Supporting the Development Process of the DataGrid Workload Management System Software with GNU autotools, CVS and RPM

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Acronyms

- European DataGrid (EDG)
- Workload Management System (WMS)
- European DataGrid Workload Management System (EDG WMS)
- Concurrent Version System (CVS)
- RPM Package Manager (RPM)

Content

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- The EDG WMS Code structure
- The EDG WMS Dependencies
- Brief - GNU autotools – autoconf, automake, libtool
- The EDG WMS Code configuration, releasing and distribution
- Deployment Procedure
- A bit of sociology (D'HO)
- The EDG WMS Status
- Future Work
- Conclusion

Problem Description 1/2

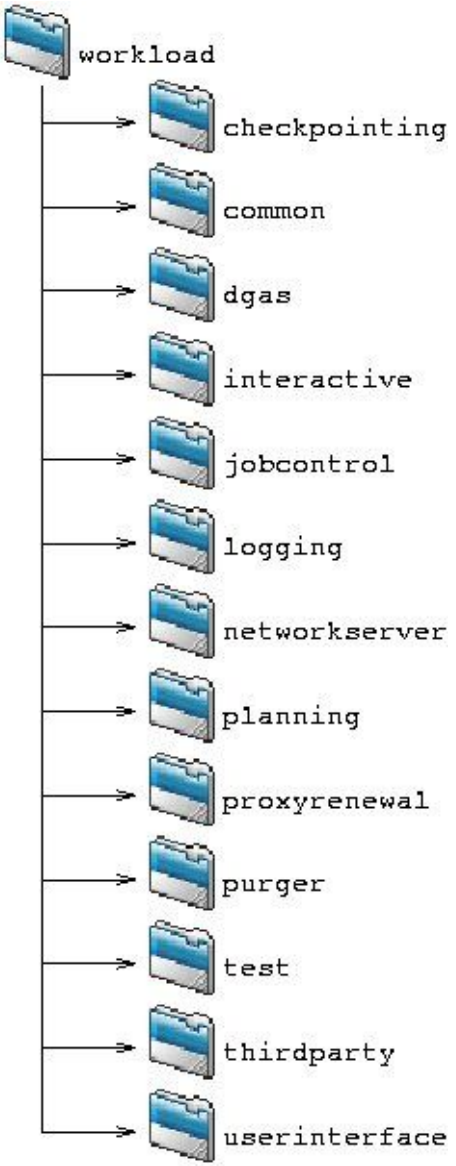
- The team was characterized by a high geographic and administrative dispersion (as shown by the ↘)
- The EDG WMS Software was divided into several components under the responsibility of local development teams

Problem Description 2/2

- Concurrent development and maintenance of various versions of the same code file were required
- Software dependencies were complex
  - it was required to integrate and interface several external and internal dependencies
- Software organization was not well defined
  - part of the code was already written
- Software had to build and run on the architecture Redhat Linux 7.3 and other platforms
  - currently it runs on Redhat Linux 7.3

The EDG WMS Code Structure

- The EDG WMS Code contains daemons, libraries, etc
- The EDG WMS package is organized in a single directory tree shown on the right
  - the main directory is called workload
- The package is divided in smaller components
  - Further levels are present inside each component sub-directory
  - They do not have a common structure
    - It was difficult to have a simple and common build strategy for each of them (NOTE!)

