



High Performance Computing

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New technologies and growing application requirements

High Performance Computing (HPC):

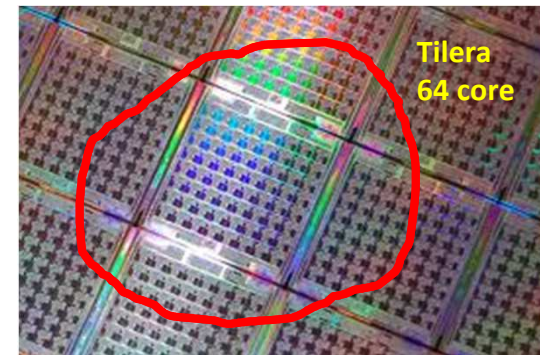
- Not only scientific computing and large-scale simulation
- Most important: opportunities for industries in Tuscany

**HPC for innovative solutions
in specific application domains,
often on-line and/or real-time**

Large servers and Cloud, and much more

Multi-/many-core technology exploitation

- Single-processors no longer exist
- Currently several tens of processors (“cores”) on single chip (Intel, IBM, Tiler, ..., GPU) – core amount will double every 2 years ~



‘Programming in parallel’: no longer a esoteric choice, instead it is a reality and a need for broad classes of users



Our experience and skills

- Pioneering work in Europe on **advanced methodologies for parallel software design**
 - today well recognized in the scientific and technological community
- Several **research products** on HPC development environments and libraries
- Participation / Coordination of several **national and European projects** and **industrial collaborations**

Recently (5–6 years):

- MIUR FAR project SFIDA
- EU-IP project BeInGrid
- MIUR FIRB project In.Sy.Eme
- 3 contracts with Finmeccanica Selex SI
 - EU-Artemis project SMECY
- Collaboration List Spa
- EU-STREP project Paraphrase





Filling the gap between machines and applications

- Parallel servers
- Cloud
- Multi-/many-core
- GPU
- Operating systems
- Sequential programming tools

New application requirements for HPC and scalability:

- increasing amount and complexity of functions to be implemented
- data-intensive computations (Peta-/Exa-byte)
- real-time, on-line data stream processing and complex event processing
- distributed ubiquitous systems of multiple ($10^3 - 10^6$) fixed and mobile computers, devices and networks
- COMPUTER SCIENCE & NETWORKING

Software Defined Networking

Big data & Information Retrieval

Disaster prevention and emergency management

Smart Cities

Financial Markets, Trading

IT Industry

Software

Users



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Trade off: Performance *vs* Portability and Programmability

Industrial 'standards' are still unsatisfactory: difficult to be used, system-dependent, rigid

- Apache Hadoop
- Open MP
- CUDA
- ...

Broad space and opportunities for innovative and competitive products through HPC exploitation:

- possibly as **added value** to 'standards'
- high-level domain-oriented **design environments** and **applications**

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Current group composition

Marco Vanneschi, Marco Danelutto

Research fellows and PhD students:

- Massimo Torquati
- Sonia Campa
- Gabriele Mencagli
- Daniele Buono
- Silvia Lametti
- Tiziano De Matteis