SCAI
SuperComputing Application &
Innovation
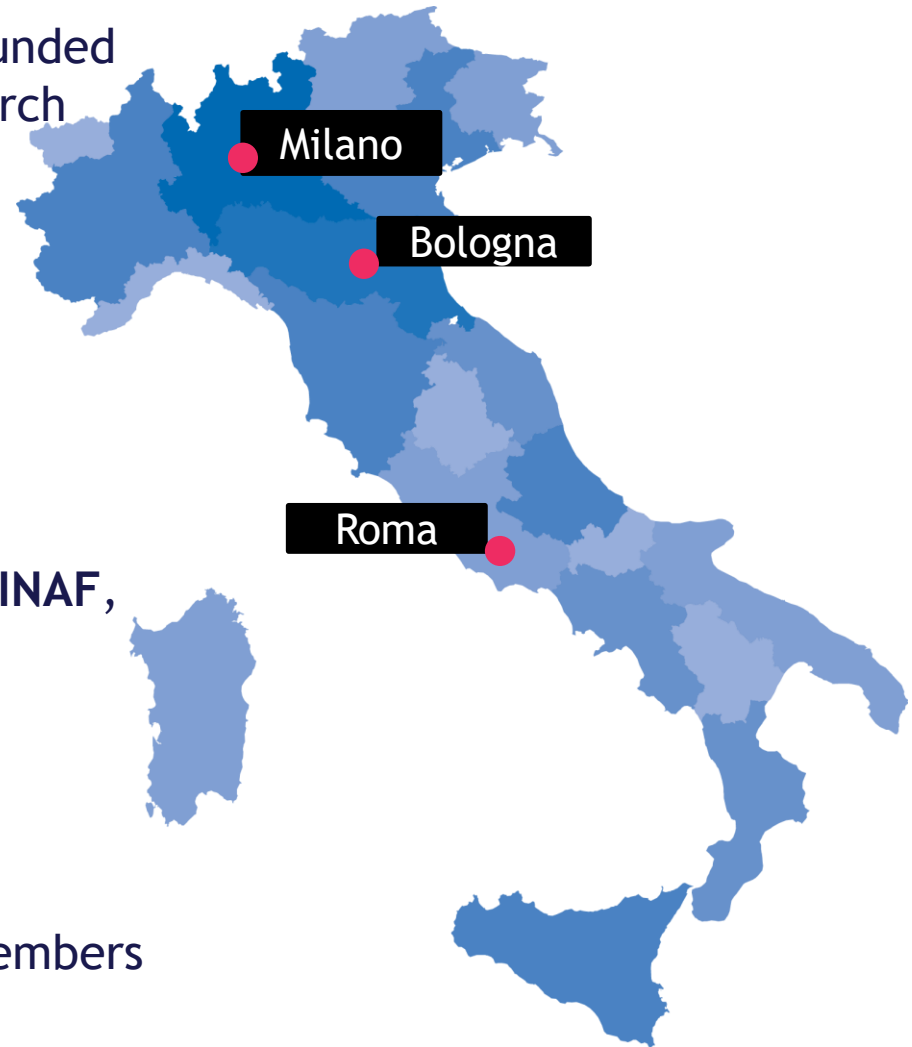# CINECA

Sanzio Bassini – December 2018

CINECA

CINECA

CINECA is a **Consortium of Universities**, founded in 1969 by (MIUR) to support scientific research **CINECA is a not-for-profit organization**

Members:

