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The case for international scientific collaboration

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Who am I?



- Started as a student at CERN, one of the largest scientific **international** organizations in the world

Je suis tombé tout petit dans la marmite!



- Compelling reason for international collaboration at CERN is the cost of developing and running huge instruments with operational cost in the order of 1 Billion € / year... no single country can afford this and the computing infrastructure to analyse the produced data (hundreds of Petabytes/year)
- In fact the computing infrastructure which I helped to design and implement in the early 2000's with substantial support from the EU Commission was a precursor of today clouds and it aggregated 100's of computer centres around the world (the LHC Computing Grid)

Data intensive science

- Like the instruments at CERN, in the last few years, HPC systems have become very expensive. Typically a supercomputer centre used to procure every 3-5 year a new system with investments in the order of 10's of millions €, now the 3 pre-exascale EuroHPC systems cost one order of magnitude more and cannot any longer be afforded at national level. This is the fundamental reason for the establishment of the EuroHPC joint undertaking and to be justified the EuroHPC computing infrastructure needs to serve an international scientific community
- Another compelling reason for international collaboration across the board is the transformation from traditional science, based on theory, algorithmic implementation of the theory, collection of experimental data and proof/disproof of the theory, to ***data intensive science*** which needs to acquire huge amount of data and use AI/ML technology to extract the science from the data more or less automatically. In every discipline the data in this large quantify are only available internationally
 - Good example is the international collaboration for developing Covid19 vaccines in a record time by aggregating data and HPC computing power from all over the world, and this saved the world!

Practical examples

- The Barcelona Supercomputing Centre to realize the vision of a full open HPC ecosystem including the processors needed an open source ISA (Instruction Set Architecture)
- After an initial experience with ARM, which is not open source, but at least computer system vendor independent, decided to move to RISC-V
- RISC-V was originally invented by the creators of the RISC architecture John Hennessy and David Patterson in Stanford and in Berkeley California
- RISC-V has since become an international foundation with site in Switzerland
- The amount of work to develop the entire H/W and S/W ecosystem on a new architecture is huge and can only be tackled at international level with a worldwide collaboration of industry, scientists and engineers
- Developing new innovative HPC system and their ecosystem is only part of the game
 - We need to train the new generation of scientists to make the best use of this limited and highly expensive systems
- BSC and other institutes have joined forces to teach in topical schools such as at the *ACM school on HPC architectures for AI* held in Barcelona in 2019, 2021 and in preparation for early September this year and the EU-ASEN HPC school held virtually in 2021 and now in preparation in presence in Bangkok in December 2022. These are initiatives which can only be implemented with an international and collaborative approach

Practical examples continued

- No single country has today all the technological components to build a entire HPC system
- A country can have a company good enough to integrate a full HPC system, but with processors designed say in the US, interconnects in Israel, memory chips in South Korea or Taiwan and most of the Fab in Taiwan anyway
- Clearly in the present difficult geopolitical situation Europe must thrive to digital sovereignty but the gap is today so large that only with a smart policy of alliance with international technology suppliers it could be filled in a reasonable time scale

- **So to conclude let's be smart, collaborate worldwide to be eventually capable to compete at the same level with the big players of this world!**



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Thank you

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