Boosting European HPC Value Chain

The vision of ETP4HPC,
the European Technology Platform for High Performance Computing

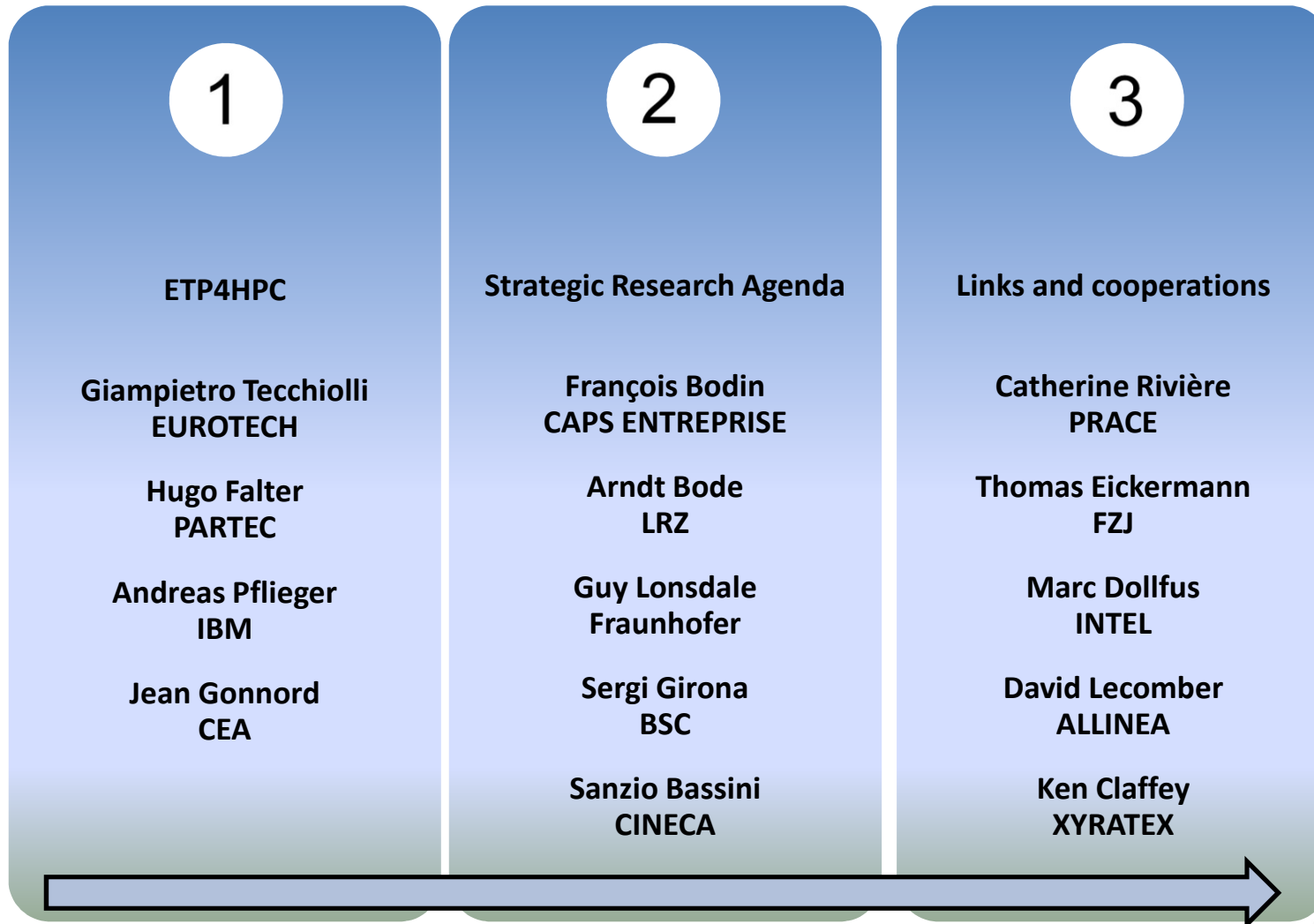SC12 Panel

Wednesday, November 14th - 10:30 AM

ETP 4 HPC

www.etp4hpc.eu

ETP4HPC Panel
Moderator: Jean-François Lavignon, BULL

1

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Giampietro Tecchiolli
EUROTECH

