ETP 4 HPC

HPC Strategic Research Agenda

January 21st 2020, Bologna

SRA issued under Michael Malms leadership
Presented by JF Lavignon

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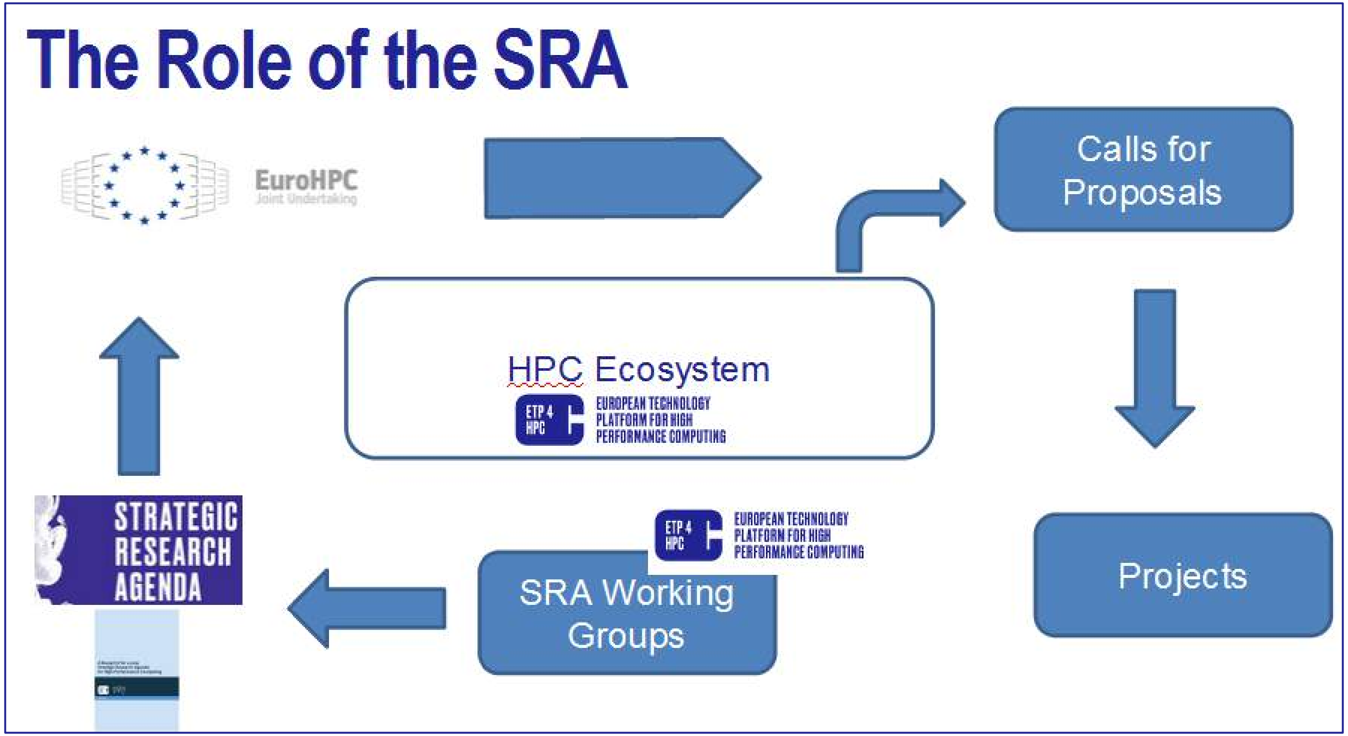
Agenda

- Positioning of the document, its value and purpose in an EuroHPC context
- All the facets view
- Major trend: Digital Continuum
- The approach to cover the field
- One example of horizontal technologies
- One example of vertical topic
- Conclusion “Trans – continuum” mission

