Continuous Integration
Plan

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   1. OME Deliverables and Releases
   2. OME source code management
   3. Continuous Integration

2. OME Continuous Integration servers
   1. Introduction
   2. Travis CI
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OME releases: Deliverables

**OMERO**
- **OMERO.server / OMERO.clients**
  - Windows, Linux, Mac OS X
  - Ice (3.3, 3.4, 3.5)
- **Tools/plugins**
  - OMERO.imagej,
  - OMERO.matlab,
  - OMERO.py
- **OMERO Virtual appliance**
- **Documentation**
  - API documentation
  - Sphinx documentation

**BIO-FORMATS**
- **Java ARchives (JAR)**
  - loci_tools.jar
  - ome_tools.jar
  - ....
- **Bio-Formats Tools**
  - Command-line tools
  - MATLAB toolbox
- **Documentation**
  - API documentation
  - Sphinx documentation
OME releases

- OME 4.4.x series (June 2012 – Jan 2014)
  - 12 releases in 19 months (1 major, 11 minor)
  - 3 emergency releases (4.4.1, 4.4.3, 4.4.8)

- Quality Assurance
  - Ensure quality standards are being met
  - Robustness/stability
  - Catching bugs early

- Every code change must be tested and reviewed
Source code management
Source code: Pull Requests

GitHub interface showing a pull request for a repository named `openmicroscopy/openmicroscopy`. The pull request is labeled `#11091: refactor server DB queries for hierarchy navigation by mtbc`. It has 788 commits and is assigned to mtbc. The pull request description includes fixes for OME-Ticket 11091 and the subsequent version 11091.0. It mentions the addition of a cache for model hierarchy lookups and other changes. The pull request is associated with Travis CI build passing.
### Source code: changes frequency

<table>
<thead>
<tr>
<th></th>
<th>OMERO</th>
<th>Bio-Formats</th>
<th>Documentation</th>
<th>Scripts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of commits</td>
<td>5502</td>
<td>3033</td>
<td>1375</td>
<td>111</td>
</tr>
<tr>
<td>Number of merged Pull Requests</td>
<td>812</td>
<td>366</td>
<td>254</td>
<td>23</td>
</tr>
<tr>
<td>Number of unique authors</td>
<td>25</td>
<td>26</td>
<td>26</td>
<td>7</td>
</tr>
<tr>
<td>Number of merged Pull Requests/day</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Number of commits/day</td>
<td>11</td>
<td>6</td>
<td>3</td>
<td>&lt;1</td>
</tr>
</tbody>
</table>

Changes on dev_5_0 branch between 25 Sept 2012 and 20 Jan 2014
The problem

**WHEN YOU HEAR THIS:**

YESTERDAY IT WORKED

YOU KNOW YOU’RE IN A SOFTWARE PROJECT

**JUST IN CASE YOU’RE STILL NOT SURE WHETHER YOU’RE IN A SOFTWARE PROJECT**

**WAIT UNTIL YOU HEAR THIS:**

ON MY MACHINE IT WORKS

http://geekandpoke.typepad.com
Continuous integration

- Continuous integration: perform software integration frequently
- Automate the build
  - OMERO suite (server, clients…), Bio-Formats suite
  - OME Consortium products
- Automate the tests
  1. Run Bio-Formats automated tests against the data repository
  2. Run the OMERO.server integration tests of the OMERO.server
- Automate the deployment
  - Deploy all deliverables for PR review/ QA release
  - Deploy the latest version of the documentation
Continuous integration server

Source: http://www.appfoundation.com/ci/
Continuous integration server

**BENEFITS**
- Automation (build, test, deployment)
- Integration with SCM
- Easy access to daily deliverables
- Time trigger/change polling
- Build history

**COSTS**
- Writing/maintenance of CI automated scripts
- Team resources
  - Server setup
  - Server maintenance
  - Individual job setup
- Team communication
OME CI servers

- [http://about.travis-ci.org](http://about.travis-ci.org)
- Externally hosted
- Integration with GitHub
- Support Java, Python, C+
- Matrix jobs
- Setup in `.travis.yml`
- Build queues/50 min timeout

- [http://jenkins-ci.org](http://jenkins-ci.org)
- Hosted by OME team
- Integration via scc tools
- Node-specific languages
- Chained jobs
- Build system (ant, `build.py`)
- Control over node number/throttling/time
Typical CI workflow

