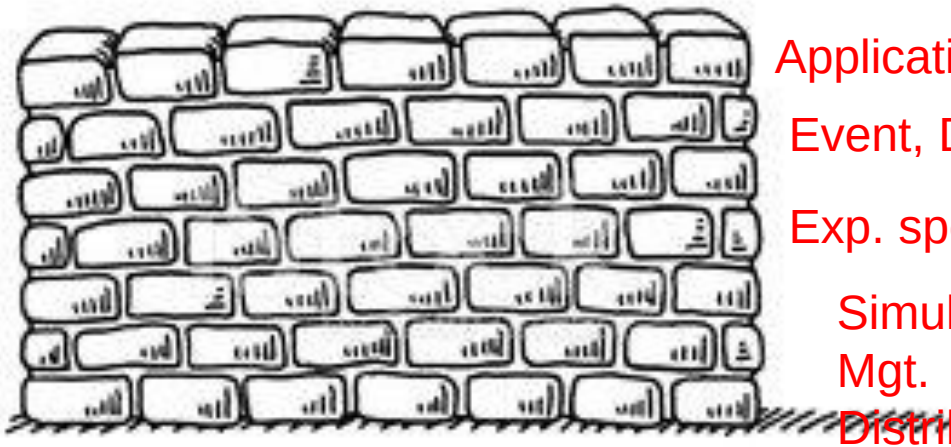
# CHEP18

# Building, testing and distributing common software for the LHC experiments

Patricia Mendez Lorenzo
for the EP-SFT/SPI project

# Overview

This talk relates to this part



Applications

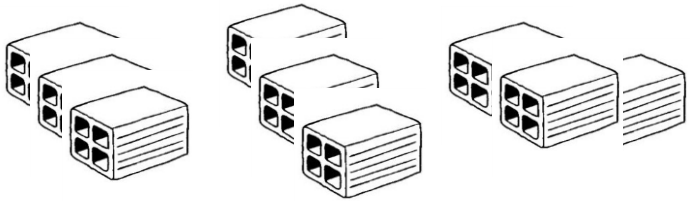
Event, Detector, Calibration

Exp. specific packages

Simulation, Data Mgt.

Distributed analysis….

And here????



Core libraries and external packages non-HEP

# What does the baseline contain? → ca. 400 packages

Including:

- Common EP-SFT projects: ROOT and Geant4
- 55 MC generators and 18 Grid MW packages
- Common tools: cmake, gcc, clang...

| Full release volume | |
|---|---|
| ~500k directories | ~6,3 million files |
| ~65k links | ~350 GB space |

# How do we provide it? → in LCG releases: LCG_XX

- Packaged → EOS: /eos/project/l/lcg/www/lcgpackages
  - https://lcgpackages.web.cern.ch/lcgpackages
  - tar files, RPMS and docker containers
- Expanded → CVMFS: /cvmfs/sft.cern.ch/lcg/releases
  - 10X2 platforms for both python 2 and 3

# Our platform declaration

Platform = ${ARCH}-${OS}-${COMPILER}-${BUILD_TYPE}

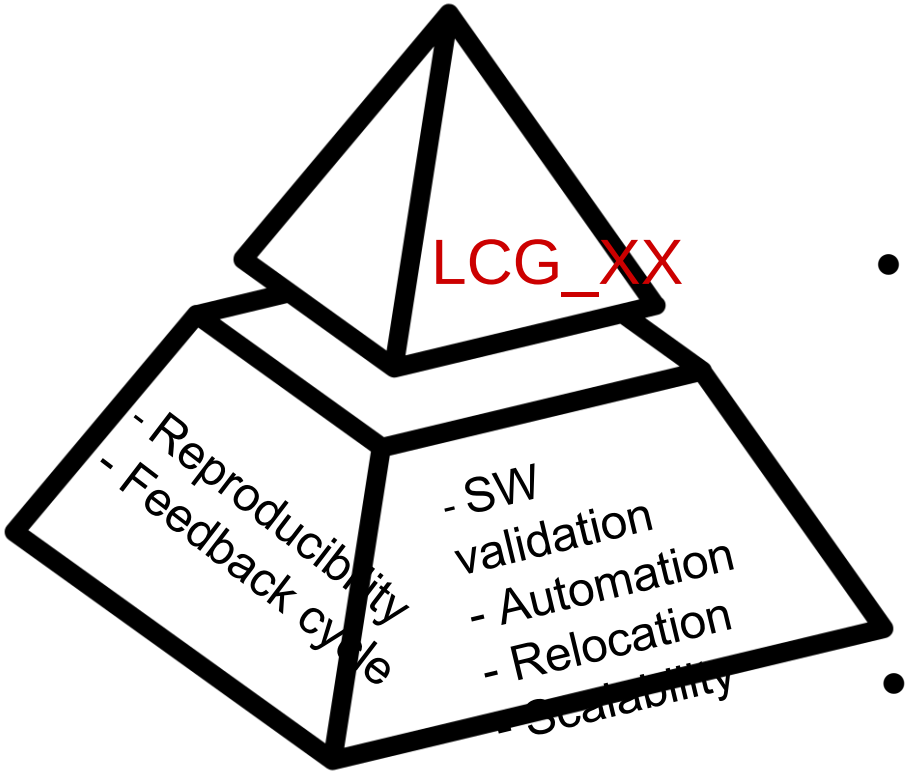
(Definition agreed by the HSF Platform naming convention)

