Servicing HEP experiments with a complete set of ready integrated and configured common software components

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CERN PH/SFT[1] & CERN PH/LBC[2]

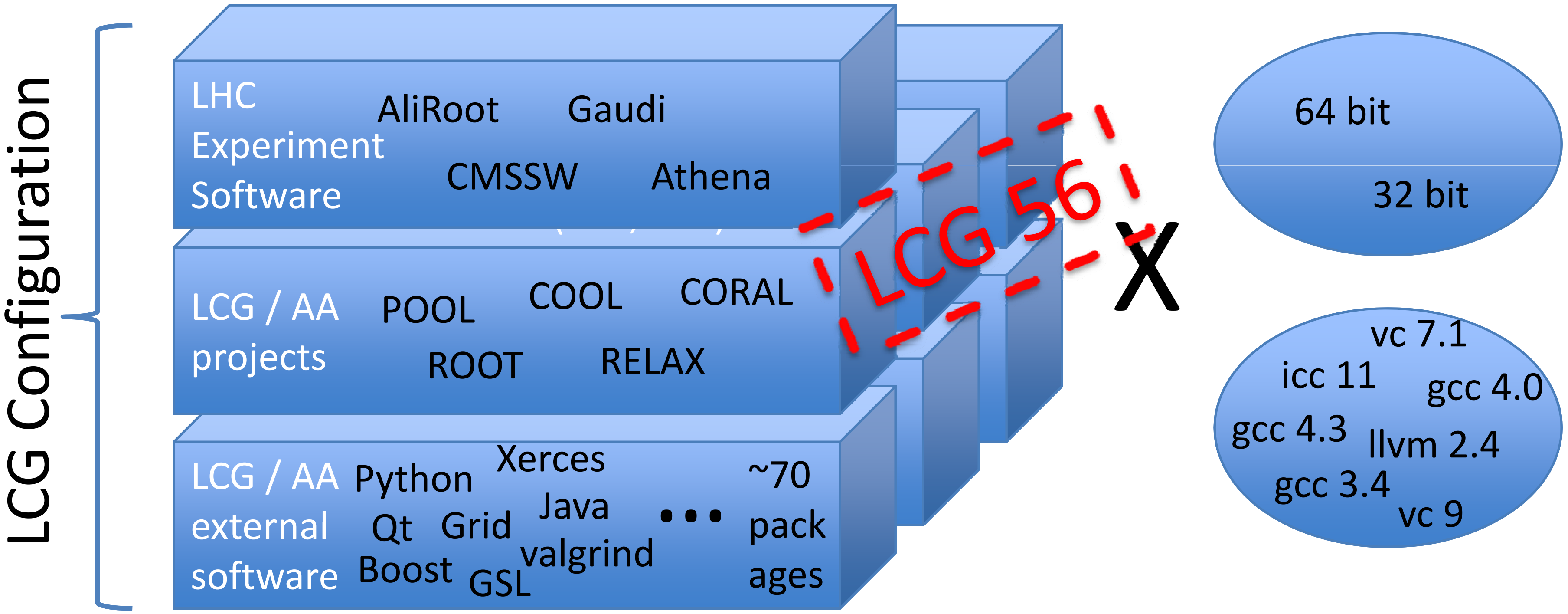
Outline

- LHC Software layers and their testing infrastructure
- How to use LCG software in a non LHC environment

LCG Applications Area

- Develops and maintains basic software components shared by LHC experiments
  - E.g. Geant4, ROOT, POOL, COOL, CORAL, etc.
  - On multiple platforms / compilers / architectures
  - Released in “LCG Configurations” on demand
- Other fields
  - Research projects
    - Virtualization, Multicore
  - Communication Tools
    - Savannah, Hypernews

LHC Software



LCG Configuration

LHC Experiment Software: AliRoot, Gaudi, CMSSW, Athena

LCG / AA projects: POOL, COOL, CORAL, ROOT, RELAX

LCG / AA external software: Python, Xerces, Java, Qt, Grid, valgrind, Boost, GSL … ~70 packages