[Diagram showing a typical continuous integration workflow with icons and arrows indicating build passing and build error stages.]
Travis CI: introduction

Activated for core OME source code repositories
Travis CI: GitHub integration
## Travis CI: OME usage

<table>
<thead>
<tr>
<th>Module</th>
<th>Code validation</th>
<th>Build</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OMERO</strong></td>
<td>py, flake8</td>
<td>./build.py build-default</td>
<td>./build.py -py test</td>
</tr>
<tr>
<td></td>
<td>java</td>
<td>./build.py build-default test-compile</td>
<td></td>
</tr>
<tr>
<td><strong>Bio-Formats</strong></td>
<td>maven, mvn</td>
<td>cmake + make</td>
<td></td>
</tr>
<tr>
<td></td>
<td>cpp</td>
<td>mvn + cmake + make</td>
<td></td>
</tr>
<tr>
<td></td>
<td>cppwrap</td>
<td>mvn</td>
<td></td>
</tr>
<tr>
<td></td>
<td>sphinx</td>
<td>make clean html latexpdf</td>
<td></td>
</tr>
<tr>
<td><strong>Documentation</strong></td>
<td></td>
<td>make clean html latexpdf</td>
<td></td>
</tr>
<tr>
<td><strong>Scripts</strong></td>
<td></td>
<td>flake8</td>
<td></td>
</tr>
</tbody>
</table>
OME Jenkins CI: main view

http://ci.openmicroscopy.org
OME Jenkins CI: build view

http://ci.openmicroscopy.org/job/JOBNAME
Jenkins CI: job naming scheme

- \$COMPONENT-\$VERSION-\$TYPE-\$DESCRIPTION, e.g. OMERO-5.0-merge-integration
- COMPONENT: deliverable name
  - OMERO, BIOFORMATS, Consortium or third-party deliverable
- VERSION: version number e.g. 5.0
- TYPE: usually merge, latest, release
- DESCRIPTION:
  - Short description (2-3 words max)
Jenkins CI: views

- **Versions**
  - 4.4, 5.0, 5.1: for OME main products (OMERO, Bio-Formats)

- **Components**
  - OMERO/Bio-Formats
  - Consortium
  - Third Party (Pytables, ITK, Zlib, …)
  - Mgmt

- **Experimental**

- **Failing**
  - all non-Experimental jobs with failing/unstable status
Jenkins CI: job types

- **LATEST** jobs
  built from the HEAD of the development branch, i.e. origin/dev_5_0

- **MERGE** jobs
  built from the HEAD of a development branch with Pull Requests merged in, i.e. snoopycrimecop/merge/dev_5_0/latest

- **RELEASE** jobs
  associated with a tag, e.g. 5.0.0-rc1
Jenkins CI: chained jobs

- Morning jobs
  - merge Pull Requests
  - build artifacts
  - deploy merge server
  - import data
  - run integration tests
  - build and deploy staging documentation
Jenkins CI: deployment servers

- One node associated to each development branch
- Multiple OMERO instances running on different ports
  - 4064: merge server for PR review
  - 14064: latest server
  - 24064: integration server for integration tests

<table>
<thead>
<tr>
<th>Series</th>
<th>Development branch</th>
<th>Server name</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.4.x</td>
<td>dev_4_4</td>
<td>howe.openmicroscopy.org.uk</td>
</tr>
<tr>
<td>5.0.x</td>
<td>dev_5_0</td>
<td>gretzky.openmicroscopy.org.uk</td>
</tr>
<tr>
<td>5.1.x</td>
<td>develop</td>
<td>trout.openmicroscopy.org.uk</td>
</tr>
</tbody>
</table>
Continuous integration documentation

Contributing Developer Documentation

This documentation is for developers who want to contribute code to OME consortium projects. It includes internal developer practices and workflows, standard procedures for tasks such as release, and other information which may be valuable to a wider audience.

- Checking out the source code
- Using Git
- Code contributions
- Team communication
- Team workflow summary
- Continuous integration branches and jobs
- Continuous integration (scm) scripts
- Release process
- Development standards

Information specific to developing OMERO, the OME Data Model and file formats, and Bio-Formats can be found in their respective developer documentation sections:

- OMERO developer documentation
- Bio-Formats developer documentation
- OME Data Model, OME-TIFF, and OME-XML documentation

If you have any questions, please see our Community support page for ways to get in touch.
Continuous integration server

The OME project uses Jenkins as a continuous integration server. To access the OME Jenkins server, bring up a web browser and go to http://ci.openmicroscopy.org.

