

Libraries and Frameworks: 2015 Programme of Work

2nd February 2015, SFT Group Meeting

Outline

- ❖ ROOT Plans
- ❖ External Packages and LCG Releases Plans

ROOT Plans for 2015 and Beyond

ROOT Main Areas of Work

- ❖ Development
- ❖ Documentation
- ❖ New Platforms
- ❖ Infrastructure
- ❖ User Support
- ❖ ROOT and the HEP Software Foundation

The ROOT Core Team

- ❖ Bertrand BELLENOT
- ❖ Philippe CANAL (FNAL)
- ❖ Oliver COUET
- ❖ Gerri GANIS
- ❖ Benedikt HEGNER
- ❖ Pere MATO
- ❖ Lorenzo MONETA
- ❖ Axel NAUMANN
- ❖ Danilo PIPARO
- ❖ David SMITH
- ❖ Eric TEJEDOR (Fellow)
- ❖ Wim WLAVRIJSEN (LBNL)

Main Development Directions

- ❖ Cling Interpreter consolidation and its full exploitation
- ❖ Parallelization
- ❖ Vectorization
- ❖ I/O Improvements
- ❖ Math Libraries
- ❖ New Histograms
- ❖ Python reloaded
- ❖ Packaging and modularization
- ❖ Re-thinking User Interface
- ❖ ROOT as-a-service

Development: Cling

Consolidation - follow closely needs from experiments
C++11 / 14, JIT compilation opens many possibilities

- ❖ Migration to MCJIT
 - ❖ Assembler instructions, exceptions handling, proper debugging
 - ❖ Pre-requisite for using recent LLVM versions
- ❖ Introduction of PCMs
 - ❖ Essential for reducing the memory footprint
- ❖ New developments exploiting Cling / C++11 / 14
 - ❖ new TTreeFormula, automatic differentiation (if manpower available)
 - ❖ C++11 features: move constructors, ...

Development: Parallelization

Seek for any opportunity in ROOT to do things in parallel to better exploit the new hardware

- ❖ Re-engineer Proof-Lite or develop something new for executing parallel tasks in both **multi-process** and **multi-thread**
- ❖ Prototype solution(s) for 4 use cases:
 - ❖ Histogram/ntuple filling (Rene's programs)
 - ❖ Ntuple processing (TTreeDraw)
 - ❖ I/O pipeline (serialization, compression, disk I/O)
 - ❖ Minimization/Fitting (task and data parallel)
- ❖ Solve problems for merging efficiently the output objects produced by the parallel tasks: (histograms, trees, etc....)
- ❖ Introduce thread-safety where needed (e.g. I/O)

Development: Vectorization

- ❖ Exploit vectorization in code which can be critical
 - ❖ Add vector signature for function evaluations (to be used for fitting)
 - ❖ Vectorization in queries of trees (TTreeFormula)
 - ❖ Computing histogram sums of histogram bin contents
 - ❖ Vectorize commonly used math and statistical functions
- ❖ Collaboration with GeantV for supporting GPUs
 - ❖ CUDA implementation of math functions (bessel, gamma,...)

Development: I/O improvements

- ❖ Support for new C++11 constructs / containers
 - ❖ e.g. STL collections, `std::unique_ptr`, `std::share_ptr`
- ❖ Performance (runtime, disk space, memory) improvements
 - ❖ switch to little-endian, compress each entry individually to improve random access, reduce cost of repeated [deep] hierarchies
- ❖ TTreeCache
 - ❖ New OptimizedBasket, add to FastCloning, investigate extending prefetching algorithms
- ❖ Fix outstanding issues with
 - ❖ I/O rules, thread safety

Development: Math Libraries

- ❖ Improve MVA tools in ROOT
 - ❖ add some new algorithm (e.g. variable importance, multi-target regression)
 - ❖ add interface for R to use MVA tools of R in TMVA
 - ❖ investigate and replace (if needed) some of the tools
 - ❖ improve kd-tree's to use for interpolation and density estimation in multi-dimensions.
- ❖ RooFit
 - ❖ improve performances looking a real case-models (e.g. Higgs combination models)
 - ❖ exploit vectorization in pdf evaluations in RooFit/HistFactory
- ❖ RooStats
 - ❖ extend support for 2D models in RooStats
 - ❖ facilitate usage of tools (e.g. command line for running RooStats limit and significance tools)
- ❖ New Random generators for concurrent environment
 - ❖ prototype work within MixMax project funded by the EU

