#### Improving XRootD's testing infrastructure CERN IT-SD Angelo Galavotti Supervised by: Guilherme Amadio



# What's XRootD?

**XRootD** is a **data management software** designed to provide high performance, scalable and fault tolerant access to various types of data repositories.

- It was born through a collaboration between CERN and Stanford University's SLAC National Accelerator Laboratory, as a successor of rootd.
- It is now **widely adopted** by the High Energy Physics (HEP) community, especially after the Run-3 of LHC.





## Overview

XRootD's testing suite uses **CPPUnit** as the main framework, as well as CMake's ctest to execute the tests.

• CPPUnit is **outdated** (latest stable release in 2017!!)  $\rightarrow$  **unreliable**.

At the same time, some design choices are **sub-optimal**:

- Some big, "randomly" generated test files are downloaded.
- Some tests require a setup comprised of a cluster of containers (difficult to integrate in CI)

Also: hard-coded information, bugs ....



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# Let's fix this!



# Conversion to GoogleTest

**GoogleTest** is Google's C++ **testing framework**. It's well maintained and has a good array of features.

• GoogleTest is also easy to use if you have experience with CPPUnit!

Thus, CPPUnit tests were **converted** in GoogleTest equivalent, as well as their auxiliary libraries (i.e. CppUnitXrdHelpers.hh). This resulted in:

- Bug fixes
- Cleaner code



#### From containers to local instances

• Many of XRootD's tests require a **cluster of servers** that communicate with each other.



- Normally, this is achieved using docker containers.
- However, this is not ideal ...
  - Uncomfortable to use when testing
  - Does not integrate well with CI



## From containers to local instances

Instead, we use multiple XRootD and CMSD **instances** running as **processes** in different ports.

- Tests were **refactored** (a lot) to work in this setup.
- The build system was modified so that the process of testing server related features is effortless ...
- ... and, most importantly, easy on the CI system.
  - In addition, when XRootD runs inside a container, we cannot see what was actually covered by the tests.



# Handling test files

XRootD's testing suite uses randomly generated files that are **downloaded** from a server and are quite **big in size**.

- This is at best a **waste of time** and at worst a **waste of CERN's bandwith**.
- There are **hard-coded values** related to them in the testing code.

Files are now locally generated and small in size.

- Lines referencing hard-coded values were also replaced, and instead **file information** is obtained **procedurally**.
- Again, quite a bit of refactoring...



# Finally, concurrent test execution!

XRootD's tests were previously executed in series.

- This needlessly takes lots of time for no reason...
- ...especially when considering that the CI suite runs at each commit!
- (Most) tests are now running in parallel.
  - Although some tests still need to be run in series (for now), test execution time was significantly reduced!
  - As you can imagine, quite a bit of refactoring again...



# And the result is ...

- Code coverage is up from 9.4%<sup>1</sup> to 20.3%<sup>2</sup>
- The code is now **more robust** to changes (i.e. changes to test files).
- (Almost) all tests are integrated in the CI.
- Testing time decreased by  $\sim 30\%$

What's next?

- Adding even more tests!
  - Authn/authz systems tests (Macaroons, VOMS, SciTokens...)
  - Addional zip files tests
  - Improving parallel test execution
  - And, in general, improving coverage!

<sup>&</sup>lt;sup>2</sup>A full report of the coverage can be found at https://xrootd.web.cern.ch/coverage\_new/



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#### Thank you for your attention! For any questions or feedback, you can contact me at angelo.galavotti@studio.unibo.it





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