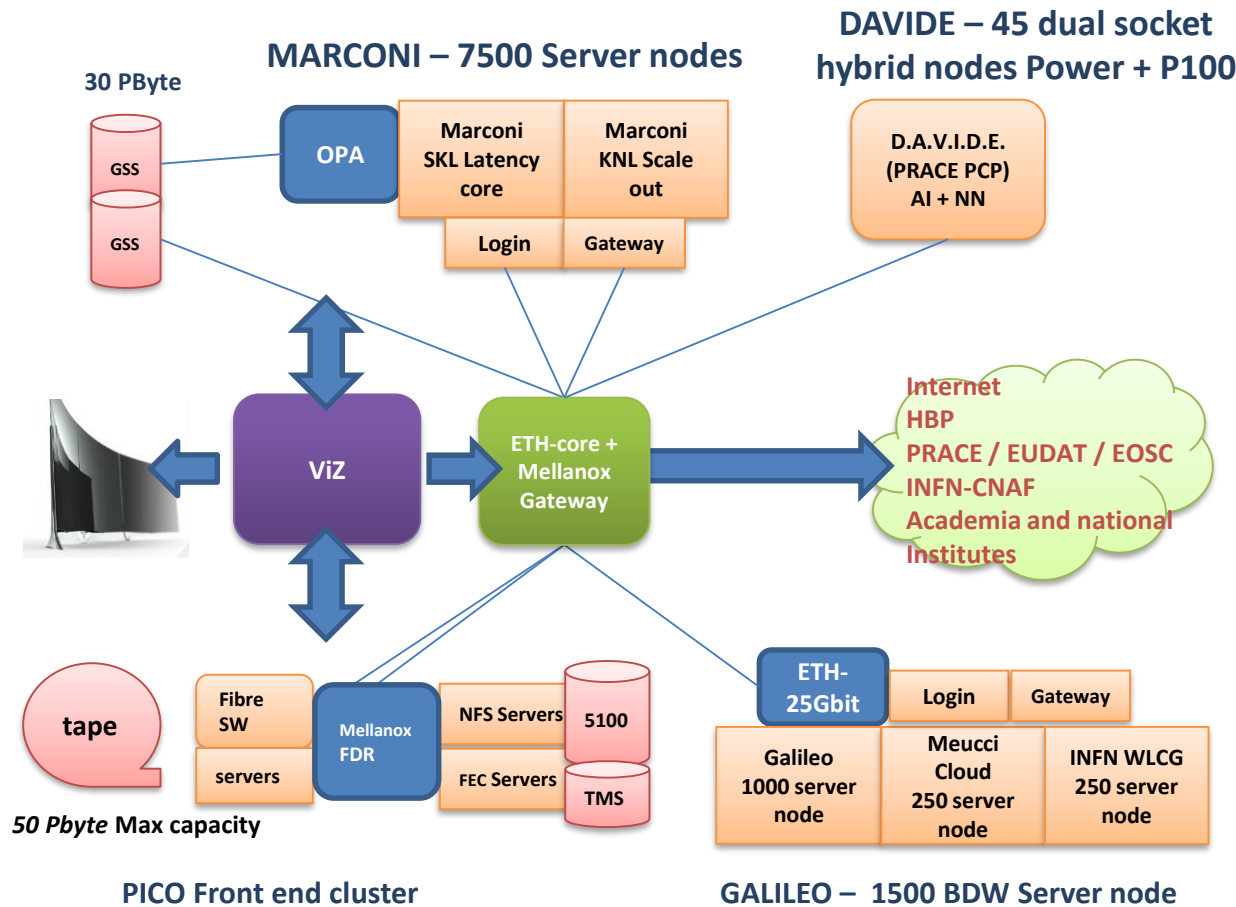➡ MIUR

➡ 67 Italian Public Universities

➡ 9 Institutions Anton Dohrn, **CNR**, CREA, **INAF**, INDIRE, **INFN**, **INRIM**, INVALSI, **OGS**

In-house provider:
✔ Supervised by MIUR
✔ No private capital
✔ 80% of activities towards Consortium members
✔ 20% Technology Transfer