Development: New Histograms

- * new TFormula and new TF1 are almost completed
 - * use the occasion for changing TF1-TF2-TF3 inheritance
 - * have a common base class (e.g TFBBase)
 - * implement TF1,2,3 and a new TFN as derived classes of TFBBase
- * Re-design histogram classes
 - * new full implementation of histogram classes with completely new interfaces (not high priority)
 - * re-design must be done together with graphics and core (ownership issues)
- * backward compatibility in I/O
 - * do we need to be able to read files written with very old versions (< 5) ?
 - * could provide ad-hoc converters for these files if needed

Developments: Python Reloaded

- ❖ Re-factoring of PyROOT
 - ❖ Wim's ongoing work
 - ❖ Details to be discussed next week
- ❖ Better tutorials and documentation
 - ❖ e.g. tree analysis
- ❖ Better integration with other scientific modules
 - ❖ E.g. NumPy, SciPy, StatsModels,...
- ❖ Distribute **rootpy** within ROOT
 - ❖ The **rootpy** project is a community-driven initiative aiming to provide a more pythonic interface with ROOT on top of the existing PyROOT bindings

Development: Packaging

Easy use third party packages

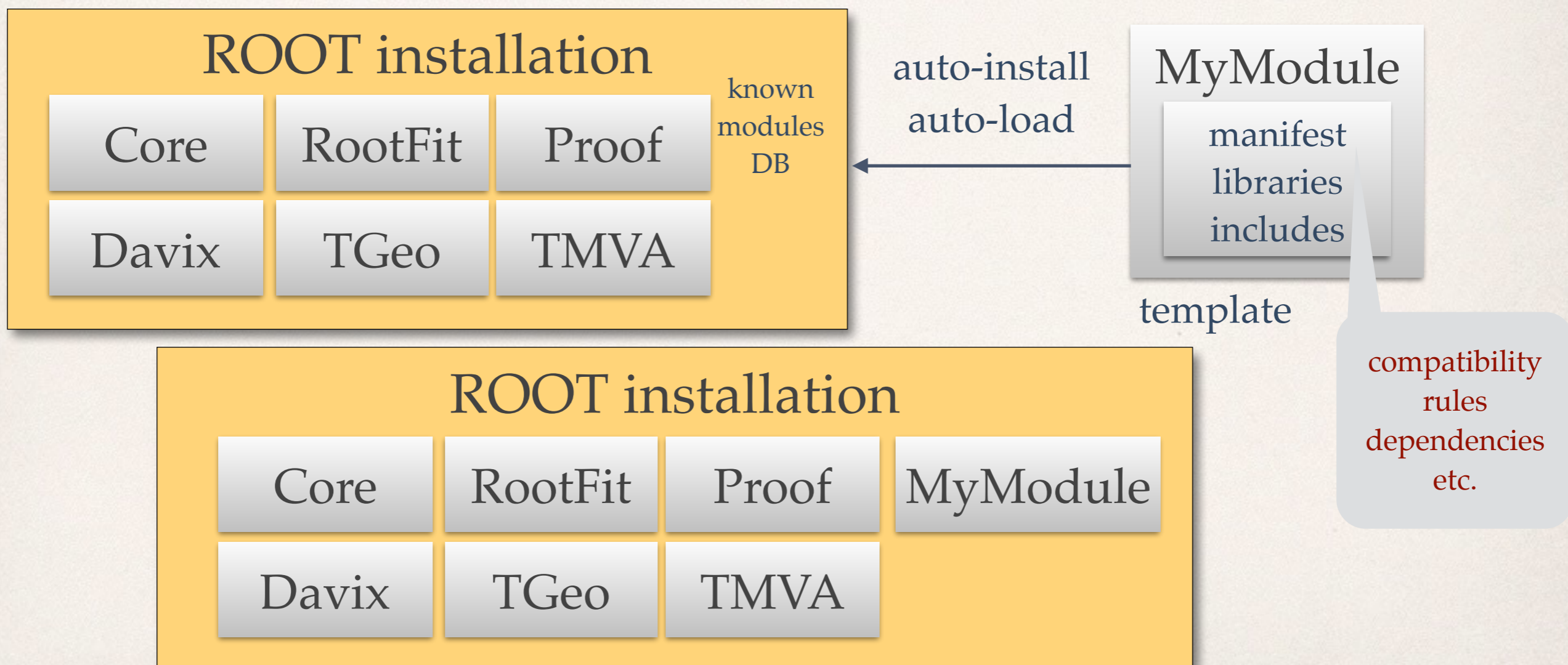
Build/install modules and plugins on demand