LCG 56

X

64 bit

32 bit

vc 7.1

icc 11

gcc 4.0

gcc 4.3

llvm 2.4

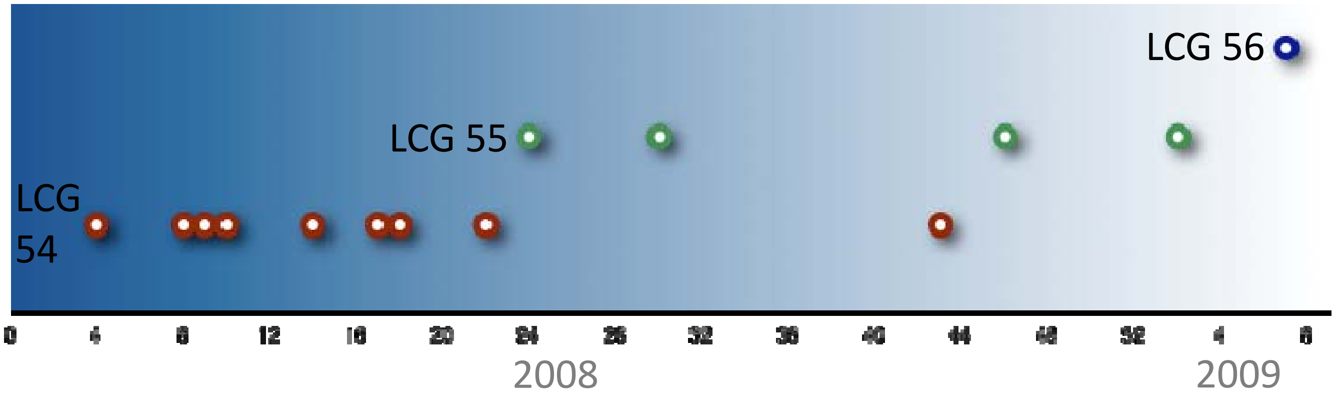
gcc 3.4

vc 9

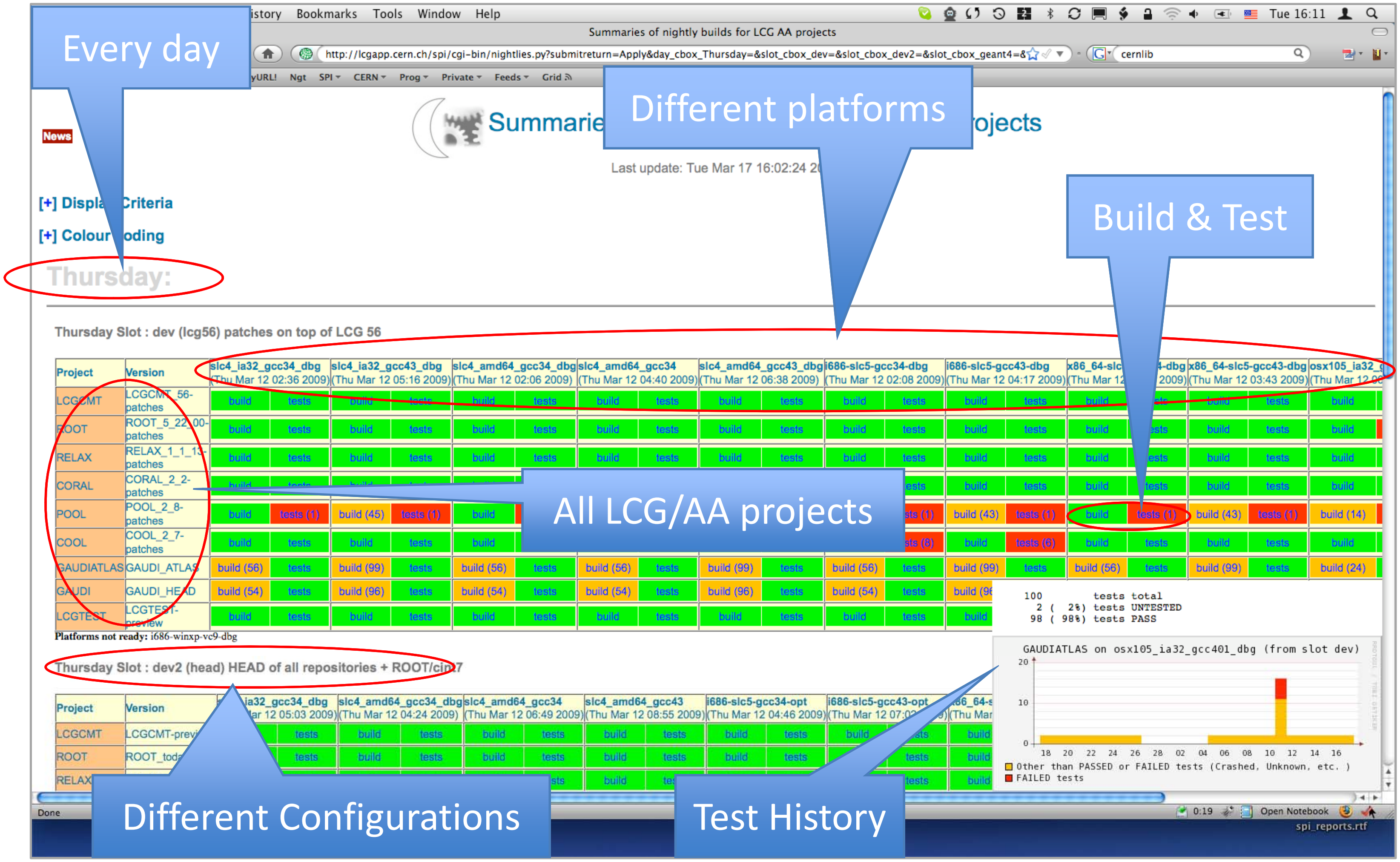
= ~ 20 different platforms

LCG Releases

- LCG Configurations released on demand
  - Schedules discussed with experiments in Architects Forum
  - Usually 2 major release series / year
    - Targeting major changes e.g. new compilers / platforms
    - + bug fix releases on top when needed