Milano
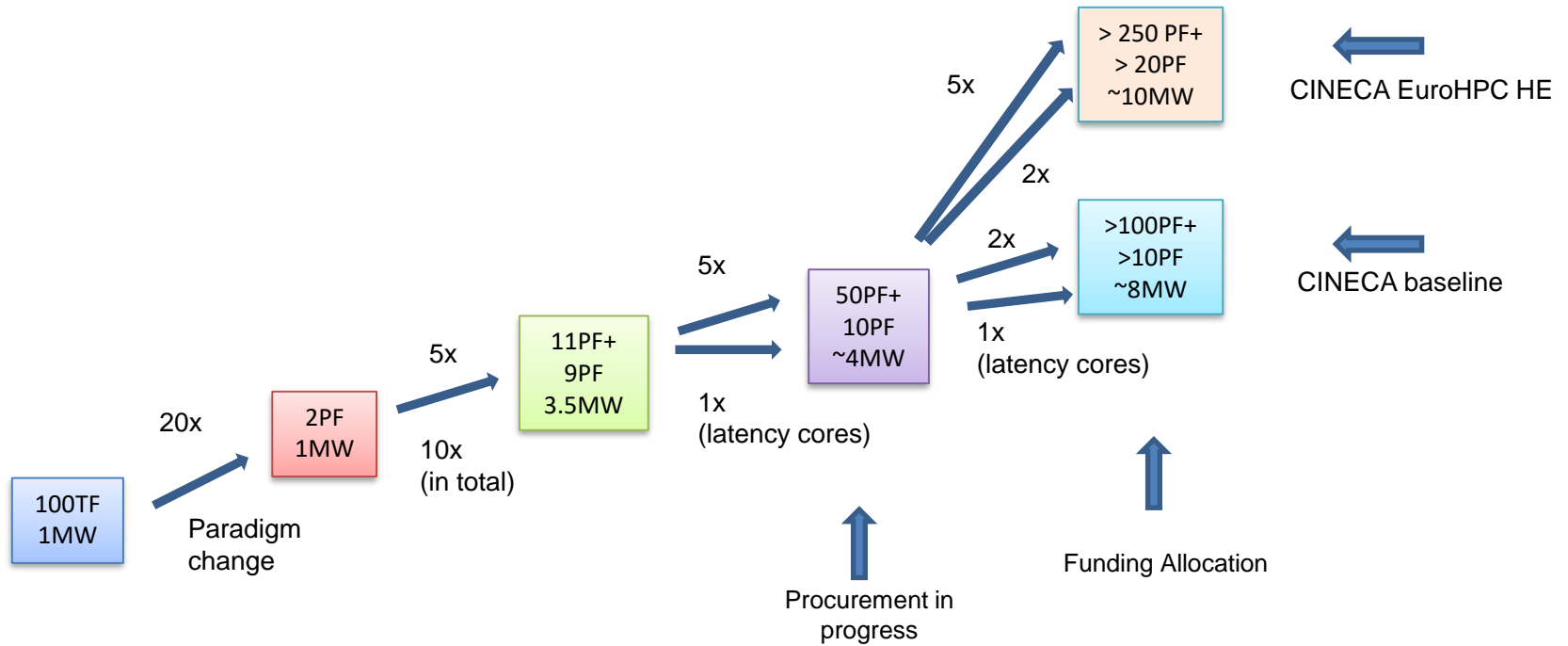
Bologna

Roma

Current HPC architecture infrastructure

MARCONI – 7500 Server nodes

DAVIDE – 45 dual socket hybrid nodes Power + P100

30 PByte

GSS

GSS

OPA

Marconi SKL Latency core	Marconi KNL Scale out
Login	Gateway

D.A.V.I.D.E. (PRACE PCP) AI + NN

ViZ

ETH-core + Mellanox Gateway

Internet
HBP
PRACE / EUDAT / EOSC
INFN-CNAF
Academia and national Institutes

tape

Fibre SW	Mellanox FDR	NFS Servers	5100
servers		FEC Servers	TMS

50 Pbyte Max capacity

PICO Front end cluster

ETH-25Gbit

Login	Gateway

Galileo 1000 server node	Meucci Cloud 250 server node	INFN WLCG 250 server node

GALILEO – 1500 BDW Server node

- Global peak performance in excess of 25 Pflops

- Global production capacity > 9000 servers nodes

- Modularity computing combining different microprocessors technology based on the same ISA and different software stack enabling effective production work flows