Slimed down initial ROOT installation (BOOT)

- * Need to incorporate new external packages in the core of ROOT
 - * e.g. VecGeom, vc, vdt, TBB, new random lib, ...
 - * streamline procedures for building, testing and deploying
- * Migrate TGeom to use VecGeom
 - * keep the same user interface if possible
- * Develop model for building/installing modules on demand and evolve ROOT into BOOT
 - * Essential for contributors

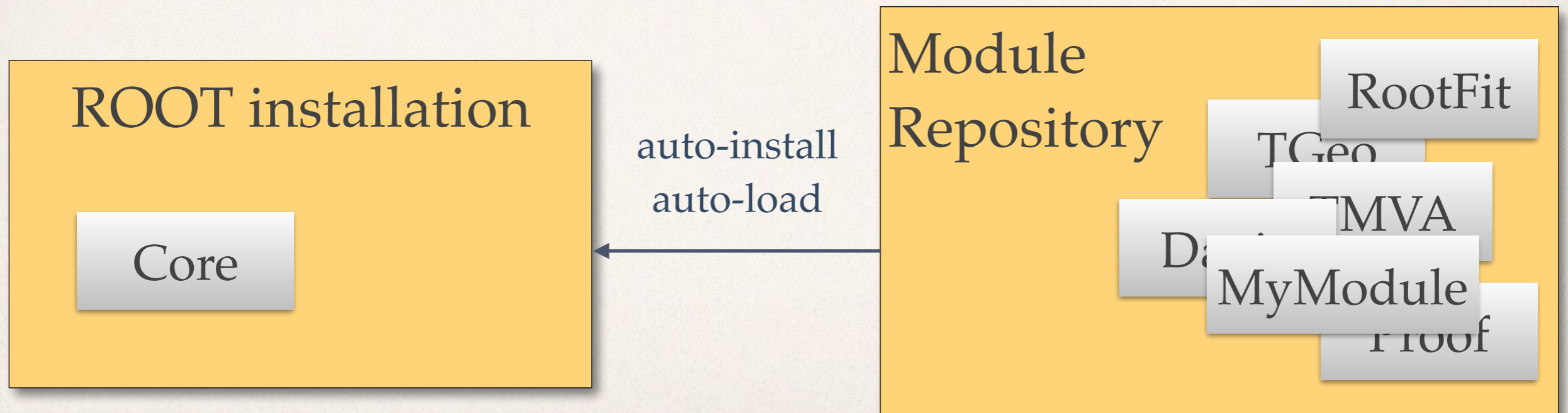
Step 1: Auto-install

- * Explicit or implicit installation of **known modules** when required
 - * type/namespace \longleftrightarrow module name



Step2: BOOT

- ❖ Once the auto-install system is well understood and working adequately we could factorize the standard ROOT installation in a number of modules
 - ❖ Minimal installation and memory requirements
- ❖ Contributors can easily provide modules



Development: Graphics

- ❖ Continuous improving, feedback from ROOT user's workshop, and user's requests, etc.
- ❖ In particular:
 - ❖ Improve the GUI fonts
 - ❖ TMathText (LaTeX interpreter) PDF output and reduce the space need for fonts