LCG Project Software Testing



Every day

Different platforms

Build & Test

All LCG/AA projects

Different Configurations

Test History

istory
Bookmarks
Tools
Window
Help
Tue 16:11
Summaries of nightly builds for LCG AA projects
http://lcgapp.cern.ch/spi/cgi-bin/nightlies.py?submitreturn=Apply&day_cbox_Thursday=&slot_cbox_dev=&slot_cbox_dev2=&slot_cbox_geant4=&
cernlib
yURL!
Ngt
SPI
CERN
Prog
Private
Feeds
Grid
News
Summarie
ojects
[+] Displa Criteria
[+] Colour oding
Done
0:19
Open Notebook
spi_reports.rtf

Last update: Tue Mar 17 16:02:24 2

Thursday:

Thursday Slot : dev (lcg56) patches on top of LCG 56

Project	Version	slc4_ia32_gcc34_dbg (Thu Mar 12 02:36 2009)		slc4_ia32_gcc43_dbg (Thu Mar 12 05:16 2009)		slc4_amd64_gcc34_dbg (Thu Mar 12 02:06 2009)		slc4_amd64_gcc34 (Thu Mar 12 04:40 2009)		slc4_amd64_gcc43_dbg (Thu Mar 12 06:38 2009)		i686-slc5-gcc34-dbg (Thu Mar 12 02:08 2009)		i686-slc5-gcc43-dbg (Thu Mar 12 04:17 2009)		x86_64-slc[illegible]-dbg (Thu Mar 12 [illegible] 2009)		x86_64-slc5-gcc43-dbg (Thu Mar 12 03:43 2009)		osx105_ia32_ (Thu Mar 12 0
LCGCMT	LCGCMT_56-patches	build	tests	build	tests	build	tests	build	tests	build	tests	build	tests	build	tests	build	tests	build	tests	build
ROOT	ROOT_5_22_00-patches	build	tests	build	tests	build	tests	build	tests	build	tests	build	tests	build	tests	build	tests	build	tests	build
RELAX	RELAX_1_1_13-patches	build	tests	build	tests	build	tests	build	tests	build	tests	build	tests	build	tests	build	tests	build	tests	build
CORAL	CORAL_2_2-patches	build	tests	build	tests	build	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	tests	build	tests	build	tests	build	tests	build
POOL	POOL_2_8-patches	build	tests (1)	build (45)	tests (1)	build	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	tests (1)	build (43)	tests (1)	build	tests (1)	build (43)	tests (1)	build (14)
COOL	COOL_2_7-patches	build	tests	build	tests	build	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	tests (8)	build	tests (6)	build	tests	build	tests	build
GAUDIATLAS	GAUDI_ATLAS	build (56)	tests	build (99)	tests	build (56)	tests	build (56)	tests	build (99)	tests	build (56)	tests	build (99)	tests	build (56)	tests	build (99)	tests	build (24)
GAUDI	GAUDI_HEAD	build (54)	tests	build (96)	tests	build (54)	tests	build (54)	tests	build (96)	tests	build (54)	tests	build (96						
LCGTEST	LCGTEST-preview	build	tests	build	tests	build	tests	build	tests	build	tests	build	tests	build						

Platforms not ready: i686-winxp-vc9-dbg

```
100        tests total
  2 (  2%) tests UNTESTED
 98 ( 98%) tests PASS
```

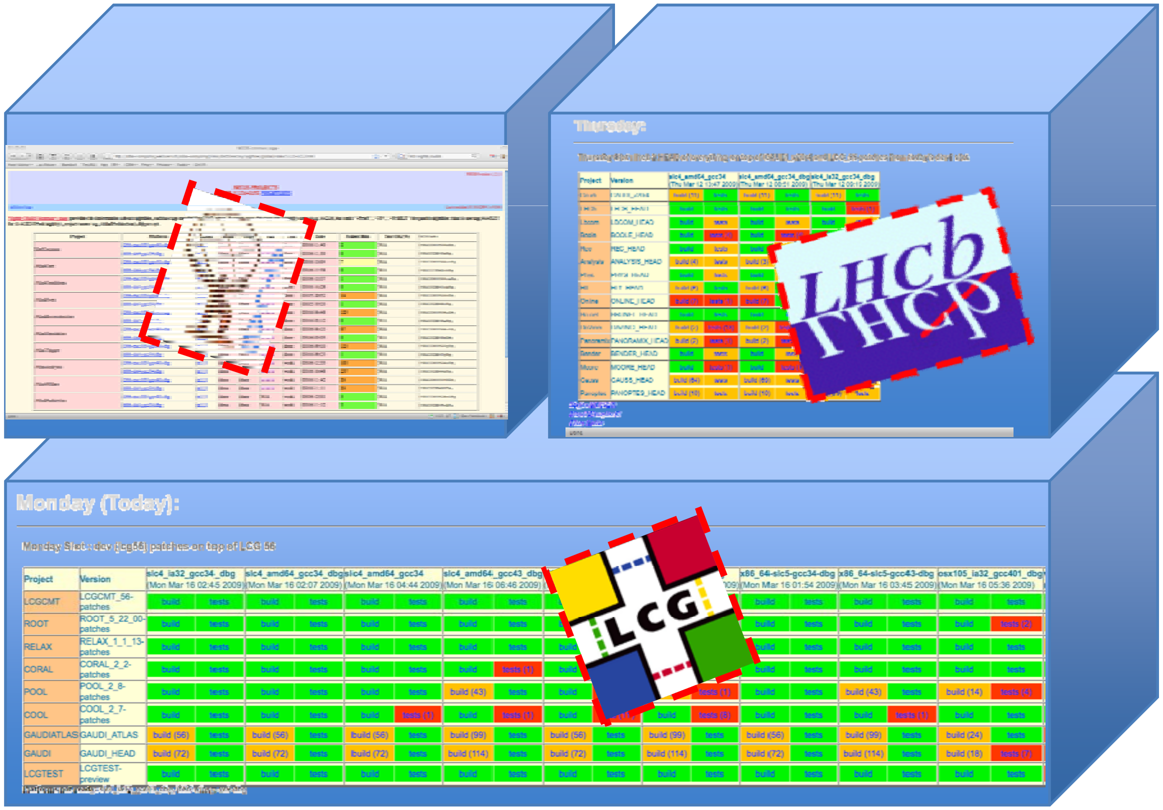
GAUDIATLAS on osx105_ia32_gcc401_dbg (from slot dev)
20
10
0
18
20
22
24
26
28
02
04
06
08
10
12
14
16
🟧 Other than PASSED or FAILED tests (Crashed, Unknown, etc.)
🟥 FAILED tests