Hugo Falter
PARTEC

Andreas Pflieger
IBM

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2

Strategic Research Agenda

François Bodin
CAPS ENTREPRISE

Arndt Bode
LRZ

Guy Lonsdale
Fraunhofer

Sergi Girona
BSC

Sanzio Bassini
CINECA

3

Links and cooperations

Catherine Rivière
PRACE

Thomas Eickermann
FZJ

Marc Dollfus
INTEL

David Lecomber
ALLINEA

Ken Claffey
XYRATEX

ETP 4 HPC

ETP4HPC: an industry led initiative

- The ETP for HPC is a forum
  - That provides a framework for stakeholders, led by industry, to define research priorities and action plans on a number of technological areas in HPC that require major research and technological advances in the medium/long term.
  - That aims at achieving growth, competitiveness and sustainability through the direct and indirect benefits that the development and use of HPC can generate in the European economical and social framework.
  - That can amplify its actions through a continuous dialogue on research priorities with the European Commission

- Already 36 ETPs in Europe
  - 9 in ICT : embedded software, microelectronics, photonics, satellite, communication networks, media, software and services, robotics, smart systems integration
- ETPs deliverables:
  - Vision Paper
  - Strategic Research Agenda

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All members as of November 2012

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ETP4HPC objectives

- To build a European world-class HPC technology value chain that will be globally competitive
- To achieve a critical mass of convergent resources in order to increase the competitiveness of European HPC vendors and solutions
- To leverage the transformative power of HPC in order to boost European competitiveness in science and business

Giampietro

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Timeline

- ## June 2012
  - Announcement of the creation of the ETP
  - Vision Paper

- ## September 2012
  - Meeting with VP of European Commission Neelie Kroes

- ## June-December 2012
  - Strategic Research Agenda preparation

- ## February 2013
  - First General Assembly

- ## H1 2013
  - Discussion with European Commission on the HPC position in Horizon 2020

- ## September 2013
  - General Assembly and election of the next board

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Freedom

- The ETP will operate in an open, transparent and democratic manner according to its organizational rules characterised by trust and accountability among all members. It will not restrict members' freedoms:

  - **Freedom of association:**
    All parties involved may associate and collaborate with whomever they want, regardless of geographical origin, name, business size etc.
  - **Freedom of competition:**
    The ETP will not comment on or otherwise influence any research proposal, commercial or pre-commercial tender. Members will compete as usual, and the ETP will have no role, publically or privately, in judging or commenting upon any particular competitive situation.
  - **Freedom of communication:**
    Participation in the ETP in no way limits members from communicating their own positions regarding HPC, provided only that they do not misrepresent any formally agreed position of the ETP.
  - **Freedom of IP management:**
    No member will be restricted in any way from developing or using IP for which they have rightful ownership nor will they be required by the association to share or otherwise open such ownership.

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Freedom

The ETP will operate in an open, transparent and democratic manner according to its organizational rules characterised by trust and accountability among all members. It will not restrict members' freedoms:

- **Freedom of association**

- **Freedom of competition**

- **Freedom of communication**

- **Freedom of IP management**

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ETP4HPC: A first answer to the wish of the European Commission

High-Performance Computing
Europe's place in a Global Race
Neelie Kroes - Commissionner for Information Society

"Europe has strength… Europe has expertise… There is a window of opportunity …Despite this, EU HPC suppliers hold a market share of only 4.3%."

To address this challenge the Commissioner for IT proposes:

6. AN ACTION PLAN FOR EUROPEAN LEADERSHIP IN HPC
The Council asked for a pooling of national investments in HPC in order to strengthen the position of European industry and academia in the use, development and manufacturing of advanced computing products, services and technologies.
This is the high-level objective driving a renewed European HPC strategy.
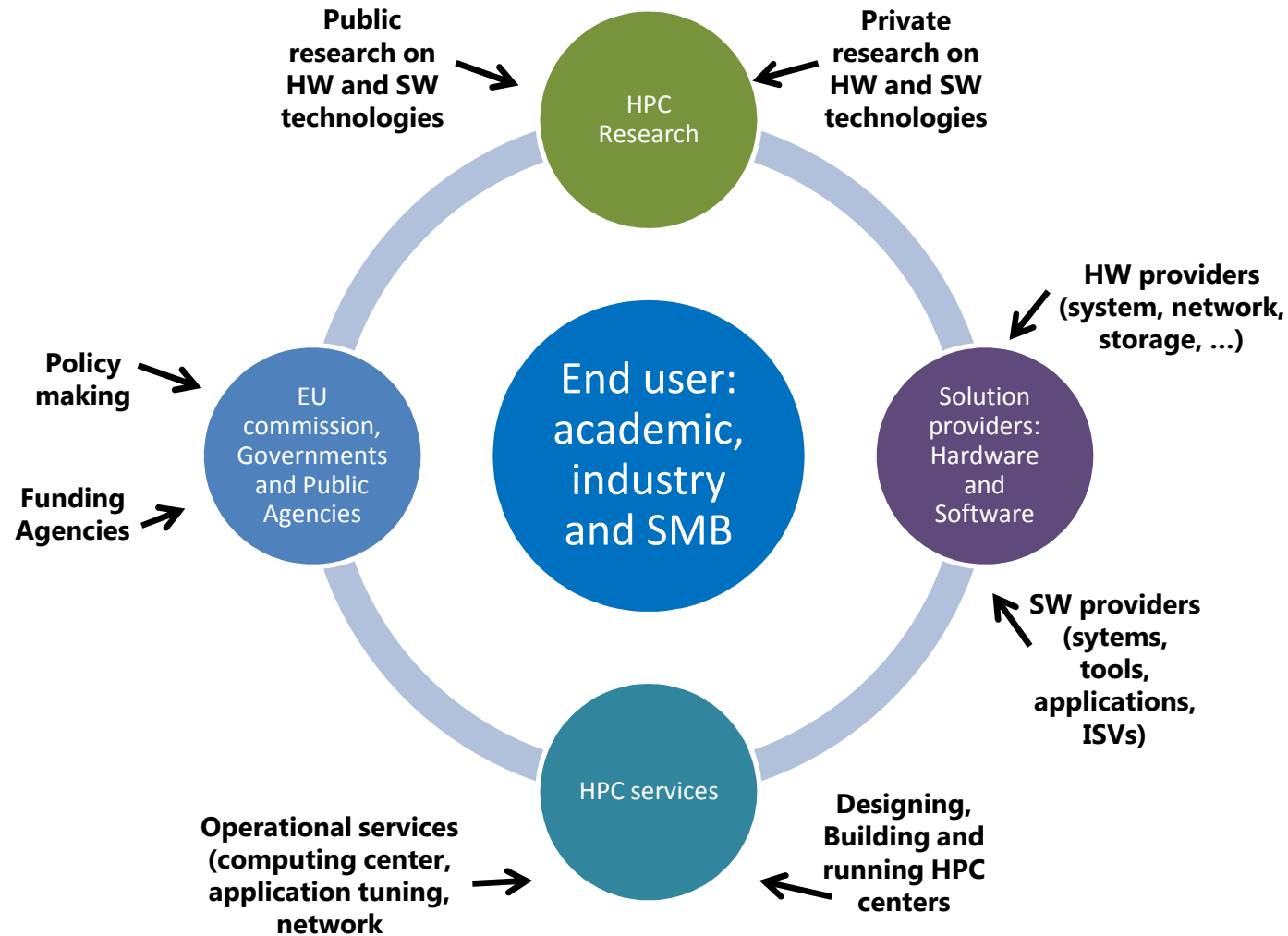*…*

Specific Objectives
1. *Provide a world-class European HPC infrastructure, benefitting a broad range of   academic and industry users, and especially SMEs,*
2. *Ensure independent access to HPC technologies, systems and services for the EU;*
3. *Ensure the EU's position as a global actor.*
…