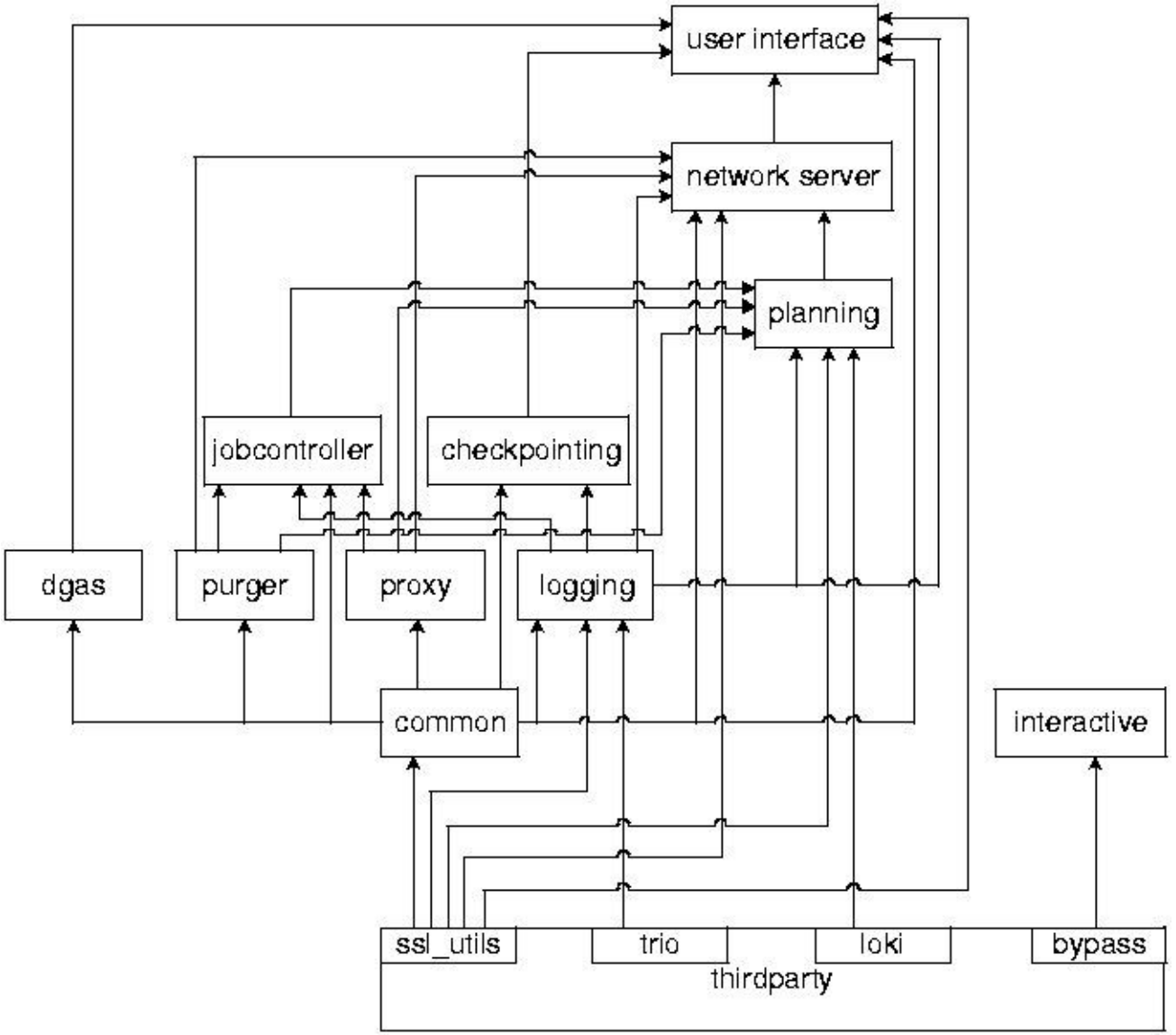


The EDG WMS Dependencies

- The dependencies are divided in four categories:
  1. Non-EDG packages – developed outside the EDG project
  2. Non-WMS EDG packages – developed by other EDG work packages
  3. Modified non-EDG packages – developed outside the EDG project that need to be modified by the WMS work package
  4. WMS components – developed entirely by WMS work package
- They have been scan and resolved by the configuration options (NOTE!)

The EDG WMS Internal Dependencies

- The EDG WMS internal dependencies are shown on the right
  - Each box represents one component
  - Part of the internal structure of a component is shown with a thin box
  - The direction of the arrow means that ”the destination object depends on the source one”



GNU autotools: automake, autoconf, libtool

- provide developers a set of prepackaged and flexibly modifiable tests
- simplify the build and distribution of code
- organize the building in two steps
  1. configuration - generates Makefile's and perhaps other files, used by the build step
  2. build - uses the Unix make program, which reads a set of rules in a Makefile and use them to build the program
- enable/disable the build of a subset of the components (EDG WMS requirement)
- easily configure sub-packages

GNU autotools: automake, autoconf, libtool

- autoconf is a system of M4 macros and Bourne shell script
- configure.in is a template of M4 macro invocations and shell code fragments, used by autoconf to produce configure script
- autoconf performs small tests designed to check each feature
- automake generates any number of Makefile file
- Makefile.am is a template of Makefile file read by automake to produce Makefile.in file
- These Makefile.in files are used by the configure script at configure time - configure script performs some substitutions on the templates to produce
- libtool is used to automate the building, linking, and installation of shared and/or static libraries
- M4 macros are used to compile the configuration files

The EDG WMS Code configuration, releasing and distribution

- Developers of a single component wanted to compile as less module as possible
- Not all external dependencies are required by every component
- Enabling options and conditions were hard-coded into the configure.in file
- The component (de)activation has been obtained with several if statements hard-coded in the configure.in file
- Each component is enabled by default
- Each enabled component will trigger the check for the presence of any other external package related to it

The EDG WMS Code configuration, releasing and distribution

- Specific M4 file for every external package has been created to detect the presence and the position of such package, testing easy functions, and set some variables
- M4 files define some macros and Makefile variables
  - e.g. if the name of the external dependency is PACKAGE
    - AC_PACKAGE
      - takes three arguments: version (when applicable), action to perform when the right dependency is found, action when it is not
    - PACKAGE_LIBS
      - contains the path and the name of the library(ies)
    - PACKAGE_CFLAGS
      - contains the path for the include files (if present)
    - RUNPACKAGE
      - contains the full path for the required executable