Thursday Slot : dev2 (head) HEAD of all repositories + ROOT/cint7

Project	Version	ia32_gcc34_dbg (ar 12 05:03 2009)		slc4_amd64_gcc34_dbg (Thu Mar 12 04:24 2009)		slc4_amd64_gcc34 (Thu Mar 12 06:49 2009)		slc4_amd64_gcc43 (Thu Mar 12 08:55 2009)		i686-slc5-gcc34-opt (Thu Mar 12 04:46 2009)		i686-slc5-gcc43-opt (Thu Mar 12 07:0 2009)		86_64-s (Thu Mar
LCGCMT	LCGCMT-previ	[illegible]	tests	build	tests	build	tests	build	tests	build	tests	build	[illegible]	build
ROOT	ROOT_tod	[illegible]	tests	build	tests	build	tests	build	tests	build	tests	[illegible]	tests	build
RELAX	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	tests	build	tes	[illegible]	[illegible]	[illegible]	tests	build

V. Diez; Geant4 testing integration into LCG nightly builds system

LHC Software Testing Stack



Thursday:

[illegible]

Project	Version	slc4_amd64_gcc34 (Thu Mar 12 13:47 2009)		slc4_amd64_gcc34_dbg (Thu Mar 12 08:51 2009)		slc4_ia32_gcc34_dbg (Thu Mar 12 09:10 2009)	
[illegible]	[illegible]	build (11)	tests	build (11)	tests	build (11)	tests
LHCb	LHCB_HEAD	build	tests	build	tests	build	tests (1)
Lbcom	LBCOM_HEAD	build	tests	build	tests	build	[illegible]
Boole	BOOLE_HEAD	build	tests (4)	build	tests (4)	[illegible]	[illegible]
Rec	REC_HEAD	build	tests	build	[illegible]	[illegible]	[illegible]
Analysis	ANALYSIS_HEAD	build (4)	tests	build (3)	[illegible]	[illegible]	[illegible]
Phys	PHYS_HEAD	build	tests	build	[illegible]	[illegible]	[illegible]
Hlt	HLT_HEAD	build (8)	tests	build (8)	[illegible]	[illegible]	[illegible]
Online	ONLINE_HEAD	build (7)	tests (1)	build (7)	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	build	tests	build	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	build (2)	tests (13)	build (2)	[illegible]	[illegible]	[illegible]
Panoramix	PANORAMIX_HEAD	build (2)	tests (1)	build (2)	[illegible]	[illegible]	[illegible]
Bender	BENDER_HEAD	build	tests	build	[illegible]	[illegible]	[illegible]
Moore	MOORE_HEAD	build	tests (1)	build	[illegible]	[illegible]	[illegible]
Gauss	GAUSS_HEAD	build (64)	tests	build (60)	[illegible]	[illegible]	[illegible]
Panoptes	PANOPTES_HEAD	build (10)	tests	build (10)	tests	[illegible]	tests

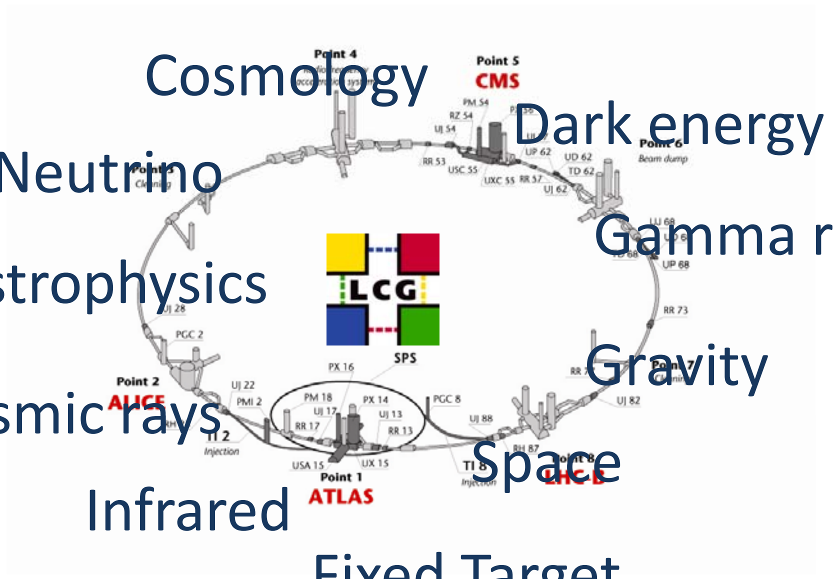
Monday (Today):