PRACE answers to the first objective, ETP4HPC will focus on the second
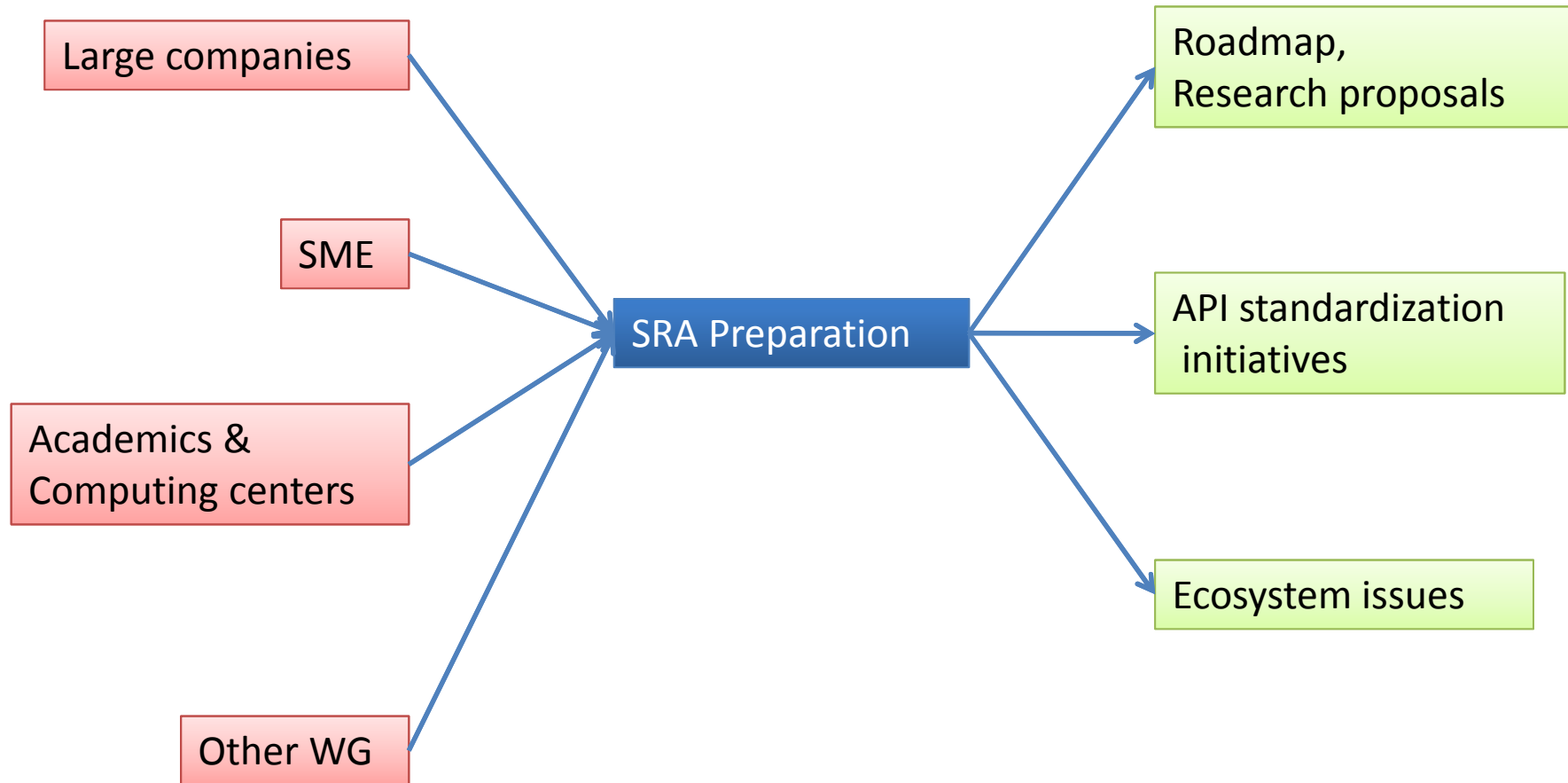**Both will participate together to the third one**

