exhibit their solutions - and network with ISC attendees and other ETP4HPC members.

The meeting corner was much appreciated and used by our staff and our 4 co-exhibitors for impromptu meetings.

Energy Efficiency workshop at ISC 2019



Our Energy Efficiency Working Group successfully submitted a Bird-of-a-Feather session on «Building Energy Efficient HPC Systems» for the ISC 2019 programme.

This BoF aimed to allow the community to present their activities towards energy efficiency in HPC and to serve as a forum to bring together like-minded people to discuss ideas, share experiences, and outline further research topics.

The BoF was moderated by Maïke Gilliot (ETP4HPC Office / Teratec). It featured talks by Michael Ott, Senior Researcher at Leibniz Supercomputing Centre and Chair of our Energy Efficiency Working Group, Julita Corbalan, Collaborator researcher/Associated professor at Barcelona Supercomputing Centre and the Polytechnic University of Catalonia, and Peter Hopton, Founder and VP of Iceotope.

ICT Proposers' Day Helsinki



The Digital Excellence Forum @ ICT Proposers' Day 2019 was held on 19-20 September 2019 in Helsinki. The event featured a rich programme of plenary sessions as well as a separate track of open dialogue sessions on the upcoming Digital Europe Programme.

It offered an exceptional opportunity to build partnerships between academics, researchers, industrial stakeholders, SMEs and government actors from all over Europe.

Our chairman Jean-Pierre Panziera was invited to present the role of our association in the Digital Europe Programme - High Performance Computing session.

Networking stands – such as the HPC stand we shared with the EuroHPC JU - served as meeting points to facilitate interactions between people interested in the same research topics.

Birds-of-a-Feather session at SC19



In 2019 again, we held a BoF at SC19 in Denver (18-22 November 2019). This event, co-organised with EXDCI, has a very good track record, accepted every year since 2014!

This year, we proposed a different flavour: instead of presenting European and international updates, this BoF saw a dynamic discussion on the Sisyphian task of adapting applications to the ever-changing heterogeneous architectures. Panellists from Europe and overseas were present to analyse this phenomenon:

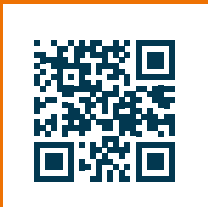
- Jean-Marc Denis (Atos/EPI)
- Estela Suarez (Forschungszentrum Jülich/ Deep projects)
- John Davis (Barcelona Supercomputing Center)
- David Richards (Lawrence Livermore National Laboratory)
- Erik Lindahl (Stockholm University/KTH/PRACE Scientific Steering Committee)

The BoF was moderated by Maïke Gilliot (ETP4HPC/Teratec). We will be back in 2020 to provoke another fiery discussion on topics affecting the global HPC community!