Monday Slot : dev (lcg56) patches on top of LCG 56

Project	Version	slc4_ia32_gcc34_dbg (Mon Mar 16 02:45 2009)		slc4_amd64_gcc34_dbg (Mon Mar 16 02:07 2009)		slc4_amd64_gcc34 (Mon Mar 16 04:44 2009)		slc4_amd64_gcc43_dbg (Mon Mar 16 06:46 2009)		[illegible]		[illegible] 009)		x86_64-slc5-gcc34-dbg (Mon Mar 16 01:54 2009)		x86_64-slc5-gcc43-dbg (Mon Mar 16 03:45 2009)		osx105_ia32_gcc401_dbg (Mon Mar 16 05:36 2009)	
LCGCMT	LCGCMT_56-patches	build	tests	build	tests	build	tests	build	tests	[illegible]	[illegible]	[illegible]	[illegible]	build	tests	build	tests	build	tests
ROOT	ROOT_5_22_00-patches	build	tests	build	tests	build	tests	build	tests	[illegible]	[illegible]	[illegible]	[illegible]	build	tests	build	tests	build	tests (2)
RELAX	RELAX_1_1_13-patches	build	tests	build	tests	build	tests	build	tests	build	[illegible]	[illegible]	[illegible]	build	tests	build	tests	build	tests
CORAL	CORAL_2_2-patches	build	tests	build	tests	build	tests	build	tests (1)	build	[illegible]	[illegible]	[illegible]	build	tests	build	tests	build	tests
POOL	POOL_2_8-patches	build	tests	build	tests	build	tests	build (43)	tests	build	[illegible]	[illegible]	tests (1)	build	tests	build (43)	tests	build (14)	tests (4)
COOL	COOL_2_7-patches	build	tests	build	tests	build	tests (1)	build	tests (1)	build	[illegible]	build	tests (8)	build	tests	build	tests (1)	build	tests
GAUDIATLAS	GAUDI_ATLAS	build (56)	tests	build (56)	tests	build (56)	tests	build (99)	tests	build (56)	tests	build (99)	tests	build (56)	tests	build (99)	tests	build (24)	tests
GAUDI	GAUDI_HEAD	build (72)	tests	build (72)	tests	build (72)	tests	build (114)	tests	build (72)	tests	build (114)	tests	build (72)	tests	build (114)	tests	build (18)	tests (7)
LCGTEST	LCGTEST-preview	build	tests	build	tests	build	tests	build	tests	build	tests	build	tests	build	tests	build	tests	build	tests

K. Kruzelezki; The nightly build and test system for LCG AA and LHCb software

LCG s/w in a non LHC environment



Dark matter

Cosmology

Dark energy

Neutrino

Gamma ray

Astrophysics

Gravity

Cosmic rays

Space

Infrared

Fixed Target

Many Physics experiments around (> 600) *

- Software built for LHC experiments

…

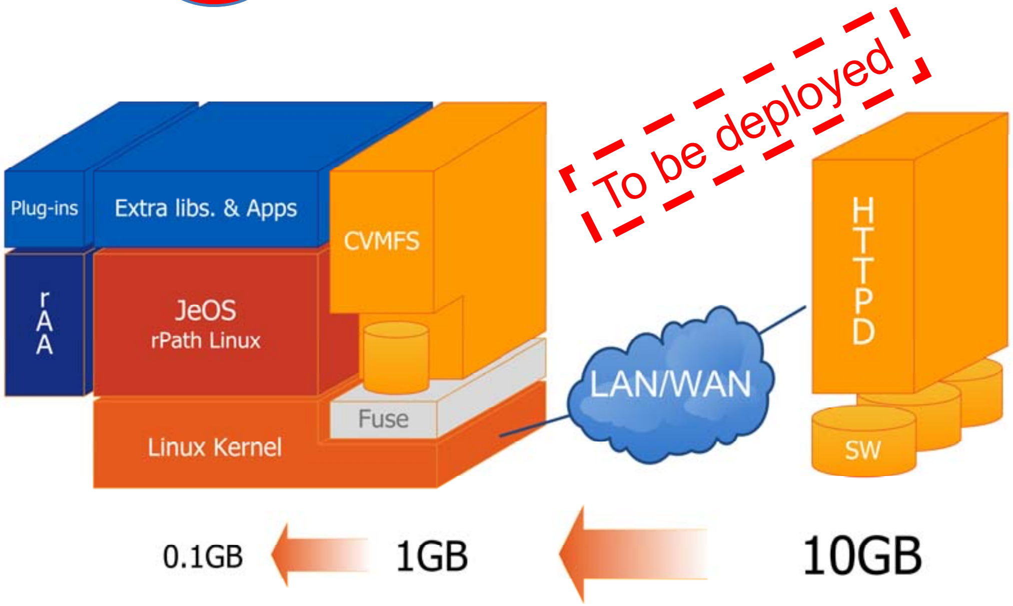
- What about making LCG Configurations usable outside LHC?