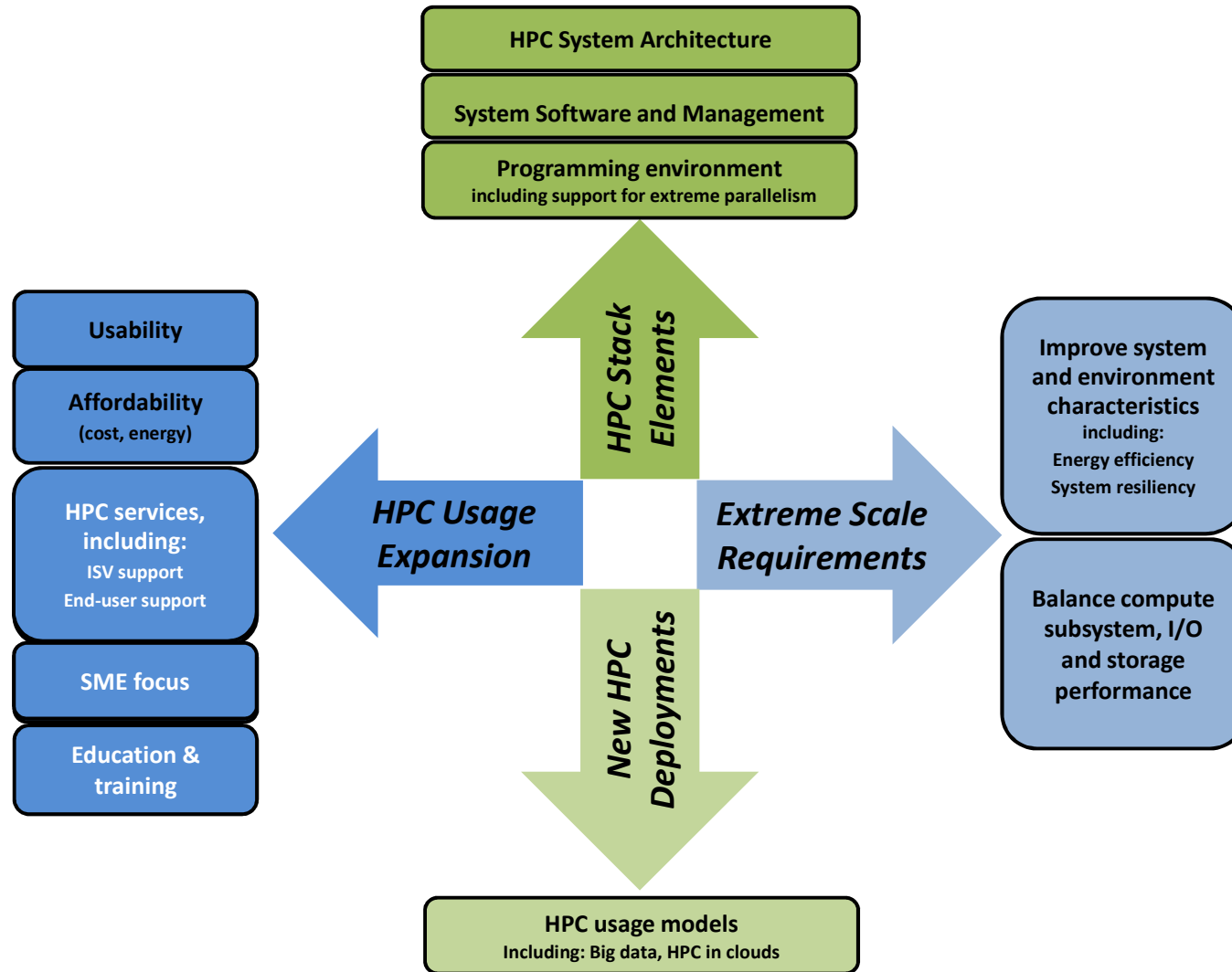ETP 4 HPC

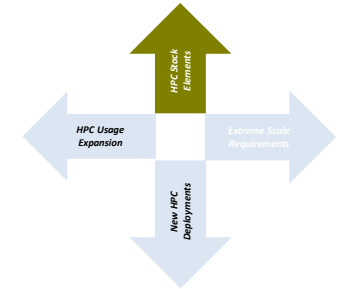# A dynamic European eco-system for improved competitiveness

Public research on HW and SW technologies

Private research on HW and SW technologies

HPC Research

HW providers (system, network, storage, ...)

Policy making

EU commission, Governments and Public Agencies

End user: academic, industry and SMB

Solution providers: Hardware and Software

Funding Agencies

SW providers (sytems, tools, applications, ISVs)

HPC services

Operational services (computing center, application tuning, network

Designing, Building and running HPC centers

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11   Jean

SRA Construction

Large companies

SME

Academics & Computing centers

Other WG

→ SRA Preparation →

Roadmap, Research proposals

API standardization initiatives

Ecosystem issues

François

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A multi-dimensional HPC vision

HPC System Architecture

System Software and Management

Programming environment
including support for extreme parallelism

HPC Stack Elements

Usability

Affordability
(cost, energy)

HPC services, including:
ISV support
End-user support

SME focus

Education & training

HPC Usage Expansion

Extreme Scale Requirements

Improve system and environment characteristics
including:
Energy efficiency
System resiliency

Balance compute subsystem, I/O and storage performance

New HPC Deployments

HPC usage models
Including: Big data, HPC in clouds

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Roadmap, Research proposals

- Example from Programming Environment and Extreme Parallelism WG (stack element)
  - Lead BSC, CAPS, Fraunhofer

- Main R&D Topics
  - Parallel Programming APIs and Languages
  - Runtime supports/systems
  - Debugging and correctness
  - Performance Tools
  - Cross Cutting Issues

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API Standardization Initiatives
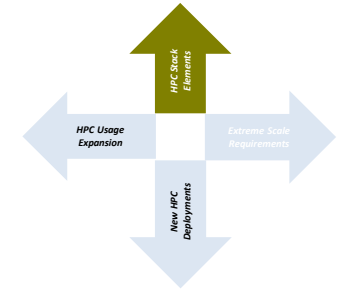
- **Integrate Exascale and Future HPC issues in standardized API**
  - Extend existing ones
  - Ensure tools operability
  - Provide visibility to application and system developers
  - Ensure consistency between APIs

