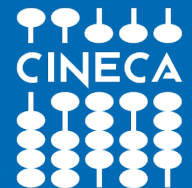
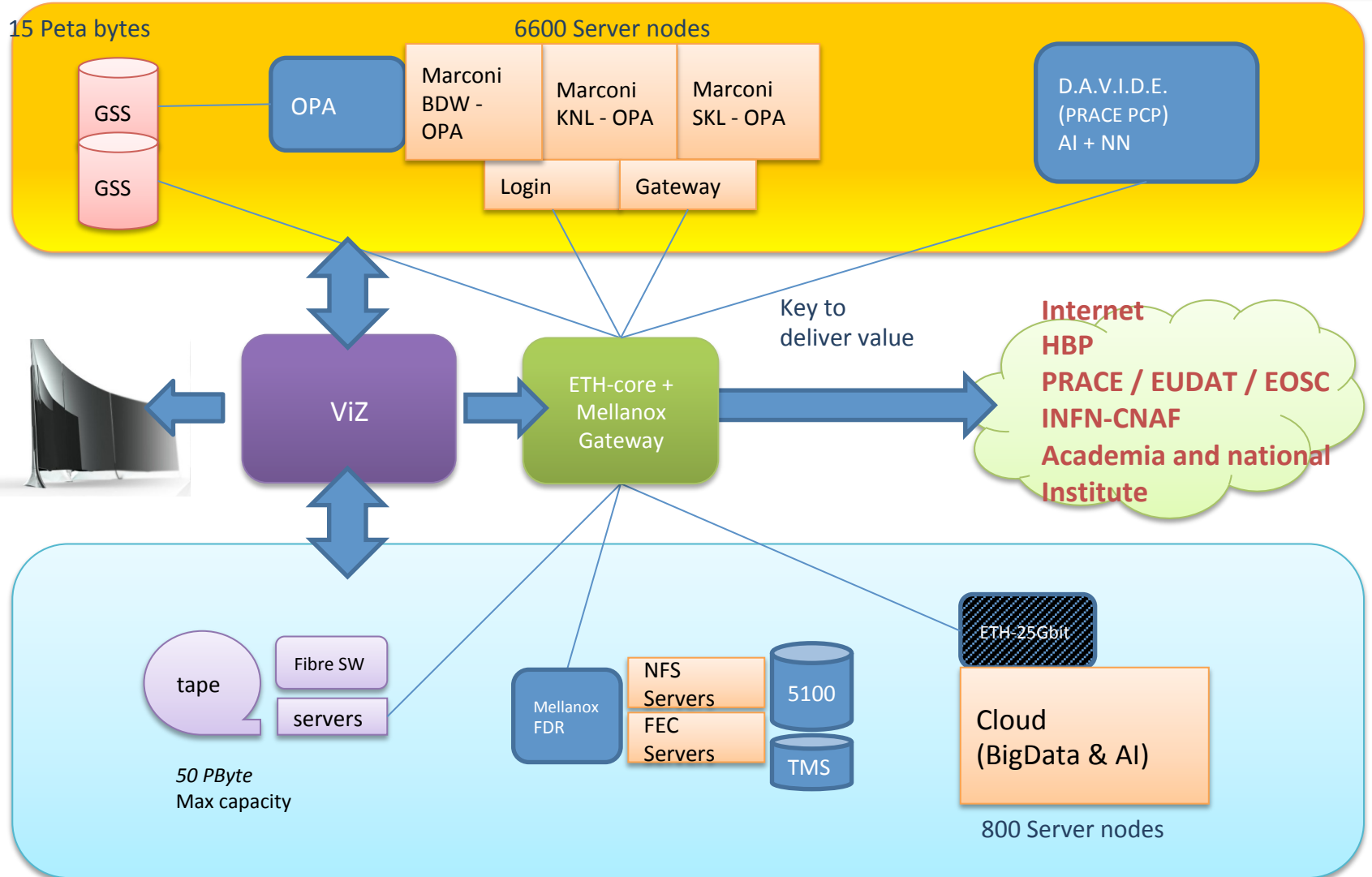