SRA in a few words

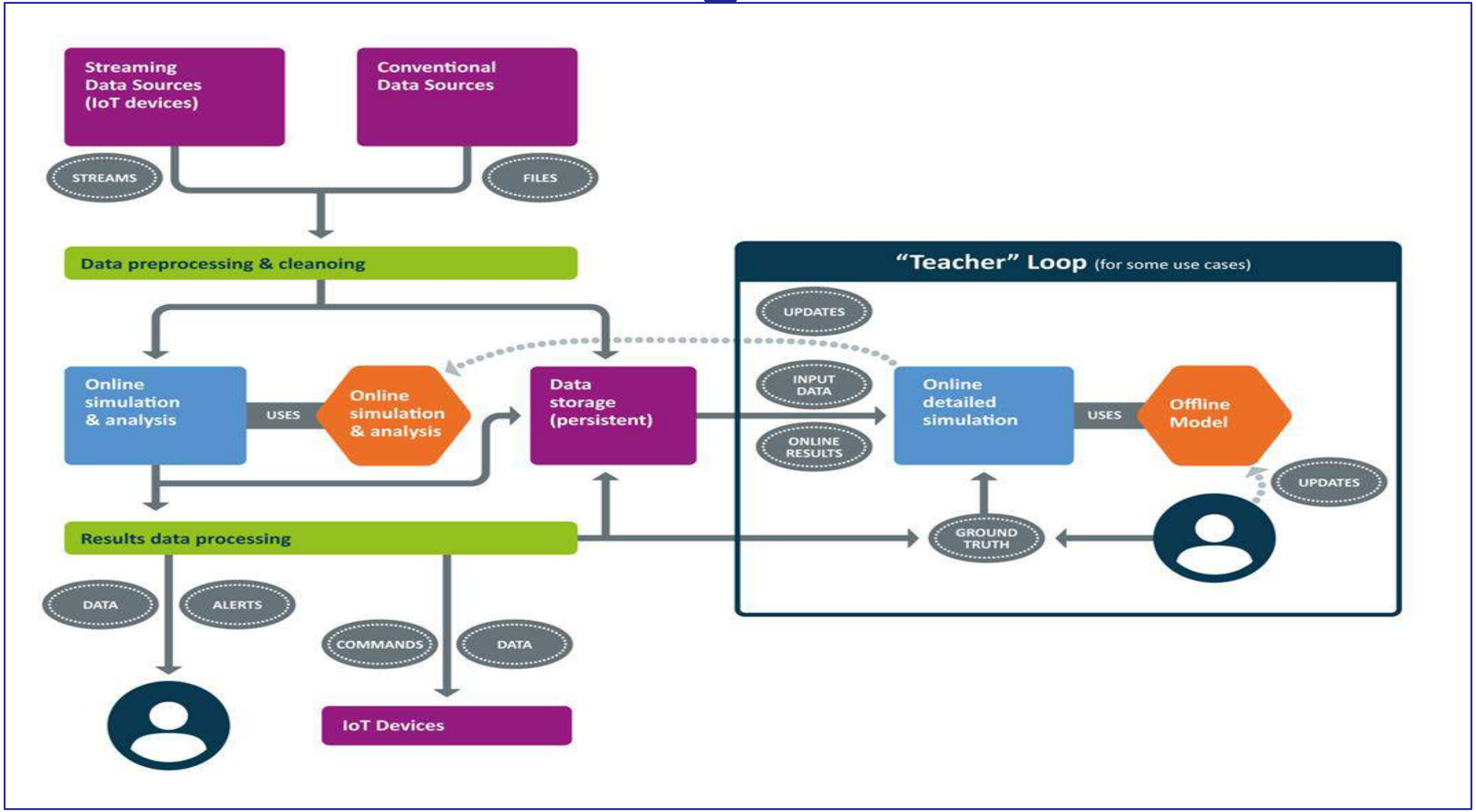
- Objective:
  - Identification of key research objectives in the 2021 – 2024 timeframe in the area of HPC and HPDA, including significant interactions with Internet of Things (IoT), Cyber Physical Systems (CPS) and Artificial Intelligence (AI)
- Audience
  - EuroHPC Joint Undertaking (EuroHPC)and in particular its Research and Innovation Advisory Group (RIAG) which will use the research objectives identified in this SRA to build its Multi-Annual Strategic Plan
  - entities interested in forming project consortia in response to the EuroHPC (and related) calls,
  - anyone interested in the development of HPC technology in Europe
- Status
  - Soon on ETP4HPC web site: https://www.etp4hpc.eu/

