ATLAS Nightly Build System Upgrade

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Abstract. The ATLAS Nightly Build System is a facility for automatic production of software releases. Being the major component of ATLAS software infrastructure, it supports more than 50 multi-platform branches of nightly releases and provides ample opportunities for testing new packages, for verifying patches to existing software, and for migrating to new platforms and compilers. The Nightly System testing framework runs several hundred integration tests of different granularity and purpose. The nightly releases are distributed and validated, and some are transformed into stable releases used for data processing worldwide. The first LHC long shutdown (2013-2015) activities will elicit increased load on the Nightly System as additional releases and builds are needed to exploit new programming techniques, languages, and profiling tools. This paper describes the plan of the ATLAS Nightly Build System Long Shutdown upgrade. It brings modern database and web technologies into the Nightly System, improves monitoring of nightly build results, and provides new tools for offline release shifters. We will also outline our long-term plans for distributed nightly releases builds and testing.

1. Introduction

ATLAS (A Toroidal LHC Apparatus) [1] is one of the largest collaborative efforts ever attempted in the physical sciences. The Phase I ATLAS upgrade [2] is designed to accommodate the detector hardware and software for the increased LHC luminosity. The upgraded software and computing systems will deal with increased data volumes and event complexity. The code should be modified to work efficiently with new computing vector-processing and multi-threading architectures. The upgrade provides opportunities to consider, make and test changes to collaborative software infrastructure. The ATLAS Nightly Build System upgrade is a central part of ATLAS Infrastructure update and will provide an improved monitoring of nightly build results, new tools for automation of offline release shifters tasks, a modern database, and web technologies, for the Nightly System.

The paper describes the plan of the ATLAS Nightly Build System Long Shutdown upgrade and outlines future development plans.

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2. ATLAS Nightly Build System overview
The ATLAS Nightly System facilitates coordination between several hundred software developers working around the world and around the clock [3]. The central part of this System is the NICOS Nightly Control Tool [4]. The ATLAS nightly build system supports more than 50 nightly release branches described in table 1. An ATLAS software release [5] comprises a large number of packages with specific version tags stored in the Tag Collector [6] database application with a web interface. Developers are able to interactively select the version tags from the ATLAS SVN code repository for the nightly releases.

### Table 1. ATLAS nightly release branches.

| Branch group       | Number of branches | Number of packages | Purpose                                         |
|--------------------|--------------------|--------------------|-------------------------------------------------|
| Major integration  | 3                  | 2000 – 2300        | Preparation of stable software releases         |
| Validation         | 3                  | 2000 – 2300        | Testing new versions before submission to major integration branches |
| Experimental       | 5                  | 2000 – 2300        | Probing new systems and compilers               |
| Migration          | 5                  | 500 – 2300         | Development of specific software domains or testing new versions of external tools and applications |
| New features       | 8                  | 10 – 2300          | Assigned to developers of new software          |
| Patch              | 15                 | 20 – 200           | Amendments to stable software releases          |
| Physics Analysis   | 17                 | 3 – 50             | Analysis software collections                   |
| ROOT-based Analysis| 3                  | 20 – 50            | Light-weight analysis tools collections         |

ATLAS nightly releases are rebuilt on 1 to 4 platforms every day for each branch (in some cases several times per day) with CMT configuration management and build tool [7] on the ATLAS nightly computing farm at CERN equipped with ~50 powerful multi-core nodes. Builds are accelerated by parallelism supported at file and package levels by CMT, with the distcc, ccache tools, and by running tests in parallel. The largest builds take up to 9 hours.

ATLAS nightly releases are packaged by PackDist tool [8] and installed on AFS and CernVM-FS [9] distributed file systems for worldwide access. The CernVM-FS is a fuse-based http, read-only file system which guarantees file de-duplication and on-demand file transfer with caching, scalability and performance. Nightly releases are kept for 2 to 7 days. When certain development goals are achieved the successful nightly release is transformed into the stable release by the team of ATLAS offline release shifters. Stable releases have unique numeric identifiers and indefinite lifetime.

The Nightly System is connected with ATN [10] and RTT [11] testing scaffolds that run tests of different granularity levels. The ATN test tool is embedded within the Nightly System and launches tests concurrently with compilations for faster results delivery. As fast feedback to developers is one...
of the most important functionalities of nightly systems, NICOS automatically posts the information
about the progress of nightly builds and tests, identifies problems, and creates the summary web pages
reflecting the system status. Automatic e-mail notifications about problems are sent out to responsible
developers.