SCAI
SuperComputing Application &
Innovation
CINECA

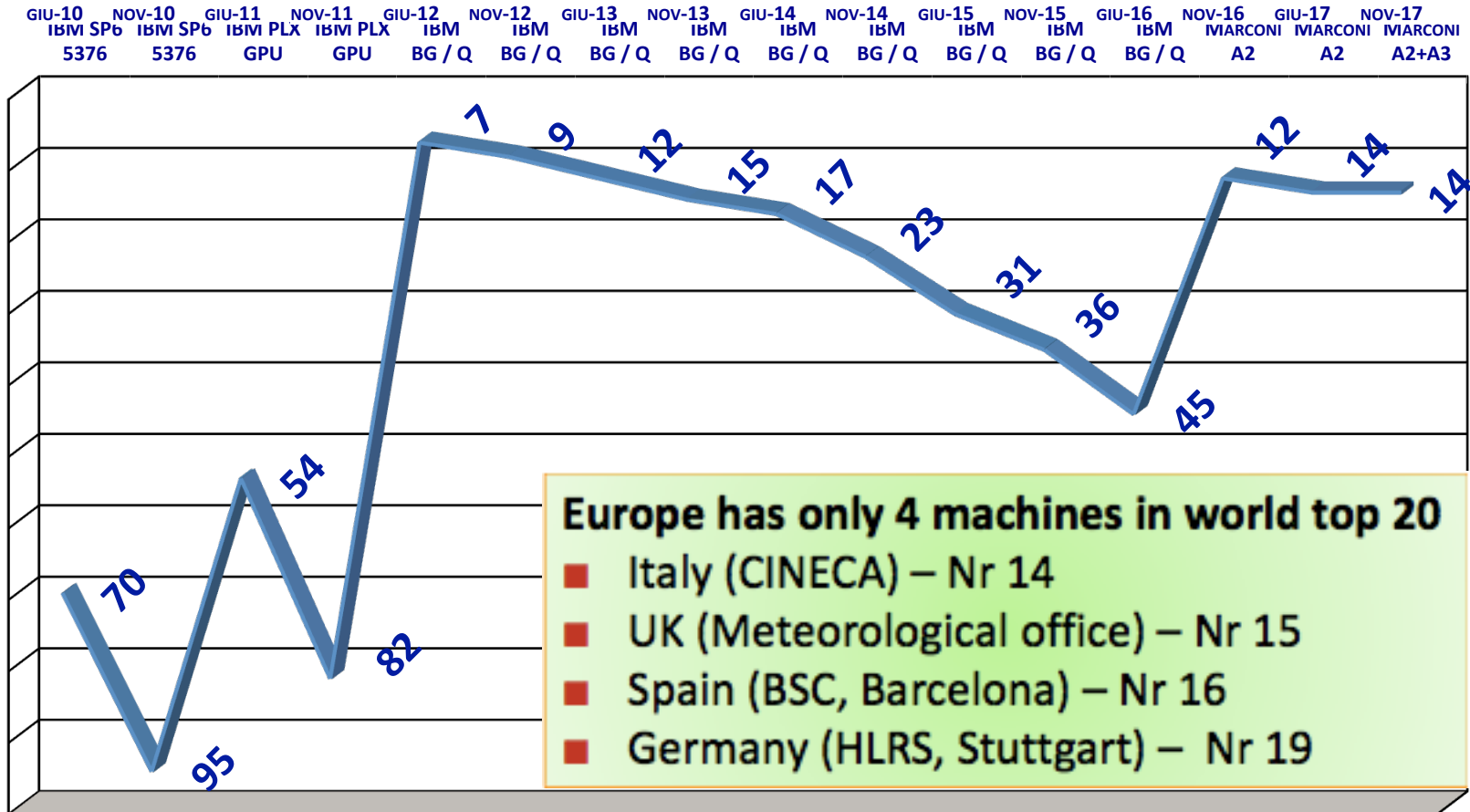
Sanzio Bassini – May 2018



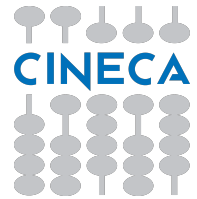
HPC infrastructure design point



Top500 (November 2017)



Marconi configuration



Scale Out

2300 Lenovo Stark servers > 7PFlops
Intel SkyLake
24 cores @ 2.1GHz. 196GByte x node

3600 Intel/ lenovo servers > 11PFlops
Intel PHI code name Knight Landing
68 cores @ 1.4GHz.
single socket node: 96GByte DDR4
+ 16GByte MCDRAM

720 Lenovo NeXtScale servers
Intel E5-2697 v4 Broadwell
18 cores @ 2.3GHz.
128GByte x node

Cloud / Data Proc.

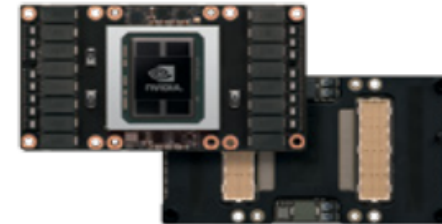
792 Lenovo NeXtScale servers
Intel E5-2697 v4 Broadwell
- 216 nodi eth x cloud HT INFN
- 216 nodi eth x cloud HPC/DP
- 360 nodi QDR x Tier 1 – HPC

100 Lenovo NeXtscale servers
Intel E5-2630 v3 Haswell
QDR + Nvidia K80

Lenovo GSS + SFA12K + IBM Flash
>30PByte

D.A.V.I.D.E.

Logical Name	D.A.V.I.D.E. (August 2017)
Model	E4 Cluster Open Rack
Architecture	OpenPower NVIDIA NVLink
Processor	OpenPower 8 NVIDIA Tesla P100 SXM2
# of core	-
# of node	45 x (2 Power8 + 4 Tesla P100)
# of rack	-
RAM per node	-
Interconnection	Mellanox EDR
Operating System	GNU/Linux
Total Power	-
Peak Performance	~ 1 Pflops



SPECIFICATIONS

GPU Architecture	NVIDIA Pascal
NVIDIA CUDA® Cores	3584
Double-Precision Performance	5.3 TeraFLOPS
Single-Precision Performance	10.6 TeraFLOPS
Half-Precision Performance	21.2 TeraFLOPS
GPU Memory	16 GB CoWoS HBM2
Memory Bandwidth	732 GB/s
Interconnect	NVIDIA NVLink
Max Power Consumption	300 W
ECC	Native support with no capacity or performance overhead
Thermal Solution	Passive
Form Factor	SXM2
Compute APIs	NVIDIA CUDA, DirectCompute, OpenCL™, OpenACC

TeraFLOPS measurements with NVIDIA GPU Boost™ technology



Italian & European HUB

The new data center of intergovernmental organization for medium range weather forecast ECMWF will be located in Bologna big data technopole.



Protezione Civile / SMR Regione Emilia Romagna Operation numerical weather forecast



FENIX: Digital infrastructure federation between CINECA (Italy), Barcelona SuperComputing Centre (BSC) Spain, Commissariat à l'énergie atomique (CEA) France, ETH Zurich's Swiss National Supercomputing Centre (CSCS) Switzerland, Jülich Supercomputing Centre (JSC), Germany.



MaX European Center of Excellence for supports developers and end users of advanced applications in the field of materials, and works at the frontiers of the current and future High Performance Computing (HPC) and big data



CINECA & Eni partnership for development of new applications for seismic analysis and reservoirs simulation and technology watch for emerging domain as AI and Quantum computing. Eni is the second largest Oil & Gas Company in Europe.



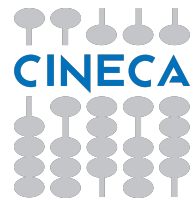
CINECA & UnipolSAI Group partnership for R&D based on big data analytics and AI in the domains of risk management, asset liability, fraud. UnipolSAI Group is the third largest insurance company in Europe.



Drug design and open lab between CINECA, Alfawasserman, Dompè Pharmaceutical, Chiesi pharmaceutical.