Why a SRA and scope

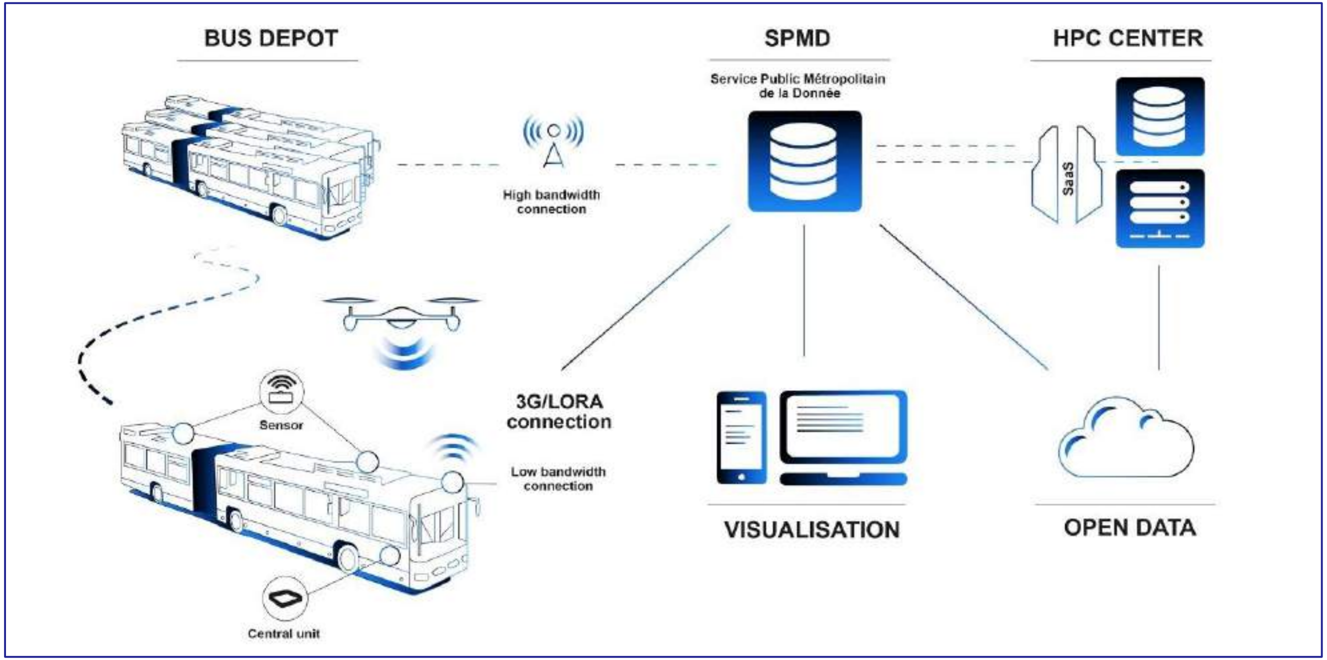


SRA-4: the increasing interplay of Simulation, AI, IoT and Analytics

New HPC use case generic model



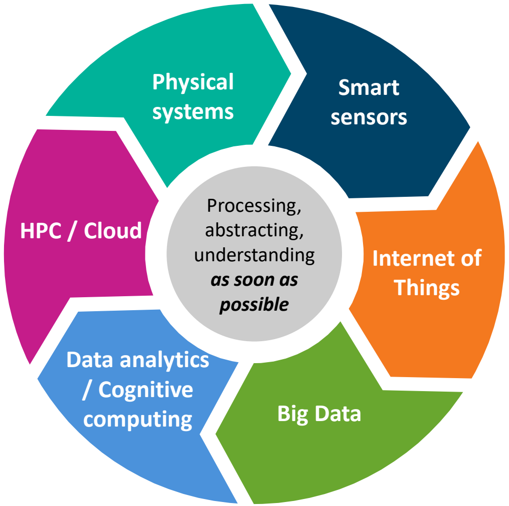
New HPC use case example AQMO*