* http://www.slac.stanford.edu/spires/experiments/online_exp.shtml

3 ways to get LCG Configurations

1 CERNVM	2 Deploy LCG binaries	3 Recompile sources
Motivation Automatic deployment of LCG/AA software	Motivation Run native on LCG/AA provided platform	Motivation Run native on non LCG/AA provided platform
Functioning Usage of virtualization technologies	Functioning Binary packages provided by LCG/AA infrastructure	Functioning Recompilation of all LCG/AA packages from source
Software deployment Done via network + special caching file system	Software deployment Download of packages via web interface	Software deployment Local deployment by user
Prerequisites Hypervisor + Cernvm image	Prerequisites LCG/AA compliant os	Prerequisites Linux/Mac OSX (!windows)

1 CERNVM



- Virtual machine running with several hypervisors & host platforms
- CVMFS allows download & caching of only needed parts for execution of the application
  - Usually a fraction of the originally deployed stack

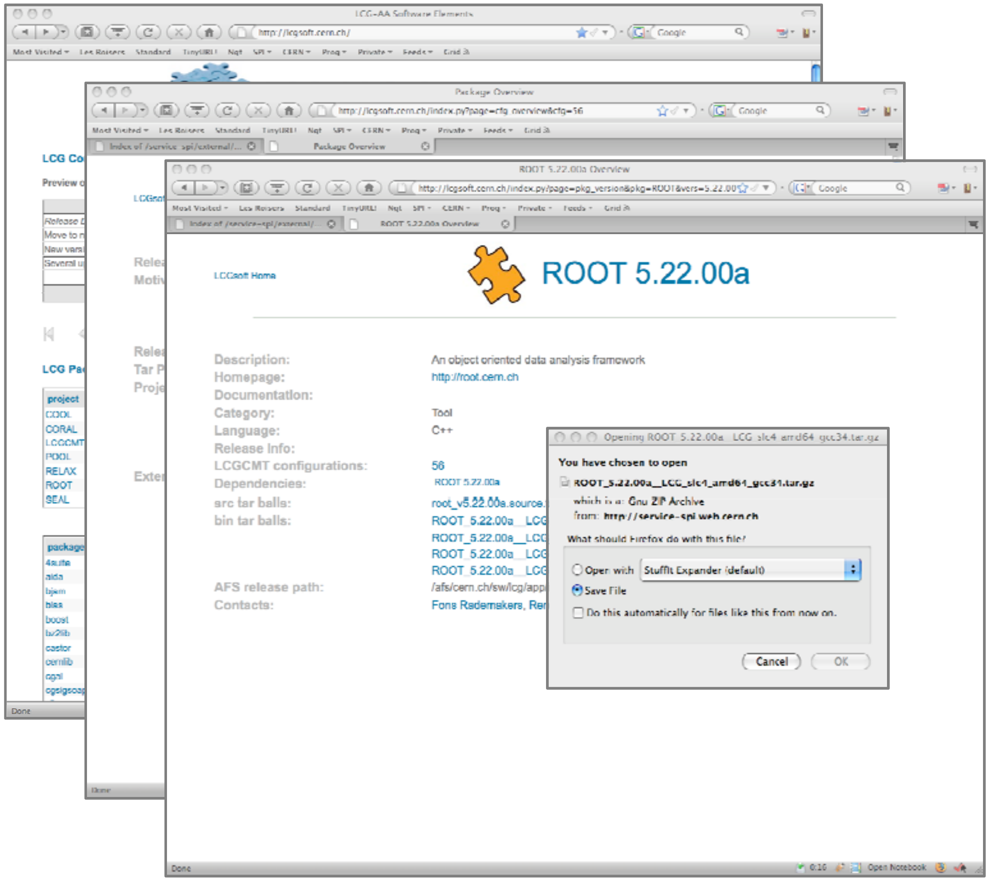
P. Buncic; CernVM - a Virtual Software Appliance for LHC applications

2 Deploying LCG/AA binaries

1 Go to http://lcgsoft.cern.ch

2 Choose your LCG Configuration

3 Choose needed packages and download tar file



ROOT 5.22.00a

Description: An object oriented data analysis framework
Homepage: http://root.cern.ch
Documentation:
Category: Tool
Language: C++
Release Info:
LCGCMT configurations: 56
Dependencies: ROOT 5.22.00a
src tar balls: root_v5.22.00a.source
bin tar balls: ROOT_5.22.00a__LCG
ROOT_5.22.00a__LCG
ROOT_5.22.00a__LCG
ROOT_5.22.00a__LCG
AFS release path: /afs/cern.ch/sw/lcg/app
Contacts: Fons Rademakers, Re

Opening ROOT_5.22.00a__LCG_slc4_amd64_gcc34.tar.gz

You have chosen to open

ROOT_5.22.00a__LCG_slc4_amd64_gcc34.tar.gz
which is a: Gnu ZIP Archive
from: http://service-spi.web.cern.ch