European funded R&D



HPC infrastructure

Digital infrastructure



PPIHBP



EUROfusion



EOSC-hub

Center of Excellence Material Science



Fabric of the future Industry 4.0



FORTISSIMO

ICARUS

Project ID: 780792



Environment



Multimedia / Cultural Heritage



Energy efficiency



Life Science



Human Brain Project



Low Power Microprocessor

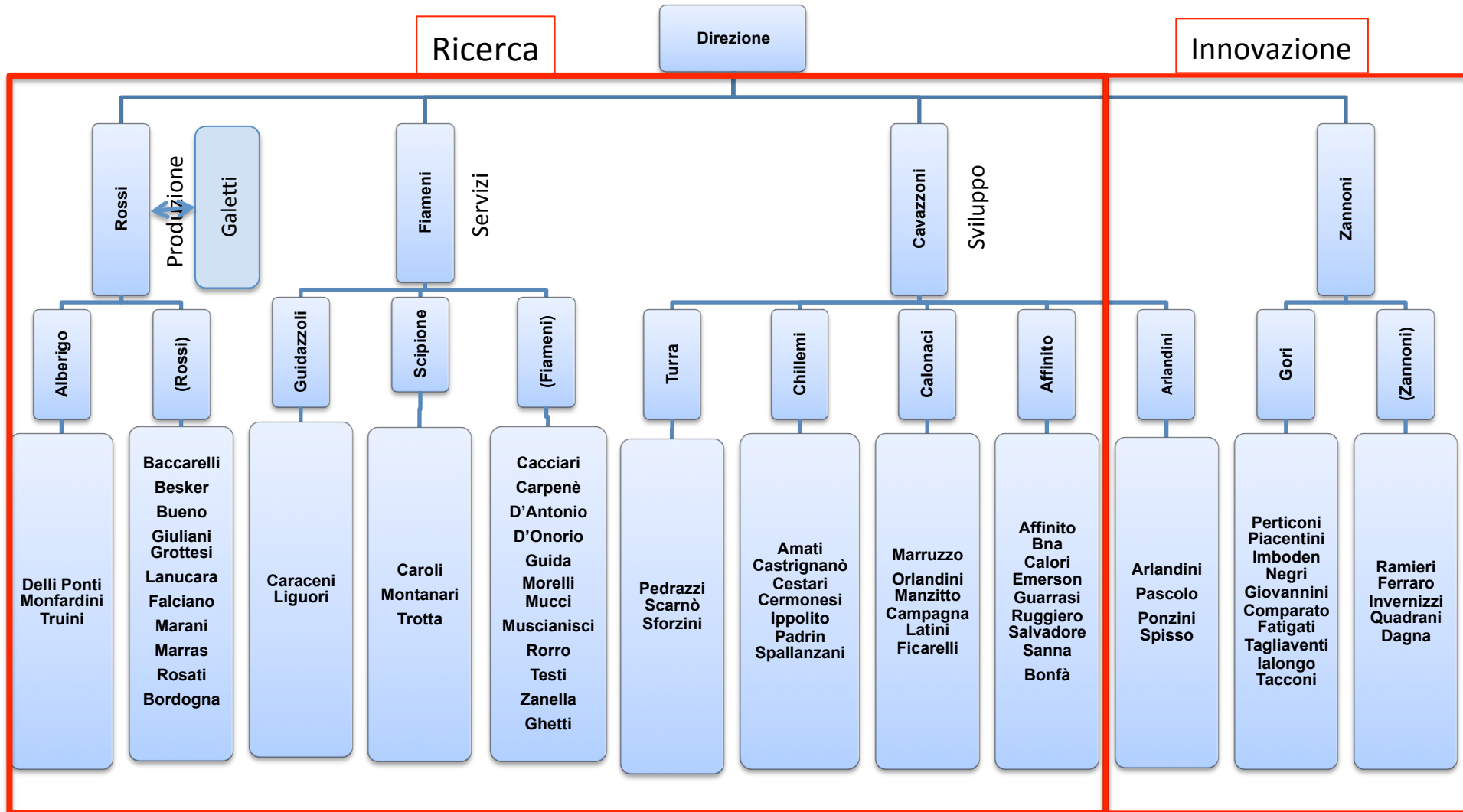
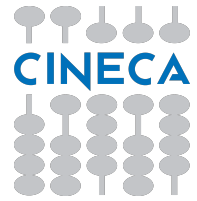


New

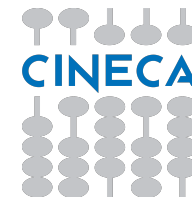
AIDA EPEEC



Assetto gerarchico



Assetto funzionale



		Direzione										
Ambito		Calcolo Istituzionale / supporto alla ricerca (Ambito prevalente)					Progetti Finanziati (Ambito prevalente)				Eni / Innovazione	
Attività	Sviluppo	Cavazzoni	Chillemi	User support di secondo livello	Turra	Big data Analytics	Affinito	Progetti EU di HPC	Arlandini	Calcolo tecnico, SME	Calonaci	SW di produzione Eni
	Servizi	Fiameni	MW e Data Management, Architettura Data storage, Open Science Cloud				Scipione	Metadati / Annotation	Guidazzoli	Visit		
	Produzione	Rossi Galetti	Definizione ambiente di calcolo e monitoraggio / User supprt di primo livello / Gestione sistemi / gestione / gestione cloud				Alberigo	Gestione call ISCRA e PRACE e cost statement progetti UE / Gestione Contratti				

Attività trasversali

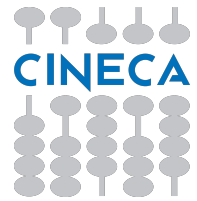
- Presidio board internazionali:
 - PRACE. BoD: Debora Testi, Council: Gabriella Scipione.
 - ETP4HPC: Carlo Cavazzoni. BDVA: Roberta Turra, EUDAT: Giuseppe Fiameni, CECAM: Fabio Affinito
 - Partecipazione al board di SIMAI: Alessandro Marani

- Open LABS/HPC thematic hubs:
 - Energy Efficiency, Unibo (Luca Benini): Carlo Cavazzoni
 - Big Data / AI, Unimore (Sonia Bergamaschi, Rita Cucchiara): Giuseppe Fiameni
 - Material Science, MaX/Sissa/CNR/QEF (Elisa Molinari, Stefano Baroni): Pietro Bonfà
 - Bioinformatica, Elixir/CNR (Graziano Pesole): Giovanni Chillemi, Tiziana Castrignanò
 - CECAM UNIBO – Cineca (Andrea Cavalli): Fabio Affinito
 - FENIX: CINECA, CSCS, JUELICH: Giuseppe Fiameni
 - LENS e HBP Italia, (Francesco Pavone): Roberto Mucci

- Collaborazioni
 - Intel IPCC: Fabio Affinito
 - Open Power Foundation: Carlo Cavazzoni

- Benchmarking / Validation: Giorgio Amati
- Review tecnica progetti PRACE, ISCRA, LISA: Massimiliano Guarrasi
- Scuole / Corsi: Elda Rossi

Access and development model



- **Open access peer review:** PRACE, ISCRA, LISA
- **European flagship and RI:** Hpc-EUROPA, Human Brain Project, EPOS, Elixir
- **Partnership:** INFN, OGS, IIT, SISSA, INAF, ICTP, Polimi, Bicocca, MI Statale, Unibo,...
- **Quality of service:** EUROfusion, ARPA-SMR / Civic protection
- **Innovation for Industries and SME**
 - Open innovation: Fortissimo, PRACE SHAPE, Lisa for innovation
 - Framework agreement: Eni, Unipol
- **Special Project:** *Quantum Computing – Access to D-Wave Qbits system*

