HPC & Quantum Technologies in Europe

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European HPC Strategy & Support
"Our ambition is for Europe to become one of the top 3 world leaders in high-performance computing by 2020"

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The Political Priorities


- **European Open Science Cloud (EOSC)**
  - Integration and consolidation of e-infrastructures
  - Federation of existing research infrastructures and scientific clouds
  - Development of cloud-based services for Open Science
  - Connection of ESFRIs to the EOSC

- **European Data Infrastructure (EDI)**
  - Development and deployment of large-scale European HPC, data and network infrastructures

- **Widening access**
  - SMEs, Industry at large, Government

"Building a European Data Economy" [COM in Jan 2017]
HPC/EDI Objectives

- **Acquisition** (in 2020-2021) of 2 operational *pre-exascale* and (in 2022-2023) two full *exascale* machines (of which one based on European technology)

- **Interconnection and federation** of national and European HPC resources and creation of an HPC and Big Data service infrastructure facility

- **Demonstrating and testing** technology performance towards exascale through scientific & industrial compute-intensive applications
HPC/EDI strategy – an outlook

- Tighter coordination of national strategies for upgrading computing, data and network infrastructures including:
  - EU-wide access to federated computing and data resources
  - Pooling of investments (EU, national) to reach critical mass needed for accelerating the move to exascale
  - Building on achievements in PRACE-2 and GEANT

- Establishing as quickly as possible a partnership with industry and Member States to offer:
  - HPC as a service to a wide range of data and compute intensive applications in key sectors (health, industrie 4.0, finance, agriculture, etc.)
  - Build up HPC industrial strengths in Europe across the technology chain
  - Build on progress in IPCEI

- Challenge ➔ make the two tracks converge and ensure "co-design" as early as possible
- **1.5 B€** for 2 pre-exascale and 2 exascale machines
- **1.7 B€** for the interconnection and federation of supercomputing infrastructures
- **0.5 B€** for processor and for wider access to HPC facilities for SMEs
- **1.0-1.5 B€** for demo and testing of industrial applications

**Total: 4.7 – 5.2 B€**
Build a world-class European High Performance Computing (HPC), Big Data and Cloud Ecosystem

Enabled by the Convergence of 3 big technologies

- Major investments so far both at MS and EU level [FP7, H2020]
- Numerous research players (academia and industry)
- HPC and Big Data PPPs, PRACE, GEANT, etc.
HPC/EDI: The Logic of EU investments

**FET & LEIT Calls:** technology development, integration, pilot test-beds and applications

- Technology development (low-power processor, SW, applications)
- Integrating and co-designing extreme scale systems

**HPC – Cloud – BDA**

Ecosystem development

**Infrastructure/CEF calls**

- Procurement and services for EDI/HPC infrastructures (exascale, big data nodes, interconnection)
HPC/EDI in Horizon 2020
Work Programs

2014-2015

LEIT ICT WP ➔ Microprocessor, integration & demonstration
Low-power processor design and development
Co-design of extreme scale demonstrators
HPC/BD/Cloud: Large scale testbeds and applications using existing HPC

2016-2017

FET WP ➔ Key components & concepts: preparing next generation & thereafter
Components: Towards pre-exascale
system architectures
SW
extreme scale, power-efficient and resilient HPC compute & data technologies and prototypes for (post-) exascale application performance
Co-design of extreme scale HPC systems and demonstrators

2018-2020

eINFRA WP and Connecting Europe Facility (CEF): Infra support & Procurement
widening HPC-enabled BD services for stakeholders
PRACE, GÉANT, Centres of Excellence
Pre-exascale systems,
Data nodes, Interconnectivity
Flagship on Quantum Technology
Why now?

- Keep EU scientific leadership while preparing for exploitation and future industrial take-up
- QT maturing
- Build on strong interest from Member States
  - **ERANET Cofund with 24 MSs** (QUANTERA)
  - **National initiatives**: NL, UK, others in preparation (DE, DK, IT, ES, PT, ...)
- Increasing interest from European industry
  - **Bosch, Thales, ASML, Safran, Airbus, ATOS/Bull...**
  - **SMEs**: VLC Photonics, E2V, MuQuans, IDQuantique...
- Global competition very active
  - **US, Canada, China, ...**
  - **Industry engaged**: MS, Google, Intel, IBM, Lockheed Martin, Toshiba...
"Action: The European Commission will start the preparatory steps for the flagship...with the aim to launch the ramp up phase in 2018."
Objectives

- Turning science into industrial success
  - "valorisation de la recherche"
  - Technology transfer

- Maintain research excellence in EU
- Expand to engineering
- Stimulate innovation
- Stimulate industrial involvement
• No single EU country can do it alone
• A truly shared European political priority
• From established industries (Bosch, Thales, Atos, Airbus, ...) to **start-ups**

Ressources?
Expertise
Engage with industry, funders & investors
Joint agenda going beyond research
Join forces and coordinate at EU level

=> The Quantum Technology Flagship Initiative
WP 2018-2020
Key features

Communication
Computation
Simulation
Sensing/Metrology

Engineering/Control
Software/Theory
Education/Training

Enabling Science

=> Starting point for WP
=> ramp-up coverage?
Big "complementary" projects, higher TRL, addressing cross-cutting aspects

- **Quantum Communications**  
  Focus on networks & network components

- **Quantum Computing**  
  Integration of key building-blocks / co-design

- **Quantum Simulation**  
  Applications/simulator co-design

- **Quantum Metrology and Sensing**  
  Exploiting quantum properties in industrial relevant environments

Smaller projects, lower TRLs, horizontal topics

- **Fundamental/enabling science**
HPC – Quantum Technologies: Commonalities
Industrial Policy

Strategic technology for EU

Long term investment

Joint EU / MS initiative

Roadmap based

QT Computing / Simulation = HPC complements?
THANK YOU!