- Architecture development driven by the scientific challenges and applications domains
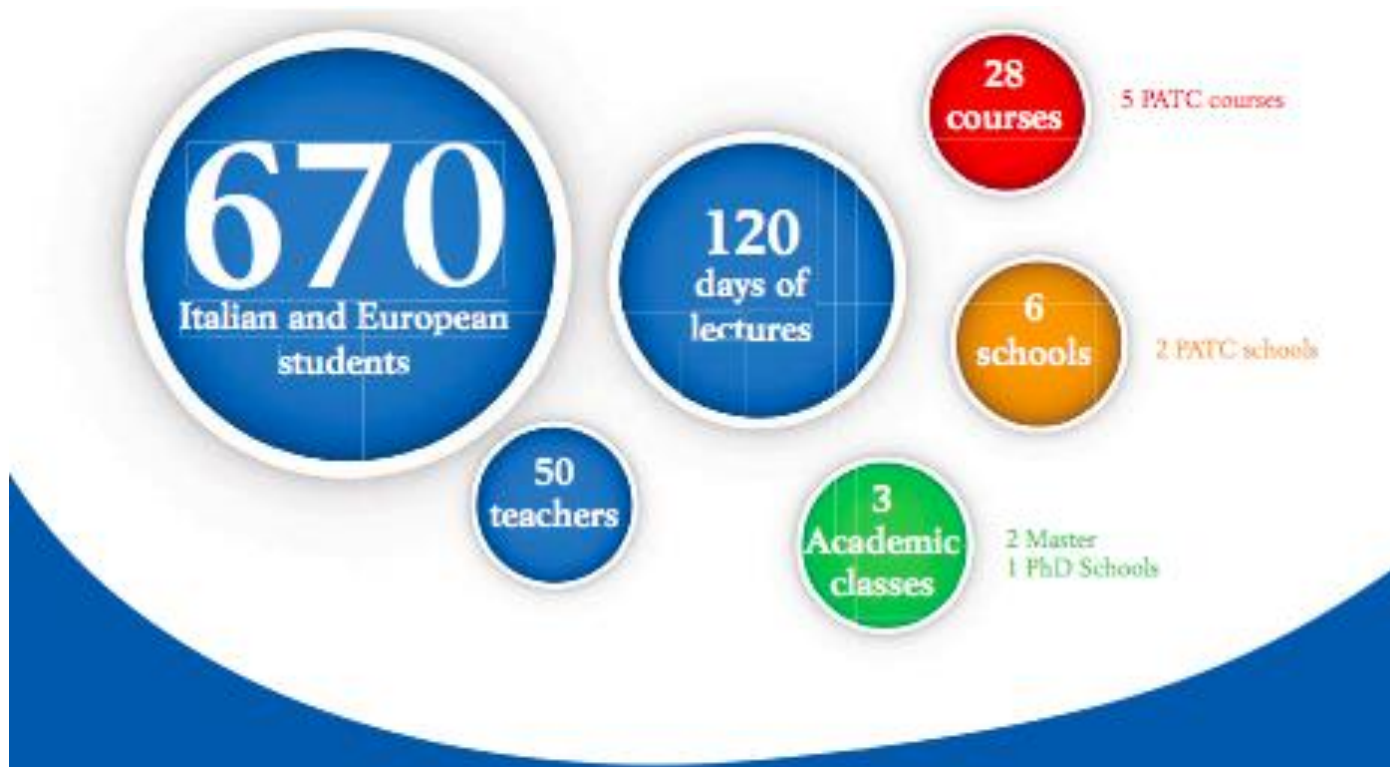
2009	2012	2016	2019	2021	2025
IBM SP6 Power6	Fermi IBM BGQ PowerA2	Marconi Lenovo Xeon+KNL	Marconi PPI4HPC ICEI - PPIHBP	Latency core consolidation for Eurofusion and Mission critical + new generation scale out	Hybrid technology Digital computing and quantum computing

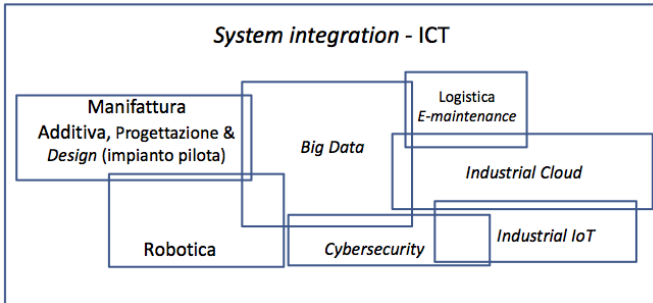# Training and promoting HPC Culture (2017)

INSPIRE Infrastructural Project – POR FESR ER.R
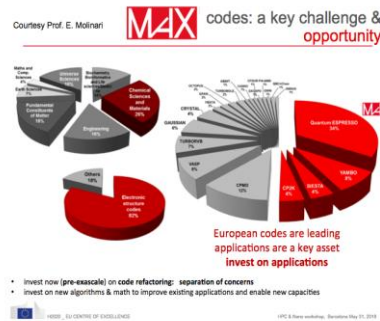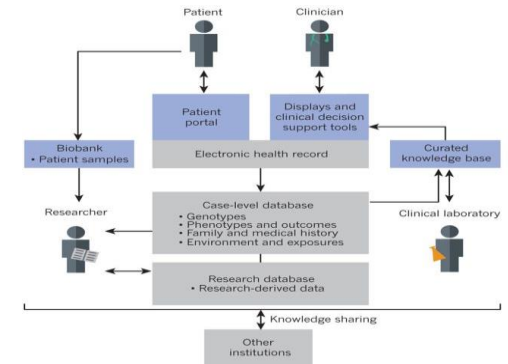# BIG DATA National Hub – Italian EOSC reference model