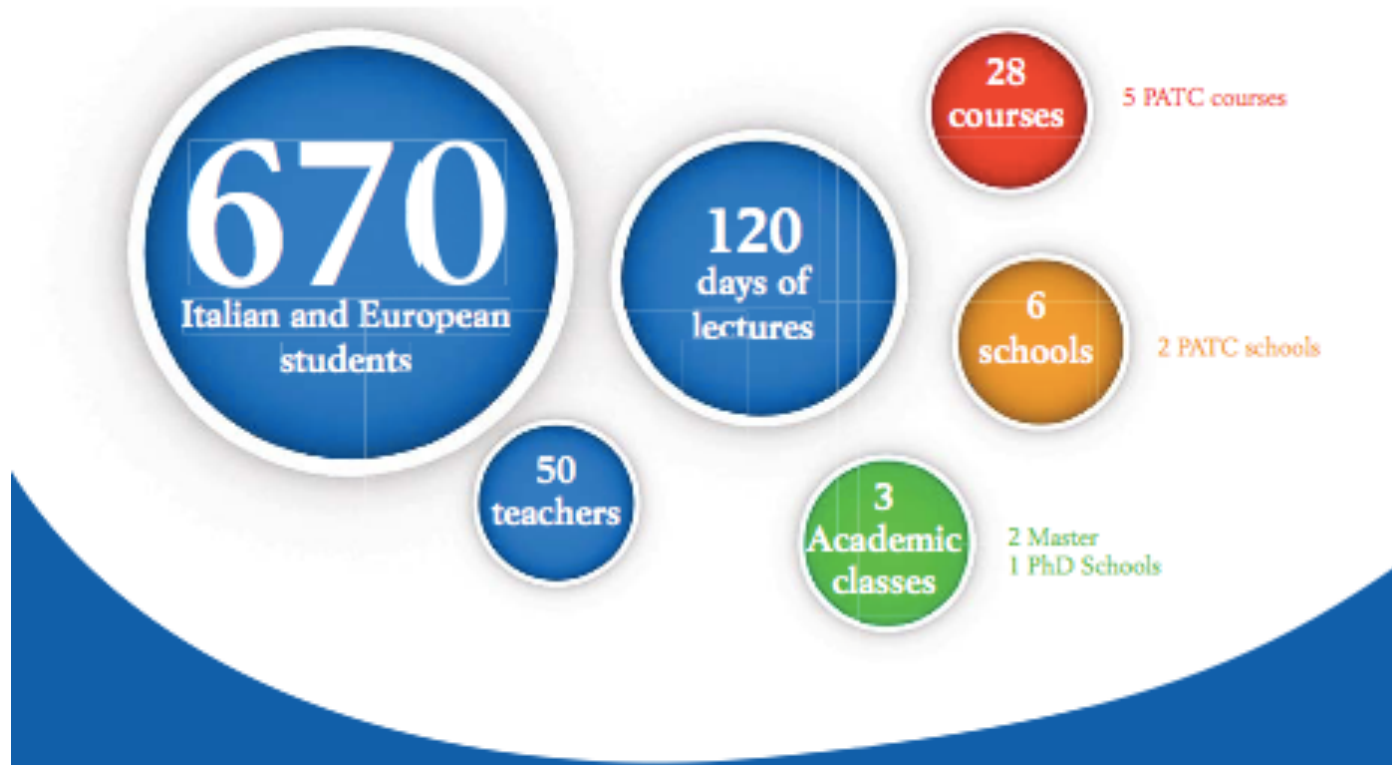
Assegnazione delle risorse di supercalcolo ISCRA

7 Membri

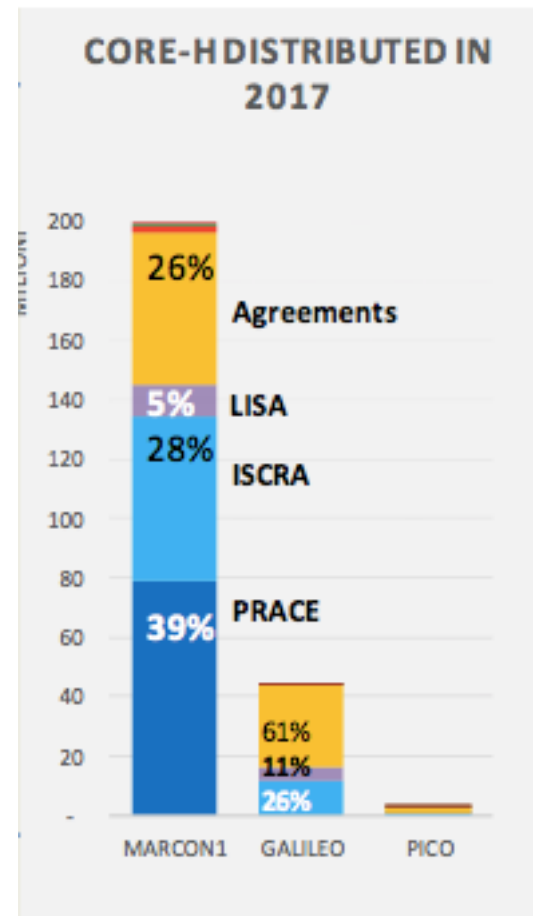
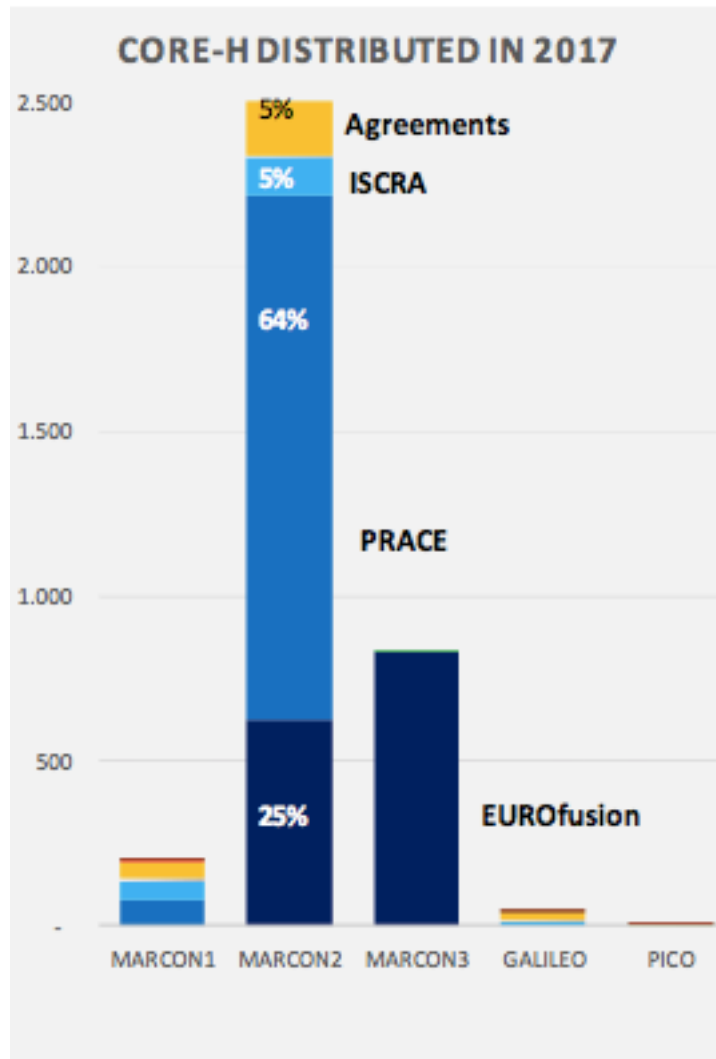
Per discipline