Participation in events

Date	Event	Location	Participation of ETP4HPC
09/01/2019	FP9 /post-H2020/ Vision Workshop	IBM Zurich	Maïke Gilliot representing ETP4HPC
22/01/2019	HiPEAC Conference:	Valencia, Spain	Joint road mapping workshop with HiPEAC
07/02/2019	Steering Board meeting	Conference call	
11/03/2019	EuroHPC JU open information day	Brussels, Belgium	Hugo Falter representing ETP4HPC
18/03/2019	Steering Board Meeting	Near Amsterdam	
18-19/03/2019	9 th ETP4HPC General Assembly	Near Amsterdam	
29/03/2019	Steering Board Meeting	Conference call	
17/04/2019	Public-Private Partnerships collaborative event	Amsterdam Schiphol Airport	Michael Malms and Marcin Ostasz representing ETP4HPC
13-17/05/2019	EuroHPC Summit Week 2019	Poznan, Poland	Pascale Bernier-Bruna co-organiser
16/05/2019	SRA 4 - Public Birds-of-a-Feather session at the EuroHPC Summit Week	Poznan, Poland	Presentation in Plenary by Michael Malms
17/05/2019	SRA 4 - Workshop at the EuroHPC Summit Week	Poznan, Poland	
23/05/2019	Steering Board Meeting	Conference call	
24/05/2019	First SRA 4 Working Group Call - 1 - System Architecture	Conference call	with Michael Malms and Maïke Gilliot
06/06/2019	Joining forces to boost AI adoption in Europe	Brussels	Hugo Falter representing ETP4HPC
07/06/2019	First SRA 4 Working Group Call - 7 - Centre-to-Edge Framework	Conference call	with Marcin Ostasz and Maïke Gilliot
07/06/2019	First SRA 4 Working Group Call - 3 - System Software & Management	Conference call	with Michael Malms and Maïke Gilliot
11/06/2019	First SRA 4 Working Group Call - 6 - Mathematics & Algorithms	Conference call	with Marcin Ostasz
11-12/06/2019	Teratec Forum	Palaiseau, France	Booth
13/06/2019	First SRA 4 Working Group Call - 8 - Application co-design	Conference call	with Maïke Gilliot and Marcin Ostasz
13/06/2019	First SRA 4 Working Group Call - 2 - System Hardware Components	Conference call	with Maïke Gilliot and Marcin Ostasz
14/06/2019	First SRA 4 Working Group Call - 4 - Programming Environment	Conference call	with Michael Malms and Maïke Gilliot
14/06/2019	First SRA 4 Working Group Call - 5 - I/O & Storage	Conference call	with Michael Malms and Marcin Ostasz
16-19/06/2019	ISC High Performance 2019	Frankfurt, Germany	Booth

Date	Event	Location	Participation of ETP4HPC
17/06/2019	Steering Board meeting	Frankfurt, Germany	
19/06/2019	SRA 4 - Workshop at ISC 2019	Frankfurt, Germany	
19/06/2019	ISC 2019 BoF: Building Energy Efficient HPC Systems	Frankfurt, Germany	Coordinated by Energy Efficiency work group
26-27/06/2019	First EXDCI-2 Review Meeting	Luxembourg	Michael Malms representing ETP4HPC
12/09/2019	European Partnerships for New Digital Age Workshop	Brussels, Belgium	ETP4HPC represented by Sai Narasimhamurthy
16-17/09/2019	Steering Board meeting	BSC, Barcelona, Spain	
19-20/09/2019	Digital Excellence Forum @ ICT Proposers Day 2019	Helsinki, Finland	Talks by JP Panziera & Marcin Ostasz
Shared booth with EuroHPC booth	cPPP meeting	Brussels, Belgium	
02/10/2019	HPC SIG-MarComms meeting	Brussels, Belgium	ETP4HPC represented by Pascale Bernier-Bruna
08/10/2019	European HPC Training Stakeholder Workshop	Brussels, Belgium	ETP4HPC represented by Jean-Philippe Nominé
11/10/2019	AIOTI WG01 Telco	Conference call	ETP4HPC represented by Michael Malms
14-16/10/2019	European Big Data Value Forum 2019	Helsinki, Finland	Michaelm Malms co-organiser of HPC-Big Data session and panellist in session Scaling horizontal partnerships for AI,
Jean-Pierre Panziera speaker in HPC-Big Data session	ICT event: Joint ETP4HPC-BDVA Networking Session - Public Review of post-H2020 Vision	Vienna, Austria	
15/10/2019	K4I Forum Working Breakfast	Brussels, Belgium	ETP4HPC represented by Hugo Falter
21/10/2019	Workshop on EuroHPC Systems Access Policy	Brussels, Belgium	
05/11/2019	European Industry Partnerships - Light-houses to thrive in the New Digital Age	Brussels, Belgium	ETP4HPC represented by Mark Asch
13/11/2019	SRA WG leader F2F meeting	Munich Airport	Michael Malms and team
14/11/2019	Steering Board meeting	Conference Call	
20/11/2019	BoF at SC19	Denver, USA	Marcin Ostasz and office team
21/11/2019	Scientific & Technical Committee (STC) of ECSO	Brussels, Belgium	ETP4HPC represented by Jens Krueger
02-03/12/2019	EXDCI-2 Second Technical Workshop	UPC Barcelona	
11/12/2019	Steering Board Meeting	Munich Airport	



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