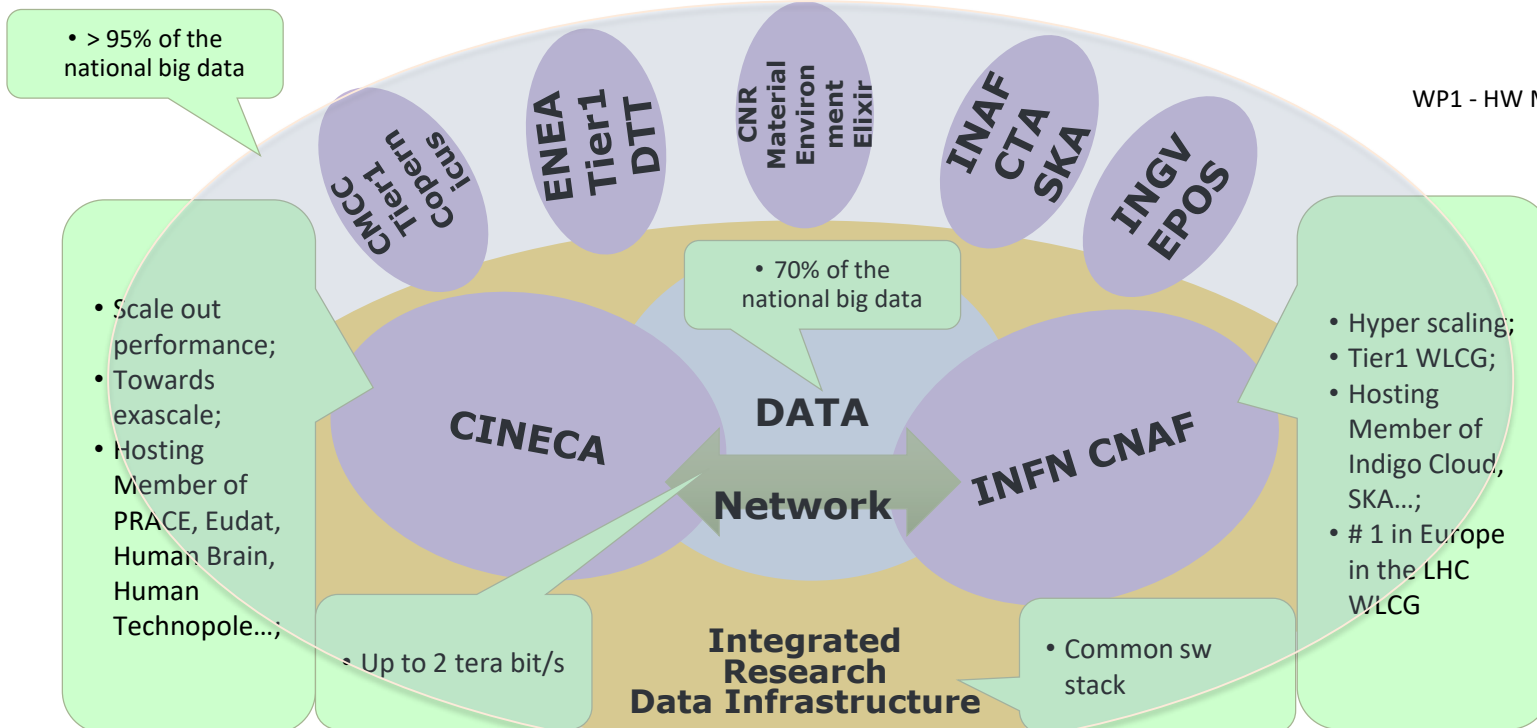**CINECA**

WP2 - I4.0, ML, IA

System integration - ICT

Manifattura
Additiva, Progettazione &
Design (impianto pilota)

Big Data

Logistica
E-maintenance

Industrial Cloud

Robotica

Cybersecurity

Industrial IoT

WP3 – New material

Courtesy Prof. E. Molinari

M4X codes: a key challenge & opportunity

European codes are leading applications are a key asset invest on applications

- invest now (pre-exascale) on code refactoring: separation of concerns
- invest on new algorithms & math to improve existing applications and enable new capacities

WP4 – Life science, genomic, biobanking

Patient — Clinician

Biobank
• Patient samples

Patient portal

Displays and clinical decision support tools

Curated knowledge base

Electronic health record

Researcher

Case-level database
• Genotypes
• Phenotypes and outcomes
• Family and medical history
• Environment and exposures

Clinical laboratory

Research database
• Research-derived data

Knowledge sharing

Other institutions

• > 95% of the national big data

WP1 - HW Middleware

CMCC Tier1 Copernicus

ENEA Tier1 DTT

CNR Material Environment Elixir

INAF CTA SKA

INGV EPOS

• 70% of the national big data

CINECA

DATA

Network

INFN CNAF

• Scale out performance;
• Towards exascale;
• Hosting Member of PRACE, Eudat, Human Brain, Human Technopole…;

• Hyper scaling;
• Tier1 WLCG;
• Hosting Member of Indigo Cloud, SKA…;
• # 1 in Europe in the LHC WLCG