- Scienze della materia
 - 1) Mauro Ferrario Università di Modena
 - 2) Claudio Zannoni Università di Bologna
- Scienze della terra
 - 3) Antonello Provenzale CNR Istituto di Geoscienze e Georisorse - Torino
- Scienze della vita
 - 4) Paolo Ruggerone Università di Cagliari
- Fisica delle alte energie
 - 5) Raffaele Tripiccione Università di Ferrara
- Scienze dell'Universo
 - 6) Giovanni Peres Università di Palermo
- Ingegneria e fluidodinamica
 - 7) Alfredo Soldati Università di Udine

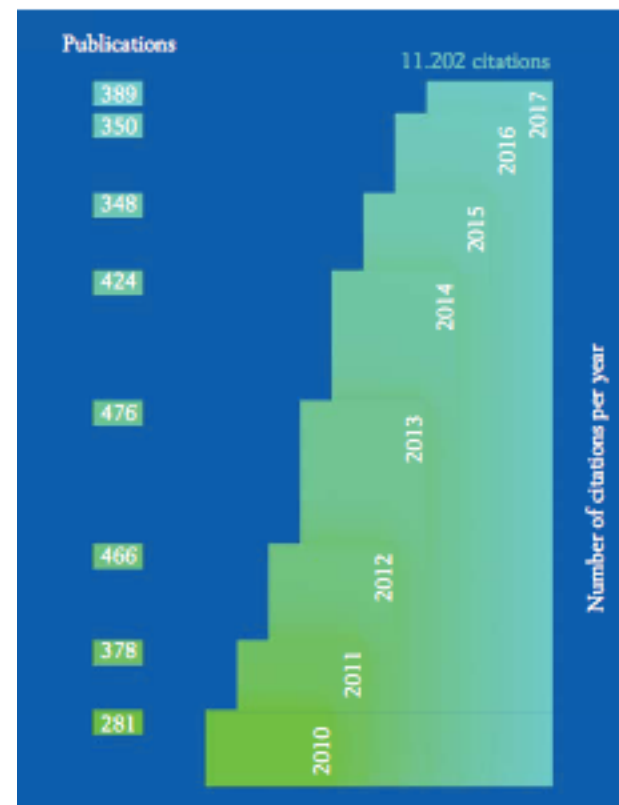
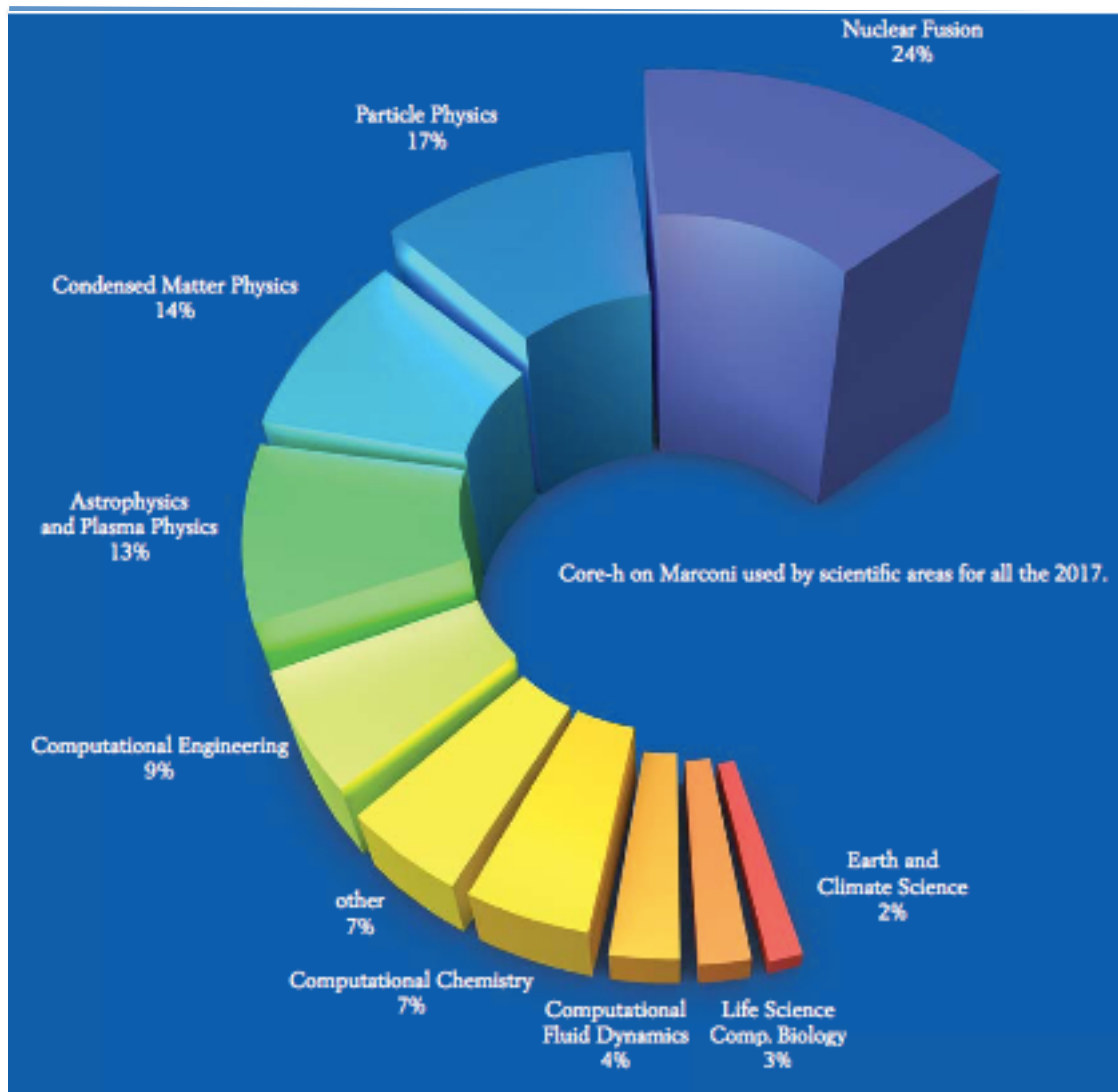
Training (2017)