Example: enabling/disabling the proxyrenewal component

- configure.in

```
opt_enable_renewal=yes
.....
dnl
dnl proxyrenewal option
dnl
AC_ARG_ENABLE(renewal,
[--enable-renewal build proxy
renewal [default=yes]],
enable_renewal=``$enableval``,
enable_renewal=no)
.....
```

```
if test ``x$enable_opt1``=``xyes`` \
-o ``x$enable_renewal``=``xyes`` \
-o ``x$enable_optn``=``xyes``; then
opt_enable_opt1=$enable_opt1
opt_enable_renewal=$enable_renewal
opt_enable_optn=$enable_optn
fi
.....
have_renweal=$opt_enable_renewal
.....
```

Example: enabling/disabling the proxyrenewal component

- configure.in

```
.....
if test ``x$have_myproxy``=``xno``;
   then
have_opt1=no
have_renewal=no
fi
.....
AM_CONDITIONAL(AMC_BUILD_RENEWAL,
test x$have_opt2=xyes\
-o x$have_renewal=xyes)
.....
```

```
.....
if test ``x$opt_enable_opt2``=``xyes`` \
-o test ``x$opt_enable_renewal``=``xyes``;
then
AC_MYPROXY(4.1.1, have_myproxy=yes,
have_myproxy=no)
fi
.....
```

Example: enabling/disabling the proxyrenewal component

- Makefile.am (in the main directory workload)

```
if AMC_BUILD_RENEWAL
WL_RENEWAL=proxyrenewal
endif
....
SUBDIRS = config m4 \
$(WL_SUBDIR1) ... \
$(WL_RENEWAL) ... \
$(WL_RENEWALN)
```

- Makefile.am (in the directory proxyrenewal)

```
if AMC_BUILD_RENEWAL
sbin_PROGRAMS=edg-wl-renewd
bin_PROGRAMS=edg-wl-renew
noinst_LTLIBRARIES=libedg_wl_renewal.la
endif
....
```

Example: delivering automatically EDG WMS RPMs

- configure.in

```
....
AC_EDG_RPMS
.....
AC_RPMS
.....
```

Makefile.am (in the main directory workload)

```
....
rpm: $(RPMS_SPECS)
  .....
rpm-check:
  .....
```

- There are four spec files:
  - one covers the EDG WMS services and API
  - two of them apply to a couple of external packages
  - the last one includes the testsuite description

Release Deployment Procedure 1/2

- Specific Internal Procedure Steps
  - the set of bugs and new features were defined and communicated via e-mail or on the IRC channel
  - when the development issues were resolved, an e-mail was sent to the work package mailing list, communicating the start time of the test session
    - before this time, developers have to commit all pending changes

Release Deployment Procedure 2/2

- Specific Internal Procedure Steps
  - when the start time was arrived, a CVS branch called *test_<version>* was created
  - software was rebuilt starting from the new CVS branch, and some tests were performed
    - including the execution of the work package specific regression test suite
  - when tests were satisfactory, the release was tagged on the branch and all the applied fixes are merged to the main trunck

A bit of sociology

- The role of the packager was introduced to help WMS working group
  - organizing the code tree structure
  - providing templates for the packaging of new components
  - overseeing on the uniformity of build procedures
  - providing all developers common formats for the Makefile.am files, M4 files, and configure.in file
  - allowing developers to concentrate just on code development

The EDG WMS Code Status

- Current version
  - makes use of the shown solution
- Prototype of new version – uses GNU autotools – has not committed yet
  - improves the description of the internal dependencies
    - re-writing the configure.in file
  - still uses M4 files for checking the external dependencies
    - removing obsolete checks
  - For the developers, configure output is more readable than it was before (IMPORTANT!)

Future Work

- autodep tool
  - is in the development phase
  - should be a new feature of GNU autotools
  - should simplify the configure.in file, making it simpler for reading, once the tool is terminated
  - should take into account complex interaction pattern
  - is able to express internal and external dependencies in a fashion similar to that of common autotools

Conclusion

- Summarized our experiences
- Described the encountered limits
- Added extensions to manage and package code accommodating the needs of the EDG WMS
- Successfully handled complex set of internal and external dependencies

Conclusion

- Requirement: code organization should be well-defined before code writing phase
  - Otherwise, it will be very difficult:
    - making developers accept architectural/structural changes on the fly
    - handling/managing dependencies between components
- Observation: a clear, well-designed initial model will allow to immediately identify major problems

Pointers

- The EDG WMS home page
  - http://infnforge.cnaf.infn.it/cgi-bin/cvsweb.cgi/workload/?cvsroot=workload
- CVS repository
  - http://infnforge.cnaf.infn.it/cgi-bin/cvsweb.cgi/workload/?cvsroot=workload
    - access: ssh, (anonymous) pserver
- Thanks to the WMS team and the European Datagrid project