| Compilers | Architectures (ARCH) | Operating Systems (OS) | Build type |
|---|---|---|---|
| • gcc62<br>• gcc7<br>• gcc8<br>• clang60<br>• native (ubuntu) | • x86_64(+avx2+fma) | • slc6<br>• Centos7<br>• Ubuntu16<br>• Ubuntu18<br>• Mac<br>• arm64 | • Release<br>• Debug |

(Under testing in the so-called nightly builds)

See G. Amadio, Robust Linux Binaries, Hall 3 12th July

# Our challenges




- Reproducibility
  - Sources stored in EOS independent of changes in code
  - Specific branches per release
  - Handling of the “internal” packages dependencies
- Scalability
  - Build software structure based on specific cmake modules handling dependencies
  - Modular approach for the implementation of new packages and versions
- Relocation
  - Ability to install packages in different $PREFIXes
- Automation

# Technical aspects of the project

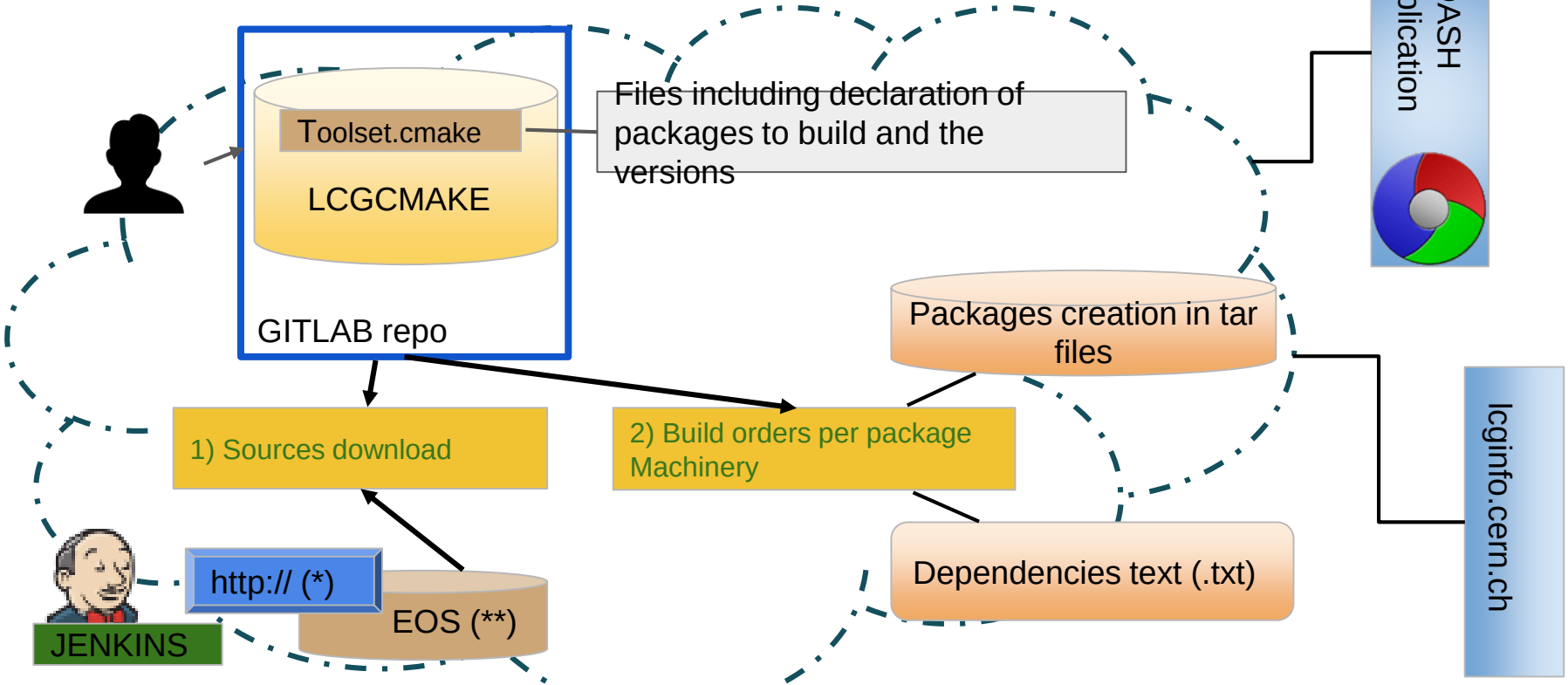
# LCGCMAKE: the core

Responsible of the individual packages build recipes and the default pack

- Build and testing infrastructure CMAKE based
  - Build specifications included in platform-independent list files
  - Modular and scalable system
- Based on “ExternalProject” CMAKE module implementation enabling:
    - Builds from external software sources

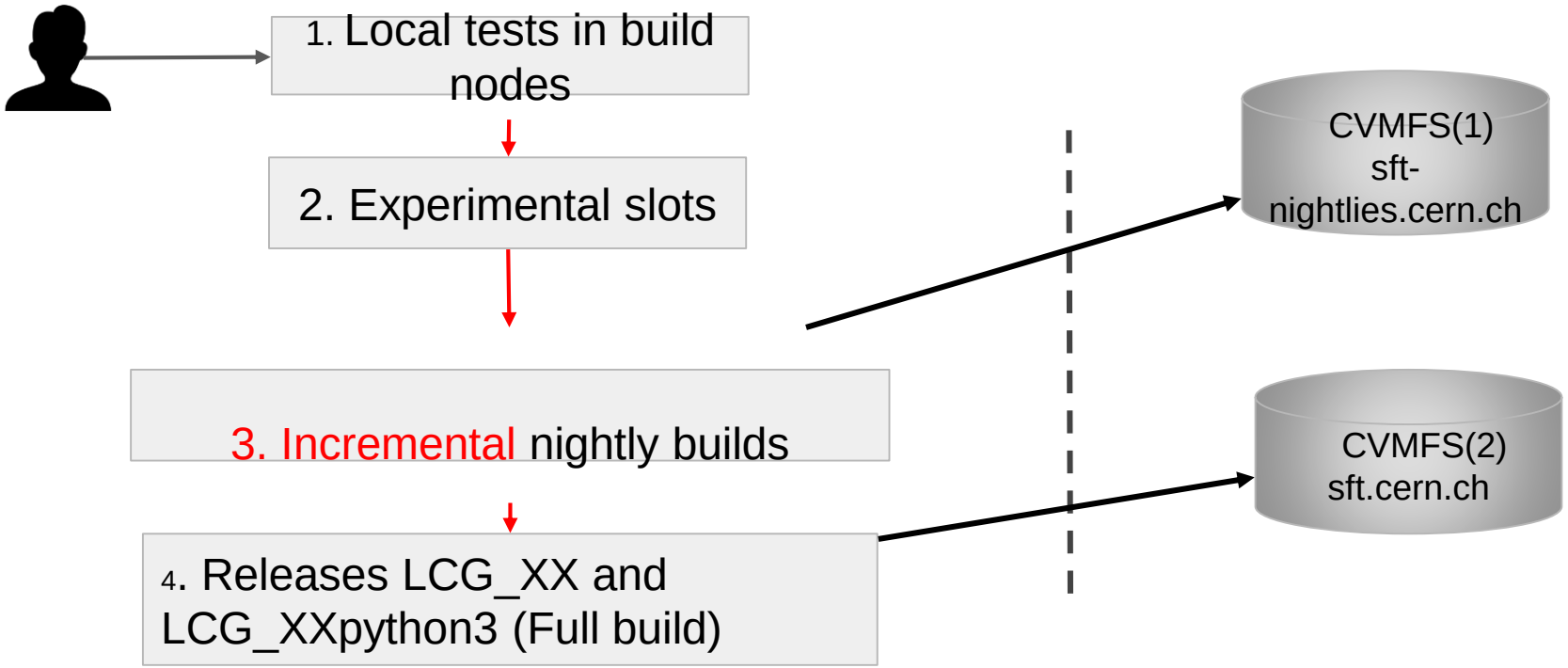
```
# ------ EXAMPLE OF a PACKAGE BUILD
LCGPackage_Add(
  mpfi
  URL ${GenURL}/mpfi-
${mpfi_native_version}.tar.gz
  CONFIGURE_COMMAND ./configure --
prefix=<INSTALL_DIR> --with-
gmp=${gmp_home} --with-
mpfr=${mpfr_home}
  BUILD_COMMAND  make
  INSTALL_COMMAND make install
  BUILD_IN_SOURCE 1
  DEPENDS gmp mpfr
)
```