Production



Usage by domain

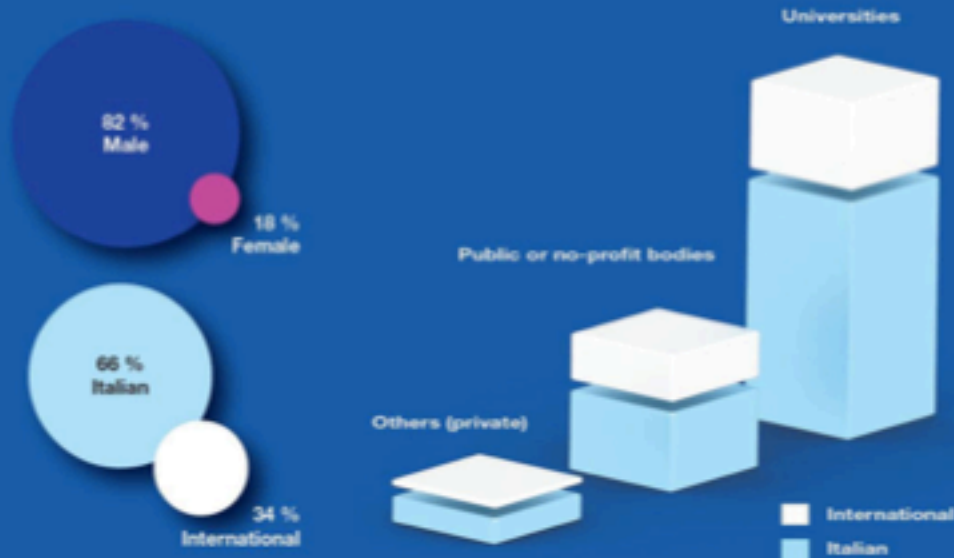


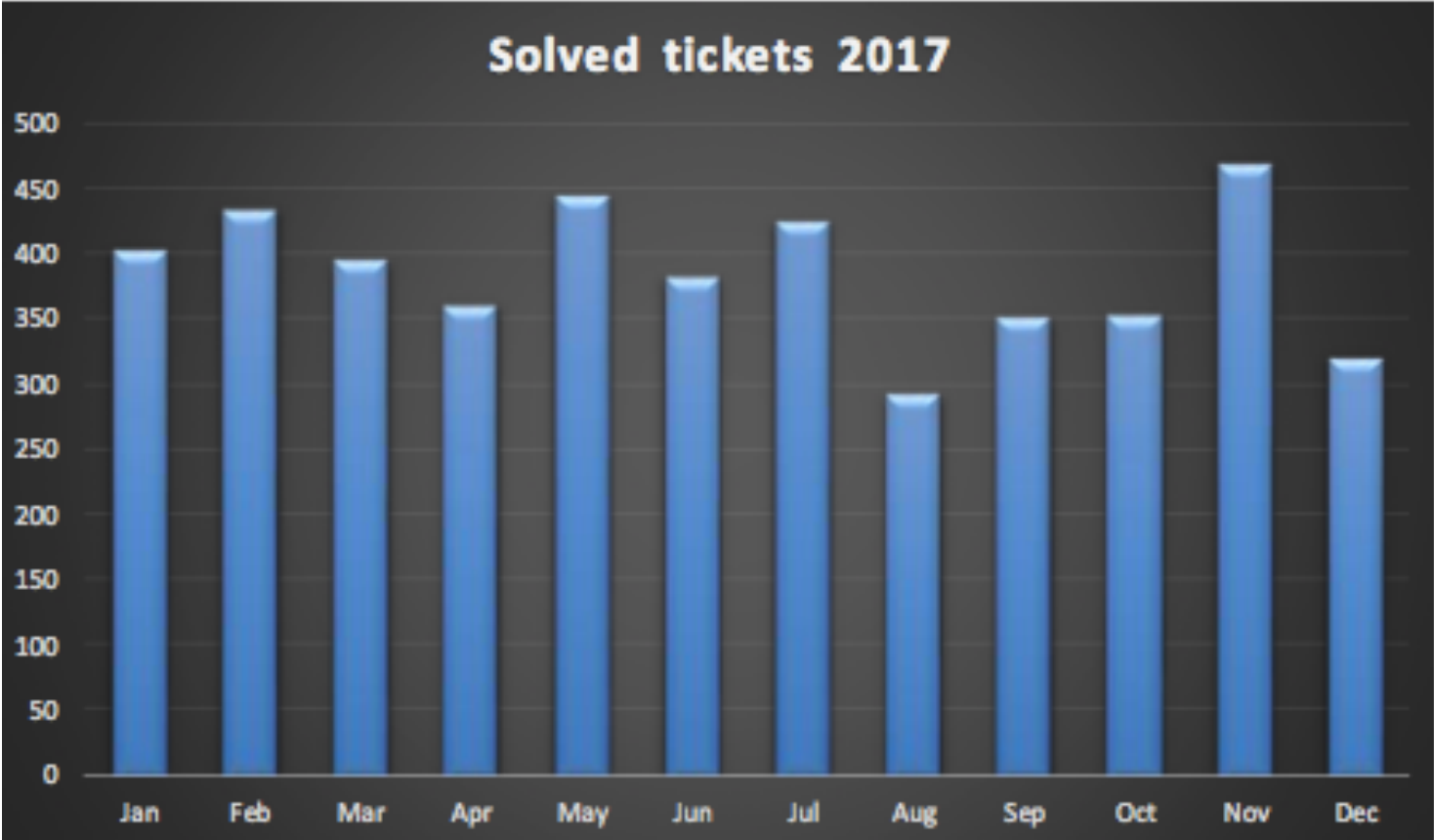
Users distribution

HPC users

At the end of 2017: 3.500 (1.200 new)

Among most represented foreign countries:
Germany, France, Spain, UK





Accordo Quadro 2012

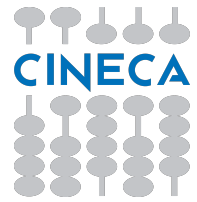
- 100 Milioni di core h di Fermi
- Accordo Attuativo: Cofinanziamento di Galileo 500K Euro corrispondenti a circa 10 milioni di core-h / anno

Accordo Quadro 2015

- 1° Accordo attuativo: 6% delle risorse Tier-0, ha validità da inizio 2015 a fine 2018; 18M core-h su A1; 120M core-h su A2
- 2° Accordo attuativo: Cofinanziamento A3+A1, ha validità da inizio 2018 a fine 2020; Contributo: 1.5 M euro - Nodi skl: 420; Contributo: 500K Euro - Nodi bdw: 216