Development: Rethinking UI

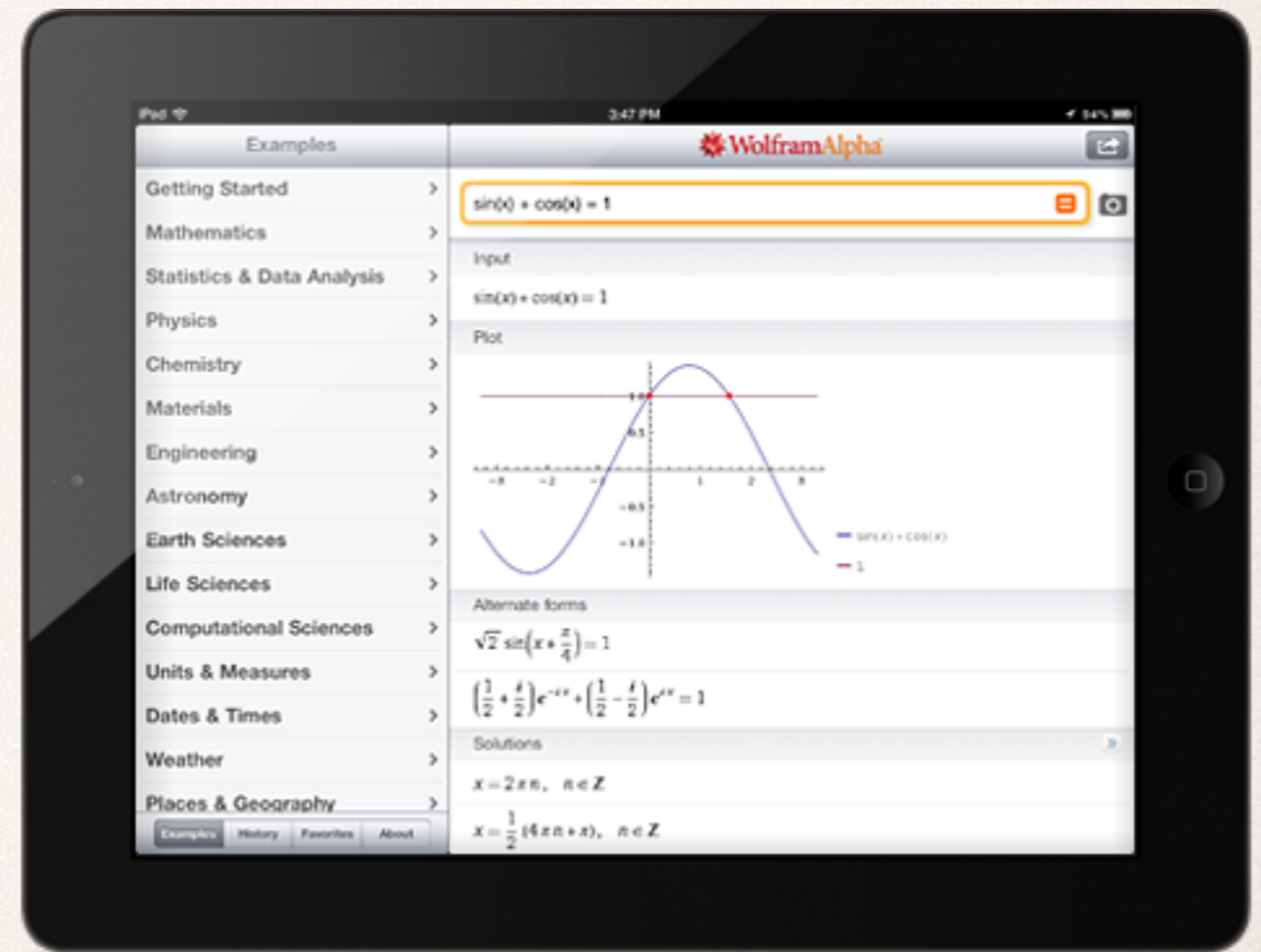
Explore new ways to provide thin-client web-based user interfaces

- * Increase interactivity using modern web technology (javascript) in a client-server model
 - * No need to install anything in the client side
 - * Worksheet style
 - * send command, display results in text or graphics form
 - * 3D geometry viewer
- * Built on the HttpServer of Sergey Linev
- * new TTreeView