The following sections summarize the main continuous integration jobs used for the development of OMERO, Bio-Formats and the OME documentation sets. Note this is not an exhaustive list of all jobs in the project. To know more about a particular job, click on the Configure button on the left-side panel of the job window.

OMERO jobs

<table>
<thead>
<tr>
<th>Job task</th>
<th>4.4.x series</th>
<th>5.0.x series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Build OMERO</td>
<td>OMERO-4.4-latest-ice33 / OMERO-4.4-latest-ice34 / OMERO-4.4-latest-ice35</td>
<td>OMERO-5.0-latest-ice33 / OMERO-5.0-latest-ice34 / OMERO-5.0-latest-ice35</td>
</tr>
<tr>
<td>Build an OMERO Virtual Appliance</td>
<td>OMERO-4.4-latest-virtualbox</td>
<td>OMERO-5.0-latest-virtualbox</td>
</tr>
<tr>
<td>Run the daily merge builds</td>
<td>OMERO-4.4-merge-daily</td>
<td>OMERO-5.0-merge-daily</td>
</tr>
<tr>
<td>Review OMERO PRs</td>
<td>OMERO-4.4-merge-ice33 / OMERO-4.4-merge-ice34 / OMERO-4.4-merge-ice35</td>
<td>OMERO-5.0-merge-ice33 / OMERO-5.0-merge-ice34 / OMERO-5.0-merge-ice35</td>
</tr>
<tr>
<td>Review OMERO PRs using a Virtual Appliance</td>
<td>OMERO-4.4-merge-virtualbox</td>
<td>OMERO-5.0-merge-virtualbox</td>
</tr>
<tr>
<td>Run the integration tests</td>
<td>OMERO-4.4-merge-integration</td>
<td>OMERO-5.0-merge-integration</td>
</tr>
<tr>
<td>Collect the OmeroJava integration test results</td>
<td>OMERO-4.4-merge-integration-java</td>
<td>OMERO-5.0-merge-integration-java</td>
</tr>
<tr>
<td>Collect the OmeroPy integration test results</td>
<td>OMERO-4.4-merge-integration-python</td>
<td>OMERO-5.0-merge-integration-python</td>
</tr>
<tr>
<td>Collect the broken integration test results</td>
<td>OMERO-4.4-merge-integration-broken</td>
<td>OMERO-5.0-merge-integration-broken</td>
</tr>
<tr>
<td>Run the robot framework tests</td>
<td>OMERO-4.4-merge-robotframework</td>
<td>OMERO-5.0-merge-robotframework</td>
</tr>
<tr>
<td>Update submodules</td>
<td>OMERO-4.4-latest-submods</td>
<td>OMERO-5.0-latest-submods</td>
</tr>
<tr>
<td>Install OMERO using Homebrew</td>
<td>OMERO-4.4-merge-homebrew</td>
<td>OMERO-5.0-merge-homebrew</td>
</tr>
</tbody>
</table>

4.4.x series

The branch for the 4.4.x series of OMERO is dev_4_4. All jobs are listed under the 4.4 view tab of Jenkins.

OMERO-4.4-latest-ice33
OMERO-4.4-latest-ice34
OMERO-4.4-latest-ice35

These jobs are used to build the dev_4_4 branch of OMERO with Ice 3.3, 3.4 or 3.5

1. Builds the OMERO server and the clients using OMERO.sh
2. Archives the build artifacts
3. If the build is promoted, copies the artifacts to production
Continuous Integration: future directions

- Lots of progress in the last 6 months
  - Cleanup of the job (integration tests)
  - Server maintenance and stabilization
  - Rationalization/organization

- Future steps
  - Refactoring of Consortium projects
  - Integration tests in Travis build
  - Maintenance/improvements of the CI documentation
  - Refactoring of the 5.0 jobs using new 5.1 jobs
CI Agent: Snoopy Crime Cop

- GitHub user
  - https://github.com/openmicroscopy/snoopycrimecop
  - Member of openmicroscopy and ome organizations

- Perform actions
  - Performs local PR merging using GitHub API
  - Open PRs for submodule bumps
  - Push merge/branches release tags to his forks

- Forks of main repositories
  - see https://github.com/snoopycrimecop/openmicroscopy
  - used for pushing merge branches/ staging release tags