• Up to 2 tera bit/s

Integrated Research Data Infrastructure

• Common sw stack
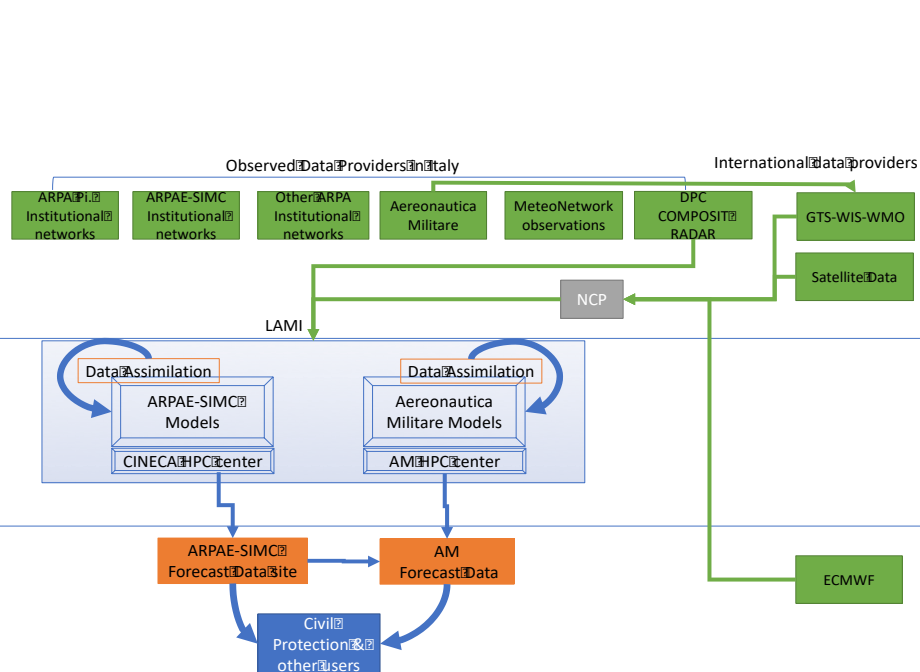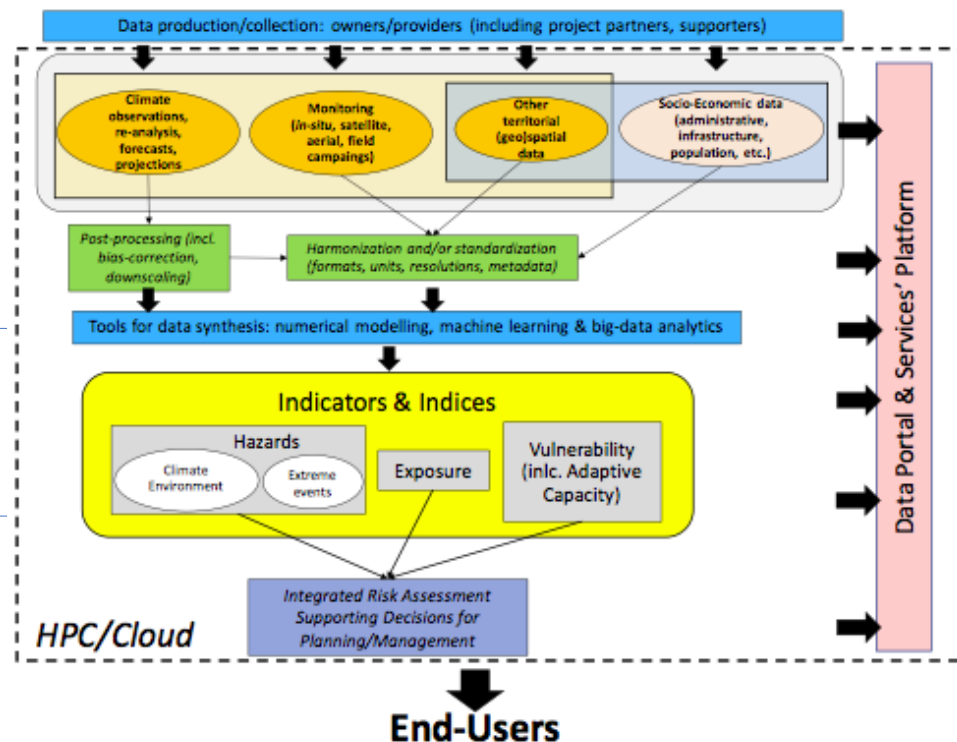
Linked open data portal for PA, SMEs, Citizens in the domains of weather forecast and climate changes impacts in the agriculture industry segment