- **Examples of API Topics**
  - Parallel Programming / Runtime APIs
  - Resources related APIs
  - Energy related APIs
  - Resiliency related APIs
  - Performance Tuning APIs
  - I/O related APIs
  - Debugging related APIs

Extreme scale requirements for exascale
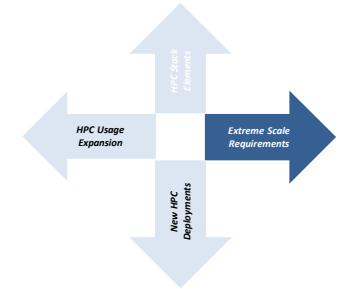
- Cross-cutting or holistic issues: <u>energy efficiency, system resiliency</u> and the overall balance of the system design

- Improving System Characteristics (Energy Efficiency and System Resiliency)
    - Already key concerns as of today
    - Energy and resiliency can be interdependent
    - Trade-offs cost/performance (cost of having/not having…)

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SuperMUC
#1 Europe, # 4 world
June 2012 Top 500#39
0.158 €/Kwh and increasing…

Energy Efficient HPC

- Reduce the power losses in the power supply chain
- Exploit your possibilities for using compressor-less cooling und use energy-efficient cooling technologies (e.g. direct liquid cooling)
- Re-use waste heat of IT systems

- Use newest semiconductor technology
- Use of energy saving processor and memory technologies
- Consider using special hardware or accelerator tailored for solving specific scientific problems or numerical algorithms

- Monitor the energy consumption of the compute systems and the cooling infrastructure
- Use energy aware system software to exploit the energy saving features of your target platform
- Monitor and optimize the performance of your scientific applications

- Use most efficient algorithms
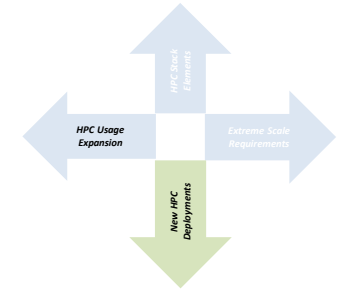- Use best libraries
- Use most efficient programming paradigm

Energy efficient infrastructure

Energy efficient hardware

Energy aware software environment

Energy efficient applications

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18

New HPC deployments
HPC Usage Models
(including Big Data and HPC in the Cloud)

- New/emerging HPC usage will impact the full HPC stack - tools, programming models, algorithms, user interfaces and hardware
  Ranging from HPC resources as (dedicated) instruments for big science or large scale data analysis, to HPC in the cloud, commoditisation of HPC for non HPC experts and embedded and real-time systems demanding denser HPC delivery

- Make HPC more user-friendly (from machine to user centric)
  Integrate data+compute (inc. security; privacy)

- An exascale computer cannot be efficient without strong investment in administration and user support

- The openness of cloud platforms could be the opportunity to share HPC expertise and facilitate the fast adoption of HPC by a company new to high end computing

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Guy

HPC Usage expansion
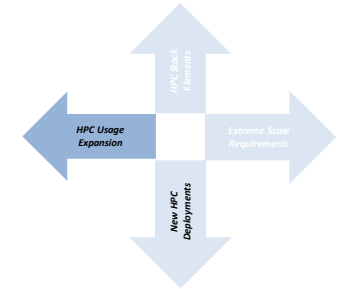
- A panel of European industrial end-users confirmed that HPC needs to become much <u>more pervasive across the entire industry</u>, including Small and Medium Enterprises (<u>SMEs</u>)
  - Other trade-offs than for extreme scale to achieve good affordability and usability, while benefiting from research at extreme scales, like energy-efficiency and ease of programming.

- Importance of HPC services as the link between vendors, ISVs and end users
  - Industry wants to focus on their core business – needs support for migration, optimisation for new platforms

- Education and training
  - Better skills needed in technology and engineering + entrepreneurship for industry
  - Better skills needed for usage and applications

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Sergi

HPC Usage expansion
Example of CINECA for Industry
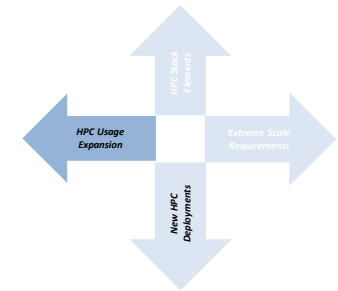
Industrial Area
Chemistry
Life Science
Engineering
Geophysics
Meteorology
Cultural Heritage

Main Activities
Molecular Dynamics
Material Science Simulations
Geophysics Simulations
Fluid dynamics Simulations
Applications Developments
Engineering Applications
Code Parallelization
Code Optimizations
Graphics interfaces