Development: ROOT as-a-Service

Thin client plugged directly into a ROOT supercomputing cloud, computing answers quickly, efficiently, and without scalding your lap

- ❖ Natural evolution of modern applications
- ❖ Combine the work on **parallelization** to exploit many cores and nodes in a virtualized computing cloud
- ❖ Together with the new **web-based interface** to provide a modern and satisfying user experience



Documentation

- ❖ Migrate the Reference documentation to Doxygen
 - ❖ convert the ROOT comments to Doxygen style
 - ❖ tools and scripts to automate the generation of figures, etc.
 - ❖ in collaboration with ALICE
- ❖ Update and revise the Reference Guide
 - ❖ Ensure that the documentation is useful to developers and users
 - ❖ Homogenization of quality level and style
- ❖ Improve web documentation and usability
 - ❖ Use the occasion of the Drupal migration
- ❖ Update the User's Guide (and collection of topical Guides)
 - ❖ Missing chapters (e.g. cling interpreter)

Support for New Platforms

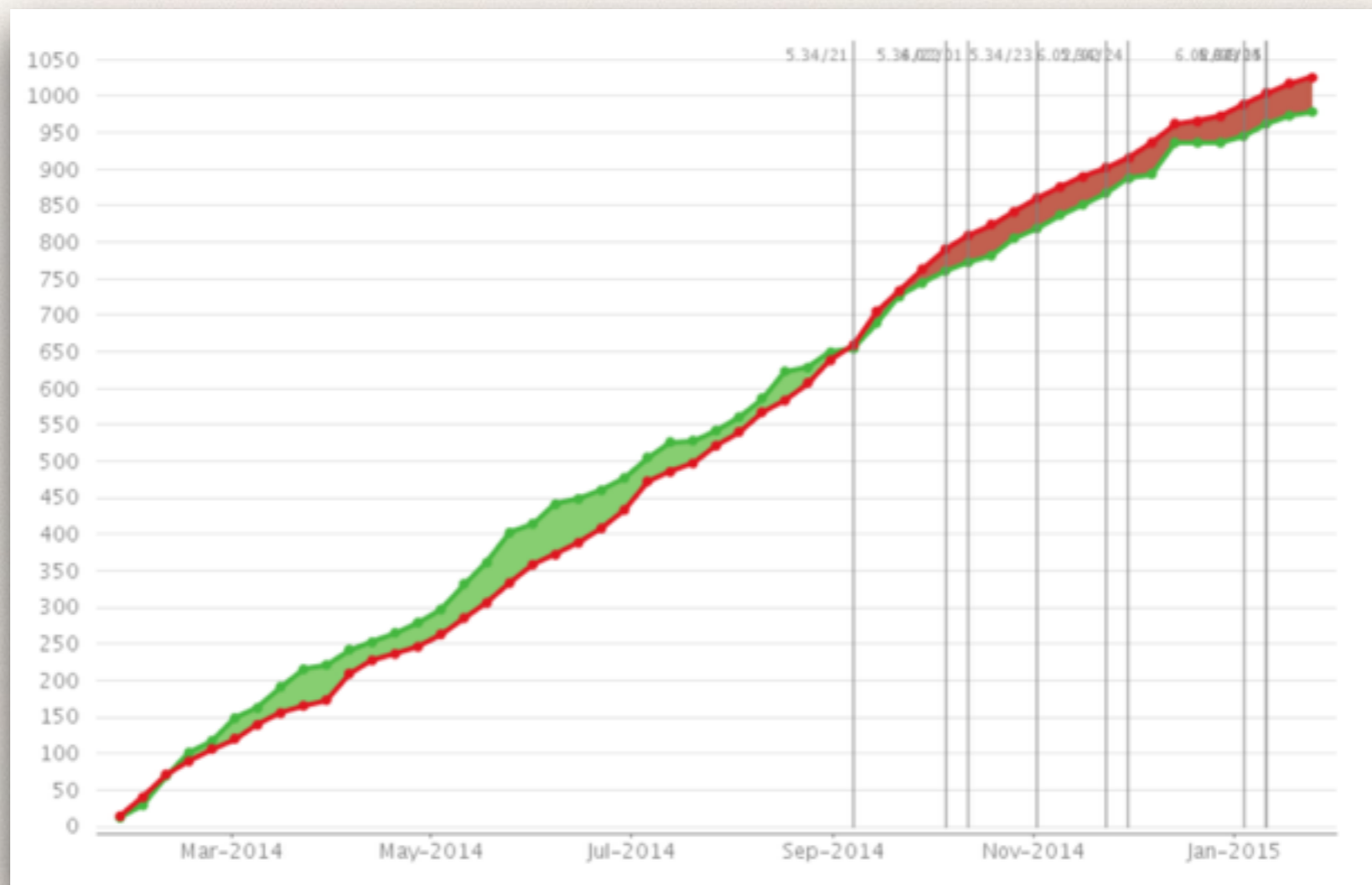
- ❖ Windows
 - ❖ win-64 bit
 - ❖ Davix
 - ❖ Multi-screen support
- ❖ PowerPC-64
- ❖ ARM-64
- ❖ Xeon-Phi
- ❖ CUDA ? (parts of ROOT)