Partneship: Agriculture confederation, ARPA-ER, ARPA-P, ASTER, CINECA, Civic protection,CMCC, DEDAGRUOP S.r.l., ECMWF, Fundation E. Mach, U. of Tuscia
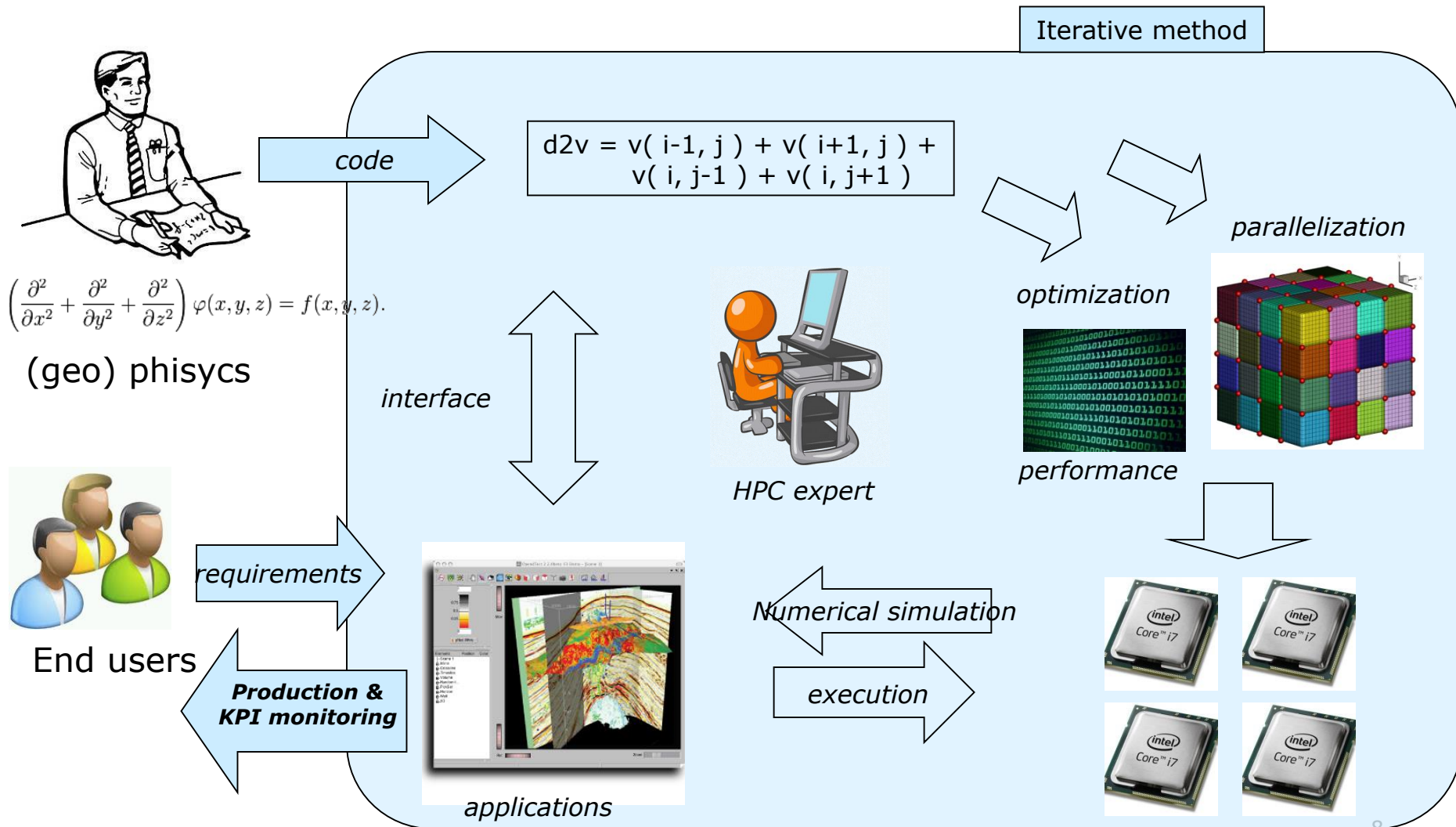
Stakeholders: Regione Emilia Romagna, Regione Lazio, Regione Puglia, Provincia Trento, Provincia Bolzano
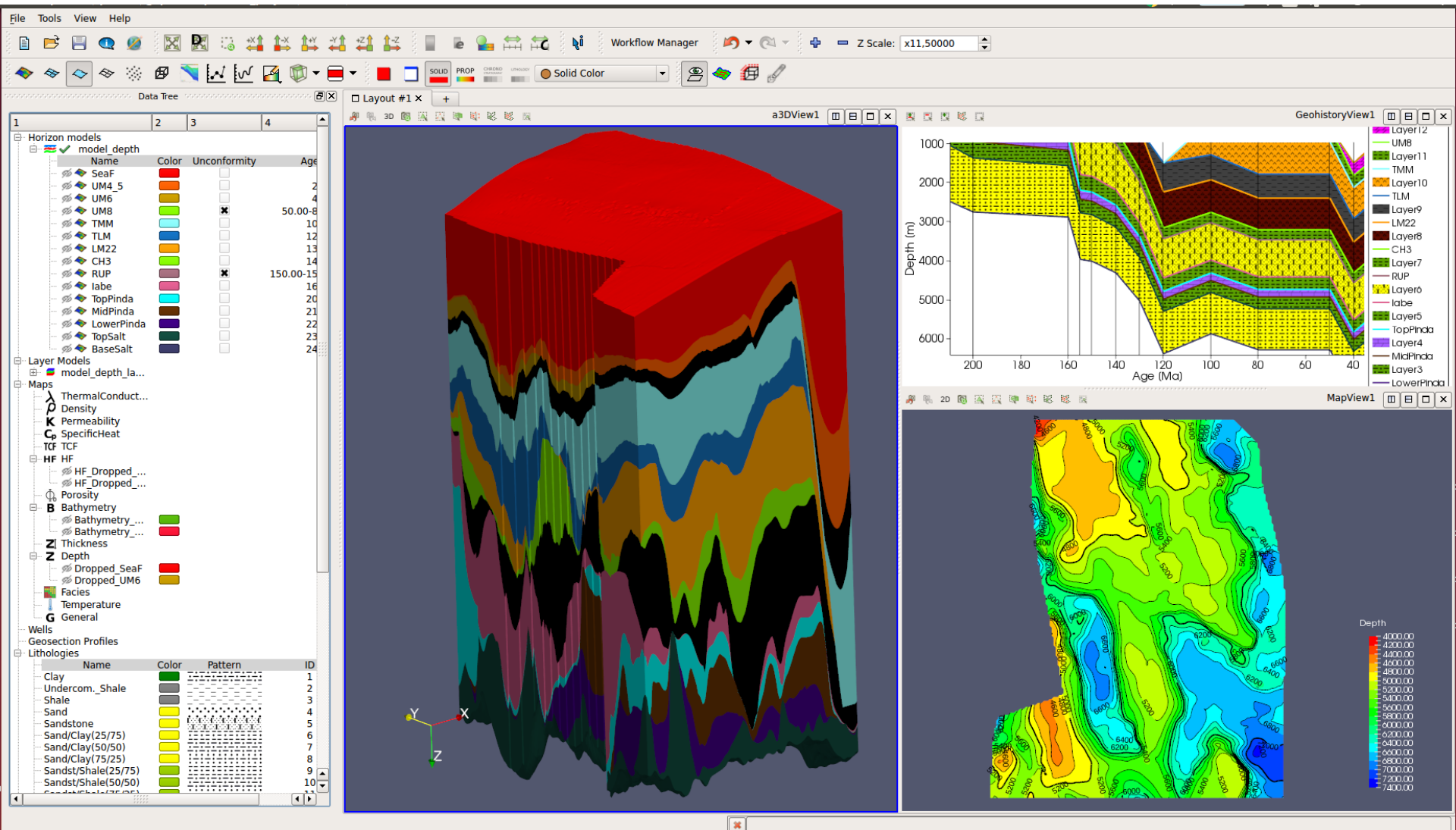