# The system elements




Separated build execution for every platform

# Lifecycle of a new package

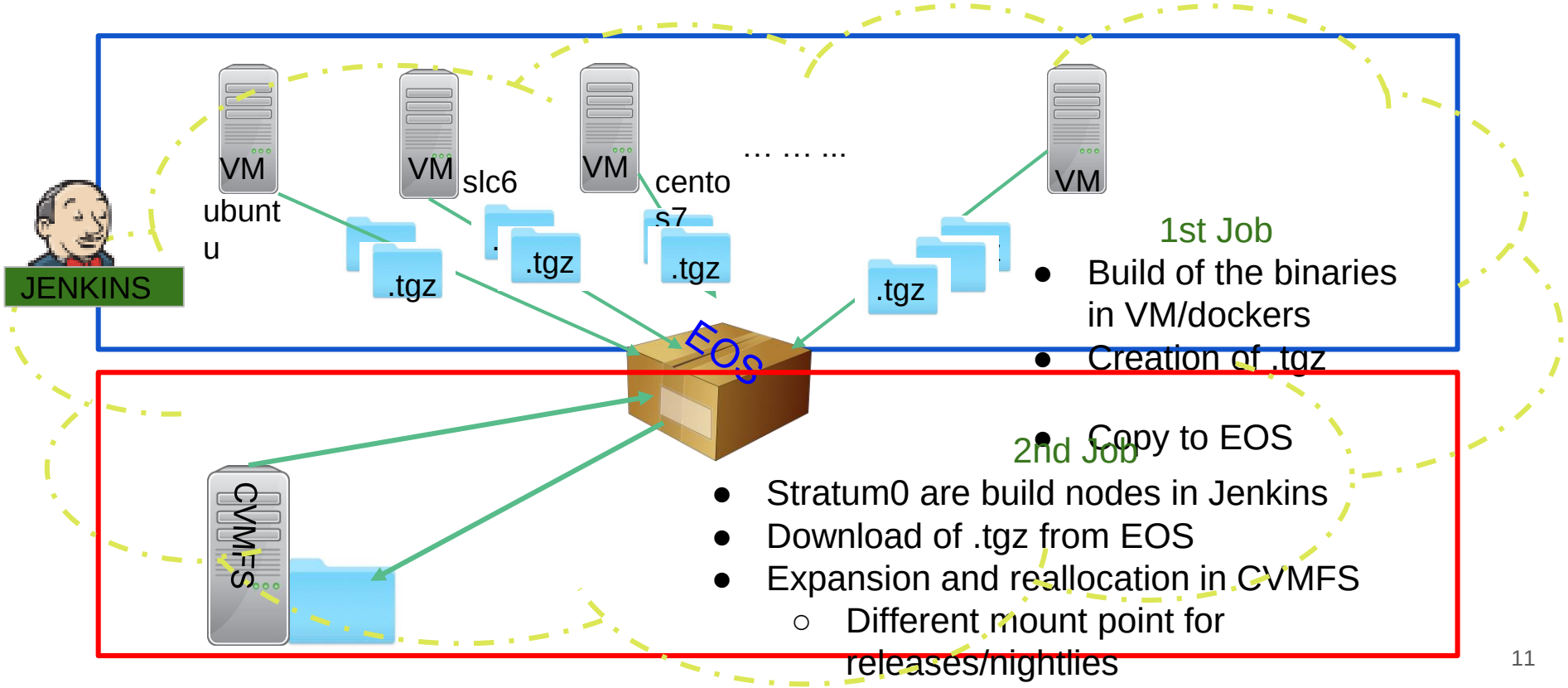


# The packaging approach

- Default packaging: .tgz files created after the individual build of any package → Stored in EOS
  - Same structure for nightlies and releases
  - Specific dependencies .txt file available
  - Copy to EOS based on an incremental approach handled by the inclusion of a HASH parameter for each package (determined by the version-revision-dependencies )

- Releases only:
  - RPMS provided also in the case of releases by experiment demand → Stored in EOS
  - Flexible Provision of docker containers → Stored in EOS

# Binaries distribution workflow



# Automation infrastructure

add description

All | CVMFS | CernVM | FCC | GENSER | Geant4 | GeantV | **LCG Externals** | LCG Nightlies | ROOT | ROOT-incr | SAS | VecCore | VecGeom | cling | hepmc3 | +

**Jenkins jobs list**

| S | W | Name ↓ | Last Success | Last Failure | Last Duration | Last Duration | Cron Trigger |
|---|---|---|---|---|---|---|---|
| | | complete_rpms_release_actions | 4 days 0 hr - #147 | 17 days - #140 | 1 hr 49 min | 1 hr 49 min | |
| | | genser-quickval | 11 hr - #2241 | 2 yr 10 mo - #173 | 2.8 sec | 2.8 sec | Build periodically: H */12 * * * |
| | | lcg-check-disk-space | 15 hr - #1425 | 5 days 15 hr - #1410 | 50 sec | 4 hr 13 min and counting | Build periodically: H(0-20) 7,14,20 * * * |