AQMO Air Quality and Mobility http://aqmo.irisa.fr/fr/accueil/

Digital continuum

HPC in the loop



Enabling Intelligent data processing at the edge:

- Fog computing
- Edge computing
- Stream analytics

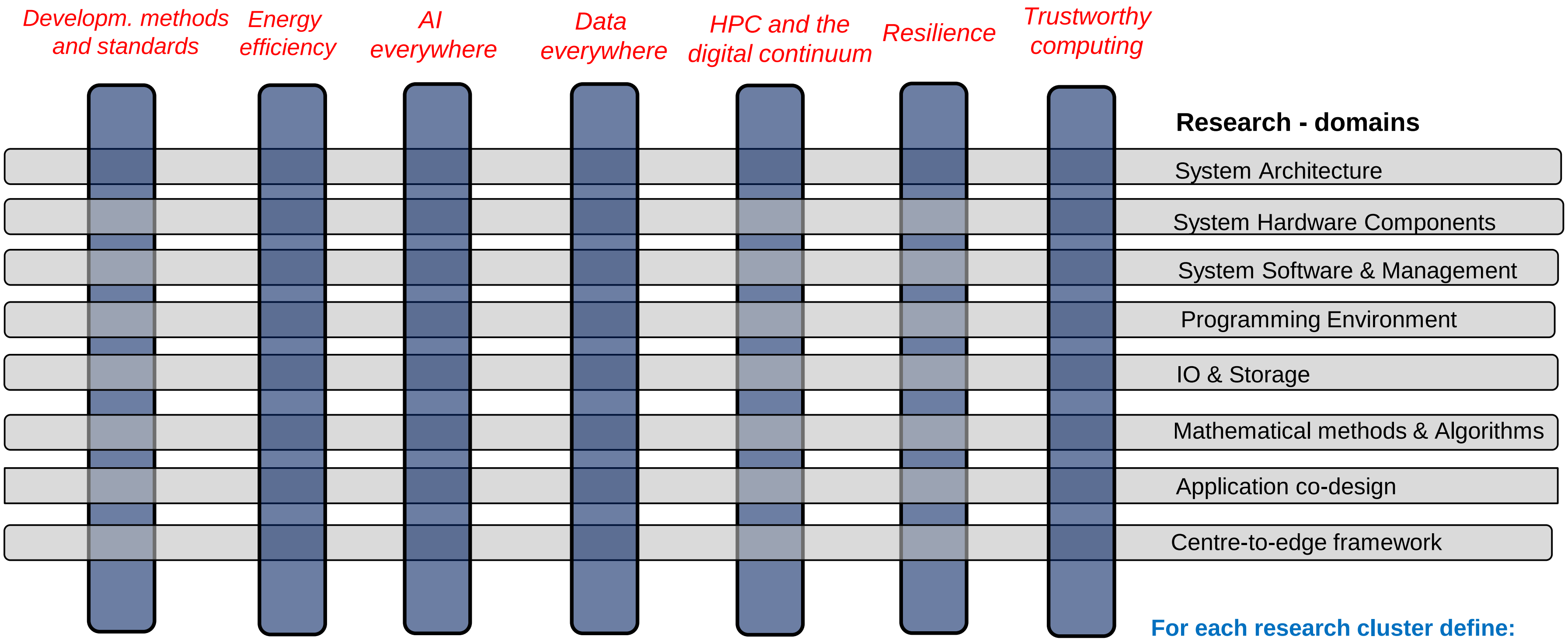
Transforming data into information as soon as possible