Mistral Project

Highlander Project

Effective HPC application development process for industries and SMEs

Iterative method

code

$$d2v = v(i\text{-}1, j) + v(i\text{+}1, j) + v(i, j\text{-}1) + v(i, j\text{+}1)$$

parallelization

$$\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} + \frac{\partial^2}{\partial z^2}\right)\varphi(x,y,z) = f(x,y,z).$$

(geo) phisycs

optimization

interface

HPC expert

performance

End users

requirements

Numerical simulation

Production & KPI monitoring

execution

applications

Seisimic and resorvoirs data processing

Current collaborations with Industry and SME

- Altran: Engineering and R&D services (Torino)

- Amet: Engineering Company (Torino)

- Chiesi farmaceutici: Innovation in healthcare (Parma)

- Dallara Automobili (Parma)

- Dompè Farma: Innovation in drug design (L'Aquila)

- Eni Oil & Gas (Milano)

- Elica hoods (Ancona)

- Ferretti Yachts (Forlì)

- Nolan Group: motorbike helmet (Bergamo)

- OlsaGroup: Optical Lighting Systems (Torino)

- R&D CFD: Computational Fluid Dynamics (Modena)

- RED Fluid Dynamics: Research & development in Fluid Dynamics (Rimini)

- Unipol Group: insurance (Bologna)

Turbulence intensity (%)

Max

Min

Courtesy of
RED Fluid Dynamics (Image and simulations)
Board: Scifi model by Slater Design