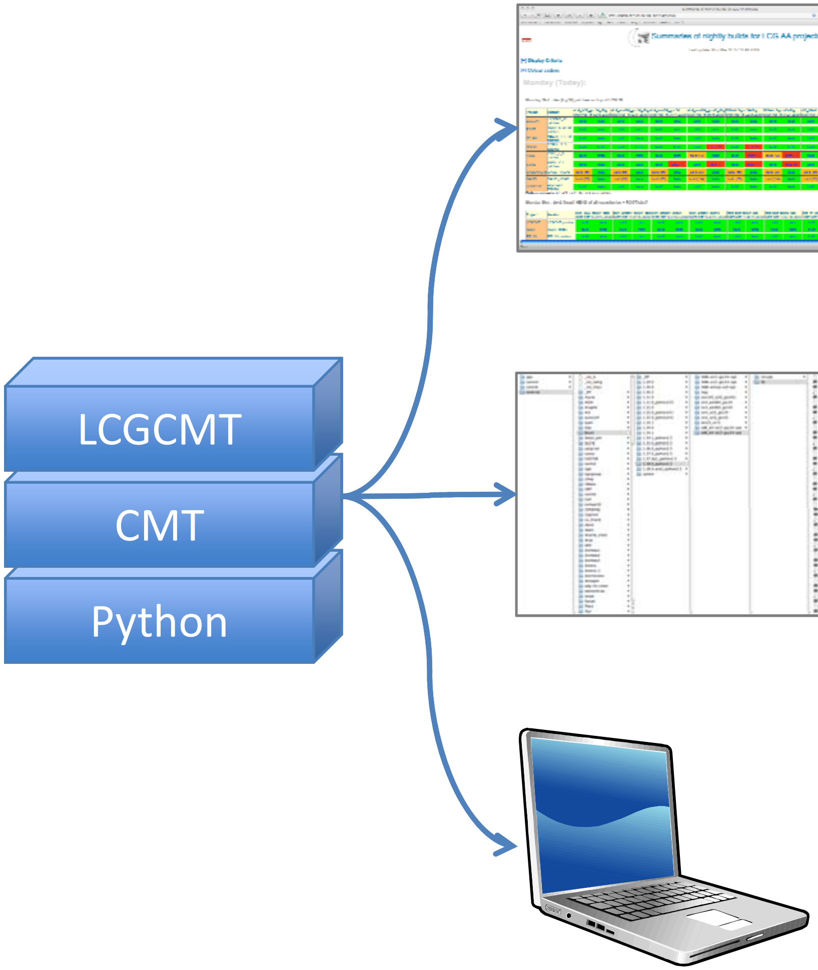
What should Firefox do with this file?

○ Open with StuffIt Expander (default)
● Save File
□ Do this automatically for files like this from now on.

3 Build LCG/AA s/w from source

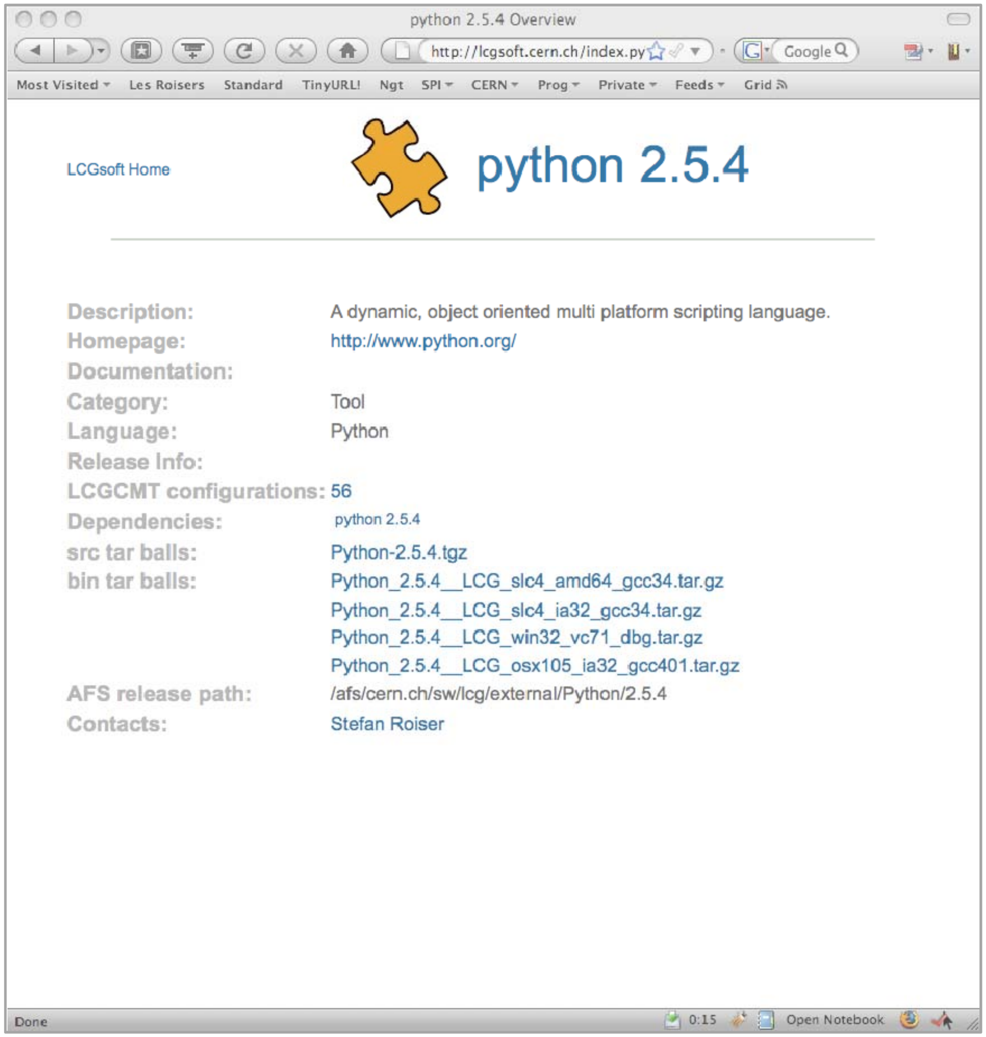
We are using the same Tools and procedure for all LCG/AA packages for