3. Key features of the ATLAS Nightly Build System upgrade
The upgrade objective is to provide ATLAS developers with an improved ATLAS Nightlies web user
interface and to automate ATLAS offline release coordinator and shifter tasks, thus reducing their
workload. The upgrade components are shown in figure 1. New key system components are the
Nightlies Oracle Database and Nightlies Web Server.

![Figure 1. Components of the ATLAS Nightly Build System upgrade.](image)

The Nightlies Database stores nightly jobs data and serves as a mediator between the Nightly and
other ATLAS systems. The upgraded Nightly System uses the database data internally, in particular
for jobs synchronization. The database-driven dynamic user interfaces replace the collection of web
pages generated by previous NICOS versions.

The new ATLAS Nightly web server is an Apache server managed by CERN IT. It is powered by
the PanDA Web Platform [12], which supports Python plugins capable of accessing data, generating
and publishing both the web content as well as user interface. The Platform data layer provides the
means to communicate with Oracle databases.

4. ATLAS Nightlies Database
The ATLAS Nightlies Database resides in the ATLAS database production cluster dedicated to offline
analysis (ATLR) [13]. It relies on the Oracle RDBMS (Relational Database Management System) and
is supported by the CERN IT-DB group. This operational database holds:

- Status for all stages of nightly jobs;
- Results of tests and compilations;
- Statistical information (e.g. number of packages in the release);
- Properties of nightly releases (e.g. packages tags).

The ATLAS Nightlies Database is the source of dynamic content for the Nightlies Web Server. The
data retention period is 12 months allowing an access to historical information well beyond the nightly
releases life on distributed file systems.
The expected data volume is about 10 – 20 GB per year. The table partitioning is designed taking into account frequent access to the recent nightly information. An active software developer can make several thousand nightly database queries daily when browsing dynamic web pages. Parent tables are configured to use range partitioning while reference partitioning is used for child tables that host the nightly jobs attributes. Reference partitioning ensures that the tables are partitioned in a uniform way. It enhances the manageability of child tables because all partition maintenance operations on the parent table automatically cascade to child tables.

5. ATLAS Nightlies web interfaces
The PanDA Web Platform [12] alleviates the maintenance of web servers, is powered by the JQuery library, is easily extensible, and integrates well with external monitoring tools and components. User interfaces are generated by the Platform from Python modules backed up by JavaScript front-ends. Each module:

• Provides access to databases;
• Publishes the content generated in json format;
• Enables JavaScript rendering functions to be defined.

The JQuery-based ThemeRoller web application [15] provides web theme designs with consistent look and feel. The PanDA Web Platform allows different interface designs, each customized for a different group of developers, to co-exist.

The nightly information web interfaces provide all kinds of information about nightly jobs. Overview and detailed results views are available:

• The “global” page provides the Nightly System status at a glance, and points at recent releases in all branches;
• Branch summaries show information for a particular nightly branch (for single or multiple platforms);
• Nightly releases summaries show build, test, and installation data for the project of a selected release;
• Compilation results;
• Test results;
• Package tags of a particular nightly release (with comparison with a previous release).

The nightly administrative interfaces require CERN Single Sign On authentication [16] and use secured HTTPS connections. They facilitate the system management and provide services for release coordination:

• Stop or restart nightly jobs;
• For release coordinators: forms for stable release building requests;
• For offline release shifters: buttons to perform certain shift tasks (e.g. generate instructions to fulfill a release coordinator request).

6. Upgrade phases and long-term plans
The ATLAS Nightly System Upgrade is planned during LHC Long Shudown I in two stages:

• Delivery of key components (Nightly Database and Web Server) and nightly information web interfaces. Prototypes of administrative interfaces should be created (1st quarter of 2014);
• Providing the full range of administrative interfaces (1st quarter of 2015).

Also probing new nightly build types is planned:

• Continuous nightlies imply triggering release builds by new submissions to a code repository. This nightlies type provides fast feedback to developers and accelerates development cycles;
• Nightlies on demand do not have a regular release build schedule. Instead a release coordinator is provided with tools to start and re-start nightly jobs as needed.

Long-term plans include the development of a distributed nightly system in which releases are created using GRID resources and then validated on GRID sites where ATLAS Production tasks run.

7. Conclusion
Over the last decade the ATLAS Nightly System served as a major tool in the ATLAS collaborative software organization and management schemes. The upgraded Nightly System provides the ATLAS community with improved tools for coordinating development of new software functionality, and paves the way for exploring new computing techniques, compilers, and platforms. It is capable of sustaining increased numbers of developers and their testing demands.

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