HSF and HL-LHC Software Challenges

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Colloque Calcul IN2P3

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HL-LHC Software Challenges

- Pile-up x 10 = CPU x 100
  - Moore's law over 10 years : only a x10
  - With a flat budget, Moore's law is the real maximum that can be expected on the HW side
- HEP sofware hardly execute more than one instruction at a time (per thread)
  - Since ~10 years, CPU (core) power increase is due to the internal parallelism (Instruction-Level Parallelism: pipelines and vectorisation)
  - x10 with the same HW only achievable if using the full power of processors : major SW reengineering required (but rewritting everything is not an option)
  - Accelarators like GPUs are of little use until the problem has been solved
- Amdhal's law : max improvement due to parallelisation is limited by the remaining sequential part
  - In a code with a sequential section representing 20%, you cannot get an improvement greater than 5 no matter how many processor you use for the parallel section
- « HL-LHC salvation » will come from software improvements, not from hardware

HSF Goals

- Facilitate coordination and common efforts in HEP software and computing
  - HEP software must evolve to meet the challenges posed by new experiments
  - The computing landscape is evolving rapidly
  - No more free-lunch thanks to Moore's Law: SW must use efficiently built-in HW parallelism, in particular Instruction-Level Parallelism (ILP)
  - Can't just buy more hardware: budget and energy constraint
- Need to exploit all the expertise available in our community, and outside it, to meet the challenges and the affordable way to do it is collaboratively
  - All the HEP experiments (and more) are facing the same challenges
  - Some other communities have more experience/expertise with these parallelisation issues
  - Not only a problem of computing techniques: many problems are intrinsiquely sequentials, how to make them parallel. Need to work on algorithms too.
  - Cannot afford anymore duplicated efforts/software: in the LHC experiments, each one has its own solution for almost everything (framework, reconstruction algorithms…)

HSF Prehistory

- April 2014: kick-off meeting for a HEP SW Collaboration
  - https://indico.cern.ch/event/326823/
  - Very large participation: ~150 people
  - Broad spectrum of views but preference for a lightweight structure
  - Call for White Papers (WP) to express what it could be or should not be
- Spring 2014: 10 WPs received from different geographical and “scientific” horizons
  - 1 from French people: M. Jouvin, D. Rousseau, D. Chamont, S. Binet
  - Differences but agreement that building a lightweight collaboration would be beneficial
- Summer 2014: official start of HSF
  - Name based on Apache Software Foundation that appeared as a good model, not a reference to funding
  - Importance on a bottom-up approach: long-term collaboration, be inclusive, tranparency crucial
  - Based on motivated individuals and projects rather than organisations

HSF Bootstrap

- A startup team formed in Sept. 14: initially 6 people, now 14
  - Group of motivated indivuals ready to spend some time on building HSF
  - People belonging to different institutions/experiments: Europe and North America
- Contact with several different communities/projects: Astrophysics (LSST/GLAST), Theorical Physics, MC generators, Intensity Frontier, ROOT, GEANT4…
- First HSF workshop organized at SLAC in January 2015
  - Well attended (~100), motivated people
  - Strong US participation, Intensity Frontier experiments well represented, some non HEP (LSST, Photon Science…)
  - Agenda: http://indico.cern.ch/event/357737/other-view?view=standard, 41 6' presentations
  - "Learning from others: 3 "long" (20') presentations from "similar" projects (ASF, SSI, …)
  - Views on HSF by experiments, projects, individuals
  - New projects that could benefit from HSF (7 presented)
  - More details at https://indico.lal.in2p3.fr/event/2782/contribution/0/material/slides/0.pdf

HSF Startup Team Members

- Peter Elmer (Princeton)
- Daniel Elvira (FNAL)
- Frank Gaede (DESY)
- Benedikt Hegner (CERN)
- Michel Jouvin (LAL, IN2P3)
- Andrew McNab (Manchester)
- Pere Mato (CERN)
- Dario Menasce (INFN)
- Richard Mount (SLAC)
- Elizabeth Sexton-Kennedy (FNAL)
- Graeme Stewart (Glasgow)
- Craig Tull (LBNL)
- Andrea Valassi (CERN)
- Brett Viren (BNL)
- Torre Wenaus (BNL)

Main Activities Foreseen

- Training: identified as the critical short/medium term activity
  - Online trainings: build/maintain a list of useful material
  - Link with Software Carpentry and similar initiatives?
- Software Project Visibility and Interactions
  - Incubabor
  - Software Knowledge Base
- Software Packaging: make easy to use an existing package, whatever build tools you are using
  - Docker potential?
- Software Licensing: ensure that software can be reused from the licensing point of view
- Technical Forum: share expertise
  - Technical Notes: not recommandations, may think at a RFC-like process in the future
- Development Tools and Services
  - Access to CERN TechLab platform: various new fancy hardware!

Where Are We?

- A web site: http://hepsoftwarefoundation.org/content/activities
- Several open mailing list
  - HSF Forum: hep-sf-forum+subscribe@googlegroups.com
  - Also a general SW and Computing mailing list, not linked to HSF: hep-sw-comp+subscribe@googlegroups.com
- Several concrete actvities in the startup hase
  - A first version of the Sofware Knowledge base
  - Technical notes: first ones before the summer
  - Training: initiative/material portal
- A lot of activities during the first year but startup team members less available nowadays: slower progress in the last months
- Need more volunteers: no dedicated manpower to serve others…
  - How to contribute: http://hepsoftwarefoundation.org/content/get-involved

HSF: French Role

- A french HSF: does not really make sense
  - HSF main members are software projects, not national bodies
  - Agreement on the do-cracy model: those who are active are taking the decisions
- A strong French participation to HSF should be encouraged
  - By motivated individuals
  - No need to be an outstanding expert
  - Be ready to spend some time to help building HSF on a specific ativity
- Establishing some links between French people involved may help
  - Probably a mailing list to start
- Paris Saclay region concentrates a significant number involved in software projects: idea of having sort of a lightweight coordination that could be expanded to other people interested
- IN2P3 may help to liaise with other communities sharing software with HEP and facing similar challenges, in particular Nuclar Physics and Astro-particles