- Nightly builds
- AFS installations
- User recompilation



3 How to build an LCG/AA package

1 Bootstrap the 3 necessary packages, i.e. download and install
   1 Python
   2 CMT
   3 LCGCMT



LCGsoft Home

python 2.5.4

Description:	A dynamic, object oriented multi platform scripting language.
Homepage:	http://www.python.org/
Documentation:	
Category:	Tool
Language:	Python
Release Info:	
LCGCMT configurations:	56
Dependencies:	python 2.5.4
src tar balls:	Python-2.5.4.tgz
bin tar balls:	Python_2.5.4__LCG_slc4_amd64_gcc34.tar.gz Python_2.5.4__LCG_slc4_ia32_gcc34.tar.gz Python_2.5.4__LCG_win32_vc71_dbg.tar.gz Python_2.5.4__LCG_osx105_ia32_gcc401.tar.gz
AFS release path:	/afs/cern.ch/sw/lcg/external/Python/2.5.4
Contacts:	Stefan Roiser

3 How to build an LCG/AA package

2 Override default values if needed + setup environment

```
macro LCG_builddir “/build”
macro LCG_home “/opt/lcg”

tag x86_64-ubuntu810-gcc43-opt
    target-linux target-x86_64
    target-gcc43 target-opt
```

```
lxplus:~> export CMTCONFIG=x86_64-ubuntu810-gcc43-opt
lxplus:~> . /opt/lcg/sw/CMT/v1r20p20081113/mgr/setup.sh
```

3 How to build an LCG/AA package

3 Repeat standardized build procedure for the needed set of LCG/AA packages

```
lxplus:~>cd LCGCMT_56/LCG_Builders/ROOT/cmt
lxplus:cmt> cmt pkg_get
lxplus:cmt> cmt pkg_config
lxplus:cmt> cmt pkg_make
lxplus:cmt> cmt pkg_install
lxplus:cmt> cmt pkg_test
lxplus:cmt> ls …/ROOT/5.22.00a/x86_64-ub81-gcc43-opt/root
bin    etc     geom    include  LICENSE  man     test
cint   fonts   icons   lib      macros   README  tmva
lxplus:cmt> ls logs
ROOT_x86_64-ubuntu810-gcc43-opt_config.log
ROOT_x86_64-ubuntu810-gcc43-opt_make.log … … …
```

3 Real world example

- Software for large water cerenkov detectors eg. DUSEL (US), MEMPHY (EU)
- Packages rebuilt so far with LCG/AA procedure for ubuntu 8.04
  - GAUDI, ROOT, RELAX, GAUDI, Cmake , Python, Clhep, Gccxml, XercesC, HepMC, HepPDT, GSL, Bjam, Boost, Mysql, QMTest, CppUnit
- New package build information was fed back to LCG/AA for OpenScientist

Advantages of LCG Configurations

- Self-consistent sets of basic software packages
  - Use of recent packages / tools
  - HEP specific patches when needed
- Several deployment method possible
  - Virtual Machine, LCG/AA binaries or recompilation
- Multi platform / architecture / compiler
  - Continuous performance / unit / integration testing
  - Adding to overall software stability
- Flexible adaptation possible
  - Using e.g. CMT as configuration tool

Future enhancements

- Software deployment
  - Integration with CERNVM
  - Package deployment system for binaries (rpm?)
  - Tool for bootstrap procedure when recompiling
- !!! Documentation !!!

Summary

- LCG Applications Area builds and tests the basic software packages for LHC experiments
- Non LHC experiments may use and profit from
  - Consistent set of packages
  - Multi platform/architecture/compiler
  - Agile package version policy
  - Continuous integration, performance, unit testing

Further Info

- Announcements of new LCG Configurations
  - project-lcg-peb-apps@cern.ch
- Details about LCG Configurations (packages, versions, …)
  - http://lcgsoft.cern.ch
- Minutes of the Architects Forum (LCG/AA steering committee)
  - http://lcgapp.cern.ch/project/mgmt/af.html
- Software Process and Infrastructure project
  - http://spi.cern.ch
- LCG/AA nightly builds overview page
  - http://lcgapp.cern.ch/spi/cgi-bin/nightlies.py
- CMT configuration and management tool
  - http://www.cmtsite.org