Physics and Software Validation for ATLAS

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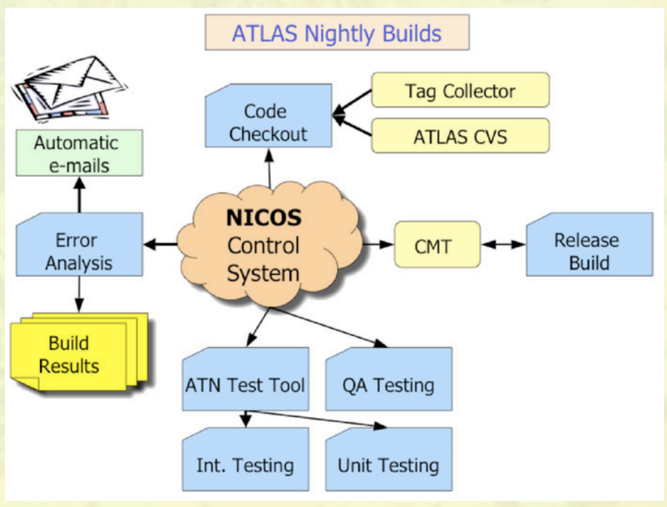
Introduction

The ATLAS experiment is entering the data taking phase, with the focus shifting from software development to validation. The ATLAS software has to be both robust to process large datasets and produce the high quality output needed for the experiment scientific exploitation. The validation of the software is done in two distinct phases. The first step includes testing robustness and software functionalities, the second step includes the production of a relatively large sample of MonteCarlo data, to test the quality of the output quantities. The infrastructure for each stage of validation is described.

From the nightly builds to the production release

At a given time, the ATLAS software consists of a limited number of open releases, typically one to be used for the data taking and one which is foreseen for major simulation production. Every 24 hours, all open releases are automatically built by the Nightly Control System (NICOS). NICOS collects from CVS the tags indicated by a database called Tag Collector and performs a number of modular steps on them: compilation of the code, testing of the compiled code, analysis of errors generated in the compilation testing phase, and finally creation of web pages reporting the results of the testing.

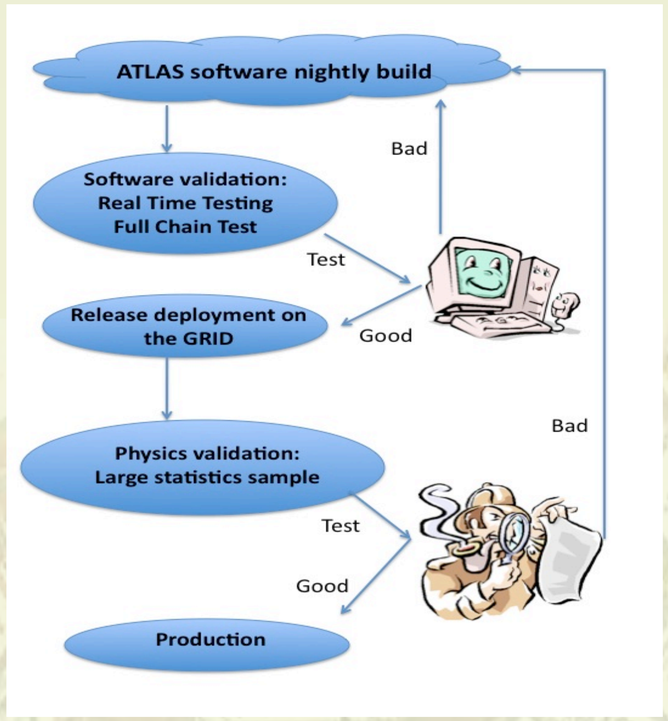


The architecture of the nightly build and test system (NICOS)

The ATLAS Testing Nightly (ATN) is a framework that allows quality assurance checks, unit tests and integration tests. The configuration of the test system is done through XML files.

- Quality assurance: the description of a package in its requirements file is checked and the consistencies of the package dependencies is verified.
- Unit tests: simple package functionalities are checked verifying the exit code of the corresponding executable
- Integration tests: the major system of the software are verified to work well and to communicate with other components of the software.

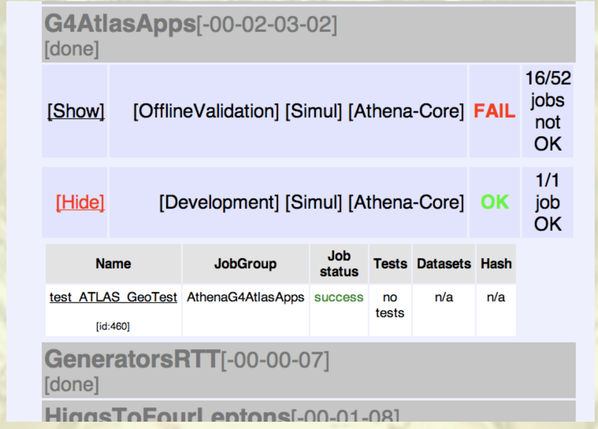
The results of the tests are returned to NICOS for processing and publication in the build summary page for every nightly



A sketch of the ATLAS validation chain.