A multi-dimensional HPC vision

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Links

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PRACE: a European Research Infrastructure (RI) & ESFRI list-item

1st Council
June 9, 2010

ESFRI

❑ **PRACE RI is in operation since April 2010**
- PRACE AISBL created with 20 countries, head office in Brussels
- Now 25 member countries

❑ **PRACE RI is providing services since august 2010**
- Now 6 Tier0 systems available
- 4.3 billions core hours awarded to 159 projects through a **single** pan-European **peer review process**

❑ **Funding secured for 2010-2015**
- 400 Million€ from France, Germany, Spain and Italy, provided as Tier0 services on TCO basis
- 130 Million€ additional funding = 70 Million€ from EC FP7 preparatory and implementation projects + 60 Million€ from PRACE members
  - ➢ Technical, organizational and legal support for PRACE
    - Prepared the creation of the AISBL as a legal entity
    - Provided extensive HPC Training
    - Deployed and evaluated promising architectures
    - Ported and petascaled applications
    - Services to industrial users

PRACE-3IP kick-off in Paris

2012: PRACE is providing nearly 15 Pflop/s...

Mare Nostrum: IBM at BSC

JUQUEEN: IBM BlueGene/Q at GCS partner FZJ (Forschungszentrum Jülich)

FERMI: IBM BlueGene/Q at CINECA

CURIE: Bull Bullx at GENCI partner CEA.

SuperMUC: IBM at GCS partner LRZ (Leibniz-Rechenzentrum)

HERMIT: Cray at GCS partner HLRS (High Performance Computing Center Stuttgart).

Collaboration between PRACE and ETP4HPC
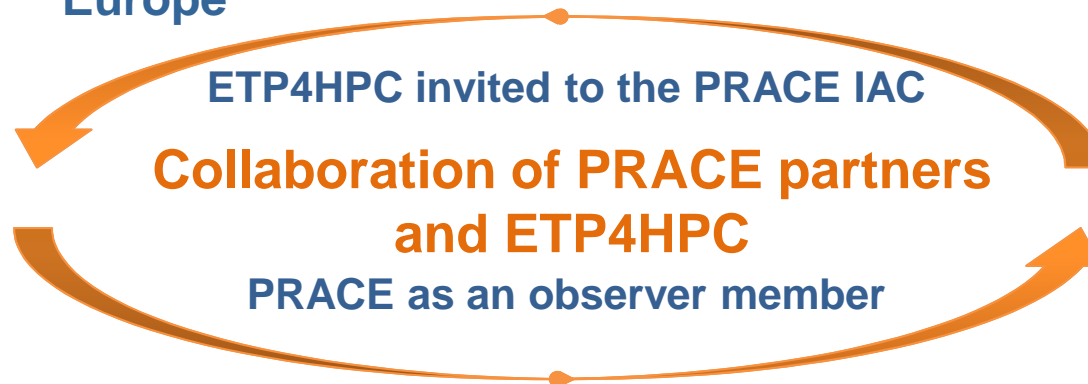
Strategic Roadmap for needs of

- Scientific and industrial applications
- Academic and industrial services
- Training and application enabling for future architectures

↳ **Setting up HPC Infrastructure in Europe**

Strategic Research Agenda (SRA) for

- Creating a common European vision
- Bringing innovation through development of HPC technologies

↳ **Interest of industry regarding EU HPC infrastructure**

ETP4HPC invited to the PRACE IAC

Collaboration of PRACE partners and ETP4HPC

PRACE as an observer member

End-User Involvement

- Co-Design
  - Development of Exascale HPC systems will require a virtuous circle of hardware and application design and development to provide energy-efficient solutions
  - Involvement of academic user communities/application developers and ISVs is mandatory to achieve this
- State of Play
  - Current ETP4HPC members are mainly vendors, technology providers, and HPC centres
  - HPC centres have long-standing close links to their user communities
  - These links can be leveraged in joint actions of vendors/technology providers and HPC-centers

Examples of Joint Actions

- Exascale Innovation Centre (EIC)
  - Partners: FZ Juelich, IBM
  - Analysis of application-level power consumption and tools for fine-grained power measurements
  - Exascale I/O and application optimization for BlueGene/Q
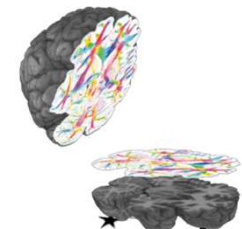- ExaCluster Lab (ECL)
  - Partners: FZ Juelich, Intel, Partec
  - System management for large scale systems
  - Development of a MIC-based booster
- NVIDIA Application Lab
  - Partners: FZ Juelich, NVIDIA
  - Application requirement analysis and GPU parallelization
  - Tools support
- All Labs rely on users and applications of FZ Jülich