Collaboration between edge devices and the HPC/cloud ensuring:

- Data security and Privacy
- Lower bandwidth
- Better use of HPC/Cloud

→ creating a continuous flow

Structure of technical chapters: “Research clusters” and “Research Domains”



For each research cluster define:

- relevance & impact (why chosen?)
- maturity (time to market)
- Hurdles to overcome
- Driving competence in Europe
- Cost of research to gain sign. uptake

A real team work: working groups and leads – more than 80 experts

- System Architecture
  - Laurent Cargemel, ATOS
  - Estela Suarez, JSC
  - Herbert Cornelius, MEGWARE
- System Hardware Components
  - Marc Duranton, CEA (HiPEAC)
  - Benny Koren, MELLANOX
- System Software and Management
  - Pascale Rosse-Laurent, ATOS
  - Maria Perez, UPM (BDVA)
  - Manolis Marazakis (FORTH)
- Programming Environment
  - Guy Lonsdale, SCAPOS
  - Paul Carpenter, BSC
  - Gabriel Antoniu, INRIA (BDVA)
- I/O & Storage
  - Sai Narasimhamurthy, SEAGATE
  - Andre Brinkmann, JGU
- Mathematics & Algorithms
  - Dirk Pleiter, JSC
  - Adrian Tate, NAG
- Application co-design
  - Erwin Laure, KTH
  - Andreas Wierse, SICOS
- Centre-to-edge-framework
  - Jens Krueger, FRAUNHOFER
  - Hans-Christian Hoppe, INTEL

System architecture (1/2)

- Challenges
  - Integration of heterogeneous computing resource to increase energy efficiency and to support diversity of computational needs
  - Memory and storage hierarchy to integrate new technology and deal with data intensive applications
  - Scalability and performance of the network
  - New integration level (interposer)
  - Sustainability to limit environmental impact

System architecture (2/2)

- Interaction with clusters
  - Development methods & standards
    - Performance portability, co-design
  - Energy efficiency
    - Fine grain power management, cooling, API for energy monitoring
  - AI everywhere
    - Neuromorphic accelerator, HPC at the edge, AI to manage the system/network performance/energy
  - Data everywhere
    - On the fly computation, network performance, fine grain data movement management
  - HPC and the digital continuum
    - Embedded HPC, HPC in control loops,
  - Resilience
    - Heterogeneity management, redundancy, API for management data analysis
  - Trustworthy computing
    - Trusted hardware, data management, user management

Trustworthy computing

- Why this cluster:
  - HPC systems connected in the digital continuum
  - HPC at the edge with embedded security features
- Relevance and impact
  - Handling critical data, HPC in the loop of critical infrastructure control
- Hurdles to overcomes
  - Trade-off performance/energy efficiency/high level of security
- Span of the cluster
  - Trusted hardware
  - Secured OS and runtime
  - Trusted software development methods for the software stack and the applications
  - User registration and permission management

Upstream technologies 2021-2024

- Continuous progress of CMOS technology: scaling + integration
- New architectures
  - **Data flow**
  - In Memory Computing
  - **Neuromorphic**
- Silicon photonics
  - **Interconnect**
  - Neuromorphic architecture
- Analog computing

Conclusion : trans continuum mission

- New system design
  - With focus on
    - Resource efficiency
    - Sustainability
    - Cybersecurity
  - Capable to address
    - Heterogeneity of resources from sensors to HPC
    - Distributed nature of the continuum
  - Allowing the implementation of
    - AI for the digital infrastructure management
    - Efficient support of AI applications

- Look at : https://www.etp4hpc.eu/

ETP 4 HPC

EUROPEAN TECHNOLOGY PLATFORM FOR HIGH PERFORMANCE COMPUTING

Thank you

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