	MARCONI 1	MARCONI 2	MARCONI 3	GALILEO	FERMI
2014					132.500.000
2015				13.000.000	225.000.000
2016	6.500.000			15.000.000	50.000.000
2017	18.000.000	120.000.000		15.000.000	
2018	9.000.000	120.000.000	164.000.000		

EuroHPC declaration



Declaration signed in Rome 23/03/2017 by:



France

Germany

Italy

Luxembourg

Netherlands

Portugal

Spain

8 more countries signed the Declaration:

Belgium

Slovenia

Bulgaria

Switzerland

Greece

Croatia

Czech
Republic

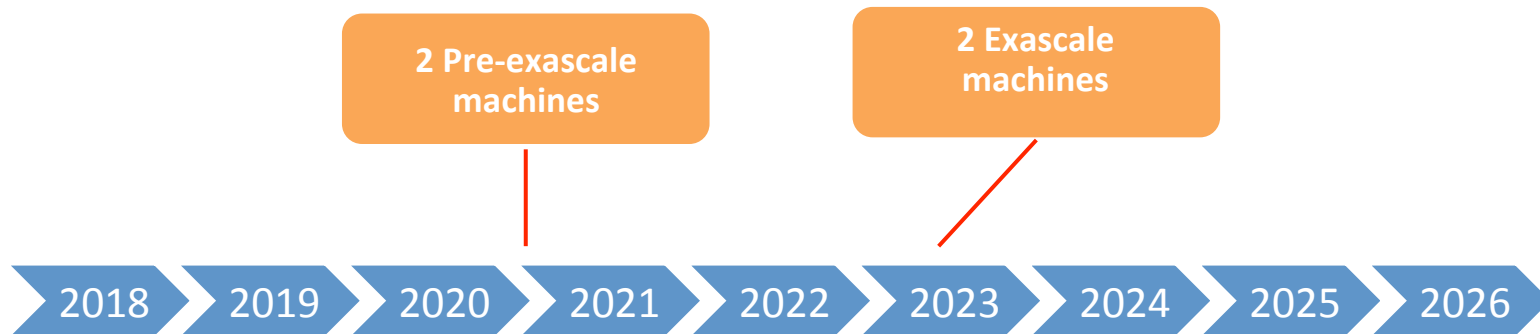
Cyprus

EuroHPC Mission and objectives

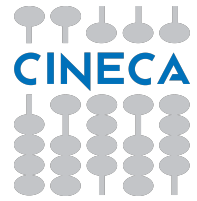
- to provide scientists, industry and the public sector from the Union with **latest HPC and Data Infrastructure** and support the development of its technologies and its applications across a wide range of fields.
- to provide a framework for **acquisition of an integrated world-class pre-exascale supercomputing** and data infrastructure in the Union;
- to provide Union level **coordination** and adequate **financial resources** to support the development and acquisition of such infrastructure, which will be accessible to users from the public and private sector primarily for research and innovation purposes;

Present EU Financial Framework

Next EU Financial Framework



EuroHPC Mission and objectives



2 Pre-exascale

Joint Undertakings



HPC ecosystem

**Infrastructure Acquisition
Operating machines**

**Research & Innovation
Applications & Skills**

■ Pillar 1:

- Acquisition of infrastructure:
 - ➔ 2 pre-exascale machines
 - ➔ \geq 2 peta-scale machines
- Installation, deployment and operation via hosting entities + access to users

■ Pillar 2:

- European exascale technologies and systems (incl. low power processor)
- Excellence in HPC applications; CoE; competence centres for industry (incl. SME); Training and Outreach

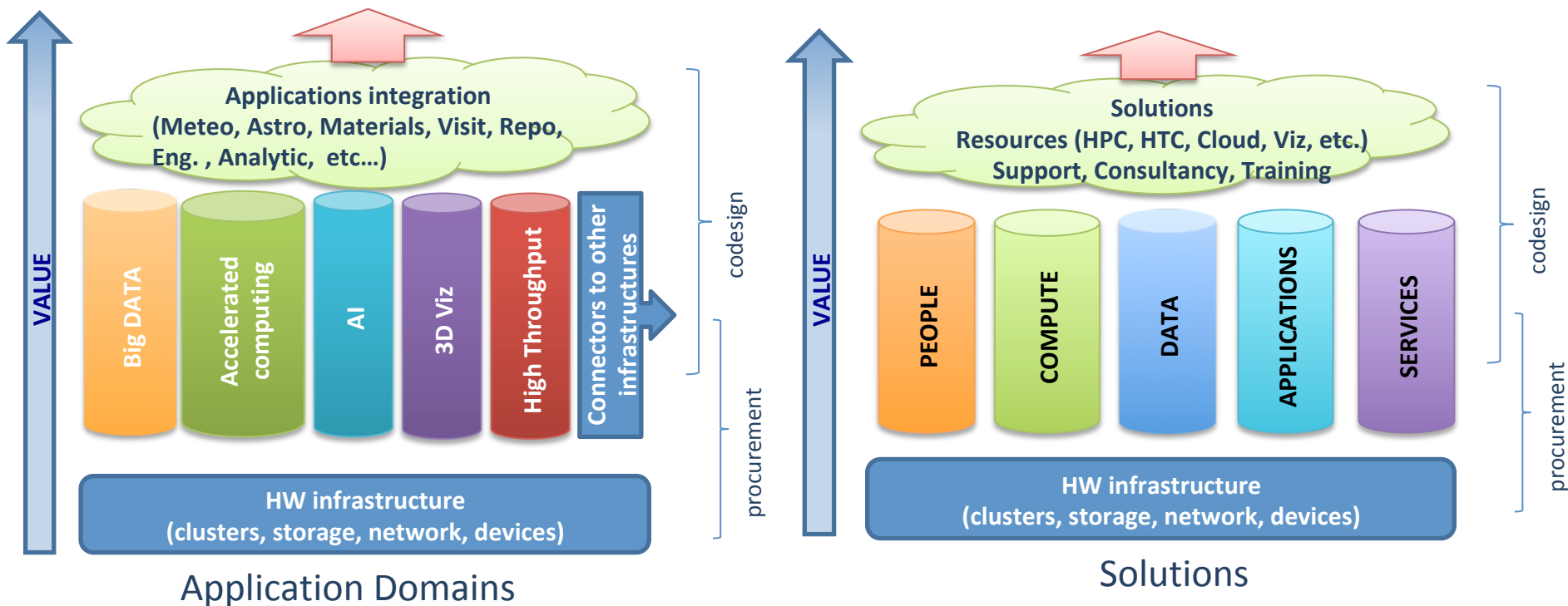
Activites and Funding

		EC	PS	Total (M€)	Private Mem.
Infrastructure Acquisition Operating machines	Pillar 1	270	290	560	
Research & Innovation Applications & Skills	Pillar 2	206	186	392	422
JU Admin/Running costs		10	10	20	