Thomas

Intel

- A global player with strong presence
  in Europe: Fab, R&D, Education, Sales, Ecosystem
  enabling

- In HPC: world class R&D, 4 joint Exascale labs
  (Belgium, France, Germany, Spain), 1 open Lab with CERN (Switzerland),
  participation in EU research projects (DEEP)

- Founding member of the ETP4HPC

- A strong interest for HPC and Exascale, with a clear focus
  to bring exascale solutions before end of decade

- Exascale challenges are incredibly difficult both from a
  hardware and a software perspective. They need to be
   addressed through international efforts and collaboration

Marc

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Intel

- The HPC challenges to reach exascale and beyond are technology challenges. They are universal.
  ETP4HPC can provide pieces of the puzzle, based on European world class expertise to meet these challenges.

  To successfully solve the puzzle, the ETP4HPC is seeking extensive collaboration and synchronization with similar groups worldwide.

- The ETP4HPC is interested to support initiatives created by Public Agencies around the globe to foster HPC R&D cooperation

Marc

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SME Perspective

allinea

Leaders in parallel software development tools

- Who is Allinea

  - A HPC SME

  - Tools heavily used by developers outside EU

  - Why ETP for us?

    - A voice to small organizations (not just Allinea)
    - Allows innovative companies to be heard at a very 'noisy' time

- What have SMEs accomplished?

  - Recently: International success stories for SMEs

    - Helping ORNL Titan be #1
    - CAPS, Allinea, and university spinouts - TU-Dresden VAMPIR

David

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Why SMEs in international collaboration?

- Europe is not enough by itself

  - Need technology to be globally accepted

  - ETP4HPC SRA sets out some of the priorities

    - Fundamentally not Europe-centric problems

    - Problems reach all areas: consensus is needed – hence global standards

- Why SMEs are a part of Exascale

  - SMEs have the ability to innovate

  - SMEs are one part of a chain that is global

  - SMEs have need for customers: hence highly collaborative approach

allinea

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Who is Xyratex and why are we involved?

- A European founded, UK based company, with a global presence
- The worlds Largest OEM provider of Storage Systems
- Major Focus on HPC and Big Data Storage "ClusterStor"
- Significant R&D capabilities and investment across the entire HPC Storage Stack
- Partnered with Cray to deliver the worlds fastest Storage System >1TBs at Bluewaters
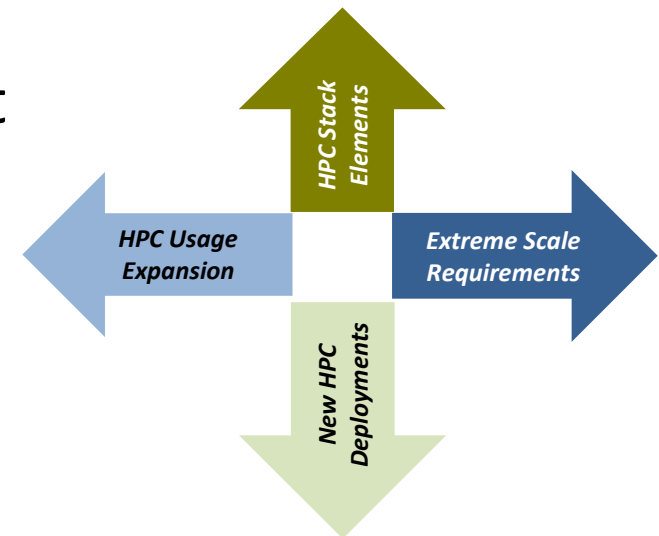

ClusterStor™

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- ETP4HPC provides a Platform for Collaboration that will enhance Europe's competitiveness by:

  - Defining a common research agenda across the community stakeholders; Industry, Academic and the Users

  - Building an HPC Technology Ecosystem in Europe

  - Driving Open Standardization and Harmonization of technological developments with other worldwide organizations

    – eg. EIOW, EOFS, Opensfs

Ken

ETP4HPC wrap-up

- Industry-led forum defining research priorities
- Main objective is to build a European world-class HPC technology value chain that will be globally competitive

- Four dimensions of HPC development
  - HPC stack elements
  - Extreme scale requirements
  - New HPC deployments
  - Expanding HPC usage

- Open organisation looking for cooperation with HPC stakeholders in Europe and worldwide

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Thank you for attending!

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