Infrastructure

- ❖ Migration of the ROOT project infrastructure services to IT
 - ❖ Drupal 7
 - ❖ GIT
 - ❖ File servers
 - ❖ Forum (RootTalk)
- ❖ Ensure proper backup, sustainable infrastructure, ...
- ❖ Build servers
 - ❖ Shared with all SFT projects (Macs, Linux, Windows, etc.)
- ❖ Jenkins
 - ❖ All procedures will be available in Jenkins (tagging new versions, building releases, building documentation, etc.)

User Support: JIRA




- ❖ Issues: 1025 created and 978 resolved
 - ❖ backlog increased by 47 issues (of total about 580)
 - ❖ ~5 new issues / working day



User Support: RootTalk

- ❖ In addition to JIRA we have the RootTalk Forum:
 - ❖ Total posts 80953
 - ❖ Total topics 18775
 - ❖ ~ 20 posts / day
 - ❖ ~ 5 new topics / day
- ❖ Setup weekly shifts to ensure that no post gets unanswered
 - ❖ A lot of effort ~1 FTE



GENERAL	TOPICS	POSTS	LAST POST
 Announcements General Announcements. Moderator: rootdev	100	128	by Axel  Wed Jan 28, 2015 12:39
ROOT	TOPICS	POSTS	LAST POST
 ROOT Support Discuss installing and running ROOT here. Please post bug reports here . Moderator: rootdev	14895	66328	by moneta  Thu Jan 29, 2015 17:03
 ROOT Documentation Discuss the ROOT documentation here. Moderator: rootdev	240	730	by couet  Tue Dec 02, 2014 11:12
 Users' Contributions Some general interest ROOT macros and programs provided by ROOT users. If you have such macros or programs you can put them here. Moderator: rootdev	5	18	by schiteur  Mon Dec 08, 2014 18:10
 PROOF Support Discuss PROOF, the Parallel ROOT Facility, here. Moderator: rootdev	455	2148	by DmytroS  Thu Jan 29, 2015 11:54
 Stat and Math Tool Support Discuss RooFit, TMVA and other statistical and mathematical tools here. Please post bug reports here . Moderators: cranmer, rootdev	1542	4416	by noam  Thu Jan 29, 2015 9:36
 PyROOT Support Discuss PyROOT, the Python ROOT language binding, here. Moderators: wlav, rootdev	775	3795	by joelvoigt  Fri Jan 16, 2015 11:40
 My ROOT App Discuss your own ROOT application. Moderator: rootdev	124	358	by dpiparo  Mon Jan 26, 2015 8:17

ROOT and HSF

ROOT should be part of HSF

- * ROOT has played the role of 'hosting' contributions that are useful to the HEP community
 - * Providing build & testing infrastructure, integration, distribution, licensing, support infrastructure, etc.
==> makes the life easier to users
- * HSF should just generalize what ROOT has been doing so far
- * ROOT can benefit from some of the services provided by HSF
 - * E.g. software repositories, computing resources, development tools, training coordination, IP and licensing issues, etc.