HPC and Verticals

Value delivered to users



Towards Exascale



Peak Performance

10^{18} Flops

Moore law

FPU Performance

10^9 Flops

Dennard law



Number
of FPUs

10^9

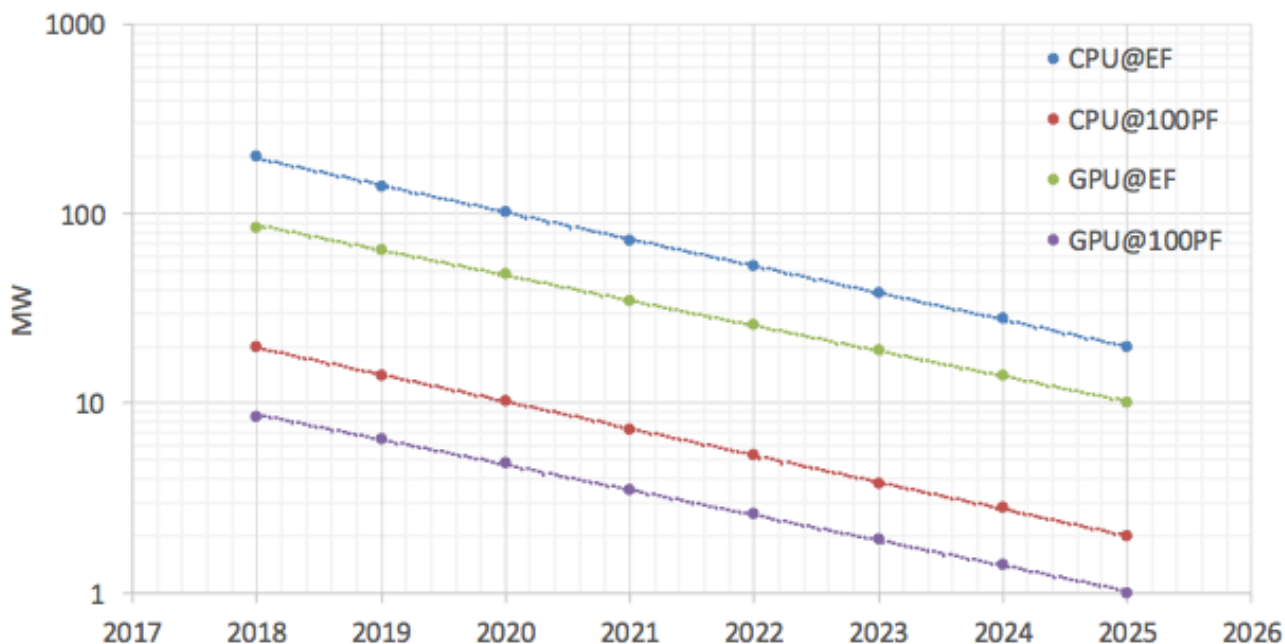
10^5 FPUs in 10^4 servers

10^4 FPUs in 10^5 servers

Working hypothesis

Cavazzoni

Energy constrains



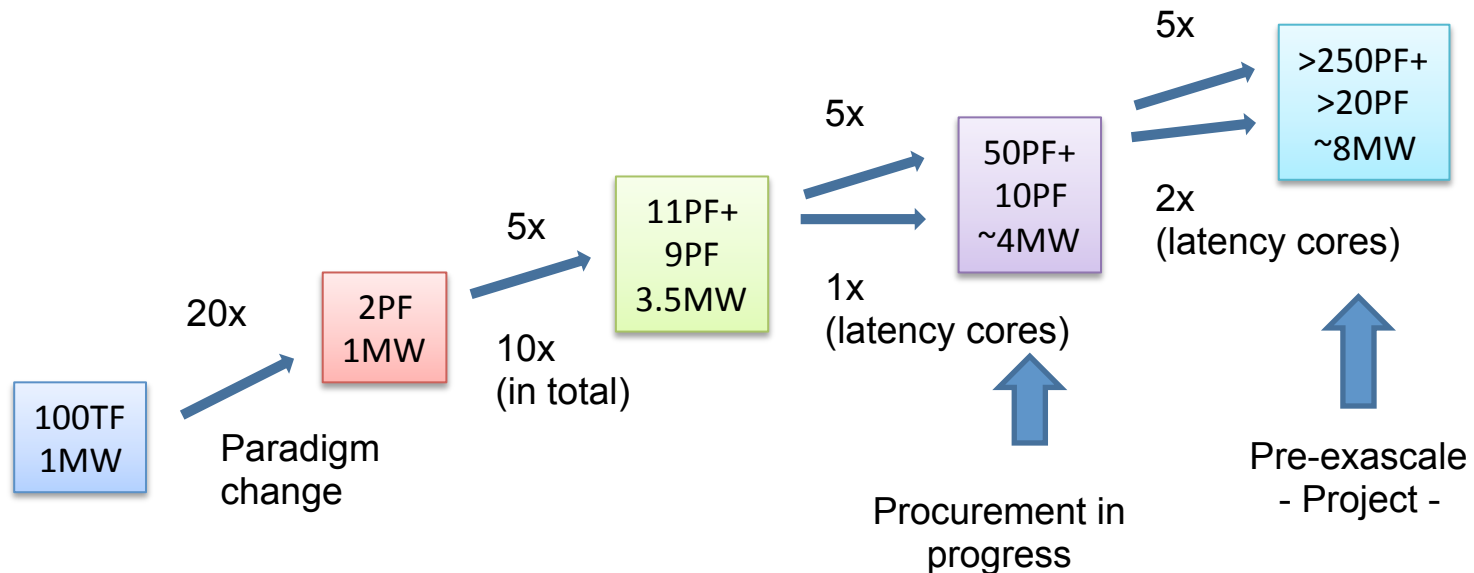
Peek Perf (DP) @ 10MW

	2018	2019	2020	2021	2022	2023	2024	2025	2026
CPU	50PF	70PF	100PF	140PF	200PF	250PF	330PF	500PF	750PF
GPU	125PF	166PF	200PF	300PF	385PF	525PF	715PF	1EF	1.3EF

Cavazzoni



Cineca Roadmap



2009	2012	2016	2019	2021/2022
IBM SP6 Power6	Fermi IBM BGQ PowerA2	Marconi Lenovo Xeon+KNL	Marconi PPI4HPC ICEI - PPIHBP	EuroHPC