| | | lcg-clean-builds | 13 days - #1614 | 17 hr - #1639 | 4 hr 39 min | 15 min and counting | Build periodically: H(0-20) 11,18 * * * |
| | | lcg-clean-lcgsoftDB | 9 mo 0 days - #409 | 13 hr - #677 | 8.1 sec | 2.5 sec | Build periodically: H H(22-23) * * * |
| | | lcg-Master-to-EOS | 19 min - #9348 | N/A | 1 min 20 sec | 1 min 20 sec | |
| | | lcg-prepare-builds | 12 hr - #1360 | N/A | 1 min 41 sec | 1 min 41 sec | Build periodically: H H(22-23) * * * |
| | | lcg_afs_install | 7 mo 12 days - | 7 mo 29 days - | 38 min | 38 min | |

Our own Jenkins structure

- Around 500 CPUs distributed among ubuntu/mac/slc6/centos6/fedora systems
- Docker containers (Centos7 VM) available for SLC6/Centos7/Ubuntu16/Ubuntu18/Fedora
- https://epsft-jenkins.cern.ch

# Build results dashboard

http://cdash.cern.ch → accesible outside CERN

Login All Dashboards

**LCGSoft**

Dashboard Calendar Previous Current Next Project

No file changed as of **Saturday, May 26 2018 - 22:00 UTC**

**5 minutes ago:** 2 tests failed on dev4-x86_64-slc6-gcc62-dbg
**22 minutes ago:** 1 warning introduced on 93-x86_64-slc6-gcc62-opt
**22 minutes ago:** 5 errors introduced on 93-x86_64-slc6-gcc62-opt
**25 minutes ago:** 1 warning introduced on 93-x86_64-slc6-gcc62-opt
**42 minutes ago:** 144 tests failed on experimental-x86_64-ubuntu18-gcc7-dbg