Opportunity for Contributors

- * We would like to facilitate contributions to ROOT without engaging our responsibility in the maintenance and user support
 - * modules or plugins that can bring new functionality to users
 - * e.g. systems like Jenkins / Drupal / R provides a platform for developers to contribute in an easy manner
- * ROOT is 20 years old, and some parts requires re-engineering
 - * Exploit modern hardware (many-core, GPU, etc.) to boost performance
 - * Modernize implementations (C++11 constructs, use existing libraries, etc.)
 - * Need to solve the backward compatibility
- * Need to produce the “How to Contribute Page”

LCG Releases

LCGCMake

- ❖ Development of LCGCMake system is completed
 - ❖ Operational from LCG_68 (June 2014)
 - ❖ It includes all MC generators + all external libraries
- ❖ Need to complete the LCGSoft web interface
 - ❖ <http://lcgsoft.web.cern.ch/lcgsoft>
- ❖ Evolve LCGCMake to produce releases in the HepSoft layout
 - ❖ all packages installed into a single \$PREFIX
- ❖ The new platforms in the pipeline will be a reality check for the new system
 - ❖ CC7, MacOSX 10.9/10, clang 3.5

From EC to Jenkins

- ❖ Evaluation of Jenkins successful - No limit in the licenses
 - ❖ LCG Releases, ROOT, CernVM,...
- ❖ Moving the remaining projects: Geant4 (already started), GeantV, CORAL/COOL, ...
- ❖ Tried to have a CERN Jenkins service (provided by IT)
 - ❖ Not successful - IT not flexible enough
- ❖ Move remaining of build machines from EC to Jenkins
- ❖ New plugins being investigated (mailer, better reporting,...)



Jenkins

Infrastructure and Services

- ❖ The project's team will participate to the maintenance and the running of the updated set of services
 - ❖ Benedikt's presentation at later time
- ❖ Prepare and produce new **LCG releases** (aiming for a rotation role)
 - ❖ Driven by LIM / AF decisions
 - ❖ Use the automated procedures and scripts developed by the project
 - ❖ Check and validate acceptance tests
- ❖ Prepare and produce new **HepSoft releases**
 - ❖ Driven by the needs of the Theory Community
 - ❖ Use the procedures and scripts developed by the project
 - ❖ Check and validate acceptance tests

More during 2015 ...

- ❖ Automation of more procedures to support life-cycle of projects
 - ❖ ROOT tagging, doc generation, binaries, ...
 - ❖ Synchronizing installations to CVMFS
 - ❖ LCG releases for LHC experiments
 - ❖ Full and partial (e.g. adding new versions of generators)
 - ❖ External dependencies packages releases (for ROOT, GeantV,...)
 - ❖ HepSoft releases
- ❖ Better Jenkins and CDash integration
- ❖ Static analysis triggered by Jenkins

Meetings

- ❖ The project participates to the following meetings:
 - ❖ C5 - CERN Computer Centre Coordination Committee
 - ❖ AF/LIM - LCG Application Area Meetings
 - ❖ ITUM - IT Technical Users Meeting
 - ❖ Concurrency Forum
- ❖ In addition, members of the team participate from time to time
 - ❖ LHCb Core software meetings
 - ❖ CMS Statistics meetings
 - ❖ CMS Core-SW meetings
 - ❖ ATLAS software meetings

Conferences/Workshops

- ❖ CHEP
 - ❖ 13-17 April, Okinawa
- ❖ ROOT Users' Workshop
 - ❖ 15-18 September, Saas-Fee
- ❖ ROOT I/O Workshops
 - ❖ Not yet fixed (end of May)
- ❖ Annual Concurrency Forum Meeting
 - ❖ Not yet fixed
- ❖ SAAGAS - Keynote by Axel
 - ❖ 23-25 February 2015, in Aachen

Tutorials and Courses

- ❖ tCSC
 - ❖ Danilo
- ❖ CSC
 - ❖ Danilo, Benedikt
- ❖ GridKA School
 - ❖ Benedikt?, Axel?
- ❖ Summer Student's Tutorial
 - ❖ Axel, Bertrand
- ❖ School Statistics DESY
 - ❖ Lorenzo