The second step of the software validation is the ATLAS Real Time Tester (RTT):

- It sets up relatively complex jobs (geant4 simulation, digitization with pileup, full reconstruction on few events).
- It runs them, performs tests and publishes the results on a web page.



G4AtlasApps[-00-02-03-02]
[done]

[Show]	[OfflineValidation] [Simul] [Athena-Core]	FAIL	16/52 jobs not OK
[Hide]	[Development] [Simul] [Athena-Core]	OK	1/1 job OK

Name	JobGroup	Job status	Tests	Datasets	Hash
test_ATLAS_GeoTest [id:460]	AthenaG4AtlasApps	success	no tests	n/a	n/a

GeneratorsRTT[-00-00-07]
[done]
HiggsToFourLeptons[-00-01-08]

Web display for the test results. One of the two RTT tests of the G4AtlasApps package is failing.

The RTT is thus checking that the ATLAS software nightly is actually able to perform all the required tasks on a limited number of events (typically of the order of 10).

For every nightly, the full ATLAS software chain, from event generation up to the production of the final Analysis Object Data, is tested in the Full Chain Test (FCT). A similar test is performed on real data with the Tier0 Chain Test (TCT). With respect to the RTT, the FCT and TCT provide:

- The use of the final scripts which are currently used on GRID for the job submission.
- The possibility of running on a relatively large number of events.
- Physics analysis and histogram checking.

They both use the same software framework used by the RTT.

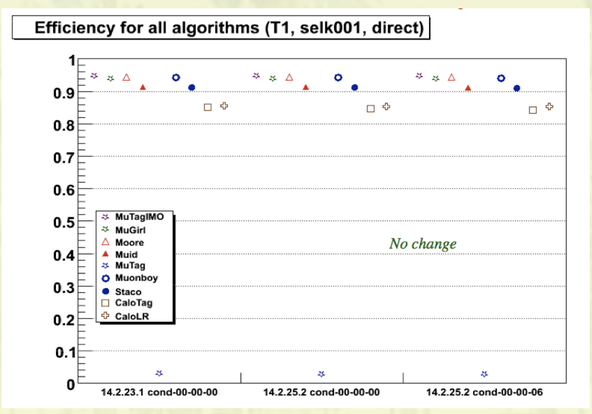
FCT and TCT allow:

- The catching of infrequent software problems.
- The first check on the quality of the output data produced. Unwanted features in the output can be caught before the release deployment on the GRID.

Physics validation

Once the software test are successful, the release can be deployed on the GRID for its final validation step. This consists in the production of a sample of approximately 250K events. The composition of the sample includes single particles, standard model processes (W and Z leptonic decays, top pair production, Higgs production) and non standard model processes (SUSY, black holes production).

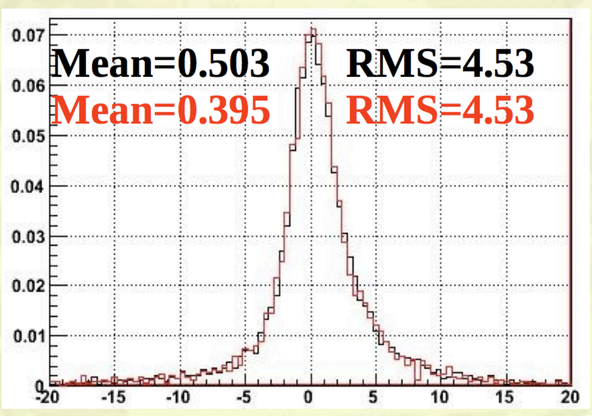
A group of experts, representative for the detector performance and physics groups, runs physics analysis on the produced sample and compare the results with those from previously validated releases.



The efficiency of several muon reconstruction algorithms is compared for different releases in top pair production events.

The relatively large statistics of the physics validation sample allows:

- To discover software bugs that appear with a rate of 10^{-5} (10^{-4} if they appear in a specific final state object reconstruction).
- To find minor problems in the output of the ATLAS software (e.g., a few percent shift in the jet scale).



The M_{reco}-M_Z distribution in Z→ee events is compared for two different ATLAS software releases.

Conclusion

ATLAS has a well established software and physics validation procedure. The different validation layers ensure software reliability and high quality output for physics analysis. The past and present experiences with simulation production show that the validation procedure is reliable and fulfils the collaboration needs.

Acknowledgements

We would like to acknowledge the ATLAS SIT group and D. Quarrie for the software components development and the ATLAS physics validation group for providing the plots.