**Experimental**

| Site | Build Name | Update | Configure | | Build | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Files | Error | Warn | Error | | | | | |
| lcgapp-centos7-x86-64-40.cern.ch-docker | experimental-x86_64-ubuntu18-gcc7-opt | 0 | 0 | 1 | 86 | | | | | |
| lcgapp-centos7-x86-64-38.cern.ch-docker | experimental-x86_64-centos7-gcc8-opt | 0 | 0 | 1 | 25 | | | | | |
| lcgapp-centos7-x86-64-33.cern.ch-docker | experimental-x86_64-centos7-gcc62-opt | 0 | 0 | 1 | 0 | | | | | |
| lcgapp-centos7-x86-64-31.cern.ch-docker | experimental-x86_64-centos7-gcc7-dbg | 0 | 0 | 1 | 4 | 1 | 0 | 119 | $563_{-460}$ | May 27, 2018 - 09:51 UTC |
| lcgapp-centos7-x86-64-39.cern.ch-docker | experimental-x86_64-centos7-gcc7-opt | 0 | 0 | 1 | $4_{-9}$ | 1 | 0 | $123^{+10}_{-178}$ | $559^{+46}_{-55}$ | May 27, 2018 - 09:46 UTC |

**LCGSoft**

Dashboard Calendar Previous Current Next

**Site:** lcgapp-centos7-x86-64-40.cern.ch-docker
**Build name:** experimental-x86_64-ubuntu18-gcc7-opt
**Build start time:** 2018-05-27 11:03:56

**URLs or Files submitted with this build**

| File | Size | SHA-1 |
|---|---|---|
| Frontier_Client-2.8.19-build.log | 1 Kb | 1e375b16ec6d82006473b732c4901f9b6f450dd8 |
| Qt5-5.9.2-build.log | 22 Kb | a0fda25a8cf8d08405c8cf556a0ff7d21b064373 |
| automake-1.14-build.log | 571 b | 46567a3743d52d4cd0dd7e3798ae364c922a3599 |
| clang-3.9.0-install.log | 409 Kb | 6c490a5843aa41fb9aa3da48ede2e90c2e6f7c9c |
| hadoop-2.7.4-build.log | 1 Mb | 39877c9d0d268660d7ae9a7d4d40390193daa7d9 |
| hdf5-1.8.18-build.log | 933 Kb | c73749d348b50a41b049308d2baa6b81e5a7172b |
| igprof-5.9.16-build.log | 12 Kb | 038d72ab6a38612ac93e471f42d29af0982169e9 |
| valgrind-3.11.0-configure.log | 2 Kb | f39350eb2a06abb1fa0deae8313e22cfb8a49ea8 |
| herwig++-2.7.1-build.log | 919 Kb | b653c51be3779a0f5d7d4fc9f7635e6375b51e06 |

```
    (void)write(1,log_msg,ret+1)
    ^~~~~~~~~~~~~~~~~~~~~~~~~~~
frontier_log.c:93:3: warning: ignoring return value of 'write', declared with attribute warn_unused_result [-Wunused-result]
   (void)write(log_fd,log_msg,ret+1)
   ^~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
/usr/bin/x86_64-linux-gnu-ld: cannot find -lfrontier_client
collect2: error: ld returned 1 exit status
Makefile:289: recipe for target 'fn-req' failed
make[3]: *** [fn-req] Error 1
/usr/bin/x86_64-linux-gnu-ld: cannot find -lfrontier_client
collect2: error: ld returned 1 exit status
Makefile:299: recipe for target 'fn-fileget' failed
make[3]: *** [fn-fileget] Error 1
make[3]: Target 'dist' not remade because of errors.
```

# Publication of the releases

http://lcginfo.cern.ch/ → accesible outside CERN

## LCG Software Elements

Main / LCG Configurations Diff (93 / 92)

| | LCG Configuration 93 | LCG Configuration 92 |
|---|---|---|
| **Tool** | | |
| Boost | 1.66.0 | 1.64.0 |
| CLHEP | 2.4.0.1 | 2.3.4.4 |
| delphes | 3.4.2pre12 | 3.4.0 |

# Summary and Future

- The EP-SFT group has enabled a robust and scalable structure to provide hundreds of binaries to the experiments and users
  - Stable working bleeding edge available on a daily basis
  - Biggest effort in the last years: Ensure a high level of automation
  - Structure ready to escalate to a large range of compilers and OS
  - Support to three packaging structures: tar files, RPMS and containers
- Covering the needs of:
  - ATLAS, LHCb, SWAN, FCC, Spark, Hadoop, BE dept. and a large range of individual users
- Future:
  - Increase the level of validation
  - Provide pre-releases
  - Structure embedded on the HSF project as part of the future build and packaging