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Unified software repositories for Wendelstein 7-X: Workflow elements for fusion software development

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Abstract

Software development for a large project like Wendelstein 7-X (W7-X) requires an appropriate development process to provide a reliable environment supporting the coordinated work of scientific and engineering stakeholders. The first step to achieve this goal was the installation of a central source code management system (SCM). Besides being a code base it provides functions allowing the specification of a release procedure by introducing levels of acceptance specified by appropriate quality criteria. The SCM system serves as a starting point for automatic generation of standard code documentation and for performing automatic testing procedures on standardized integration platforms. In order to provide a universal documentation platform for the multi programming language environment at W7-X the DocSys system has been developed which allows to employ any (language specific) document generator producing html-pages for presentation via internet. An automatic integration testing environment is still being prepared and not yet in standard use.

Keywords: Integrated data analysis; Versioning; Automated documentation; Commissioning; Software integration

1. Software development process

Software developments for Wendelstein 7-X (W7-X) aim at an integrated software project [1]. Efforts for device control, data acquisition, data analysis, modelling and theory are to be shared to avoid duplicate work and to gain most validated software modules. Development and implementation of the W7-X software project require a well-designed workflow that allows quality, safety, stability, as well as the necessary flexibility to be adequate for every use-case, ranging from operation relevant software to scientific exploration.

The workflow for W7-X software developments is not finally settled yet. However, central elements are identified and Fig. 1 shows a possible workflow organization. The private/public paradigm is oriented at similar distinctions at JET, where data are organized to be used, e.g., for development (private) or routine (public) purposes. Here, cf. Fig. 1, the developer is working in a private environment first. This can be an afs directory, a local data medium, or a professional versioning system.

A prerequisite for developments to be released for public use is a commissioning process. Directions for the commissioning process were defined [2] and are going to be extended to be in accordance with respective ISO standards. Up to now, there are development guidelines, specifications of supported programming languages and versioning systems (SVN, CVS) and formal acceptance criteria. A central element are clear responsibilities documented in publicly available documents.

In Fig. 1 all changes in the public repository are to be accepted by the commissioning responsible officer. Formal criteria for acceptance cover exhaustive software documentations including application programming interface (API) description, references, user manual, and further application specific

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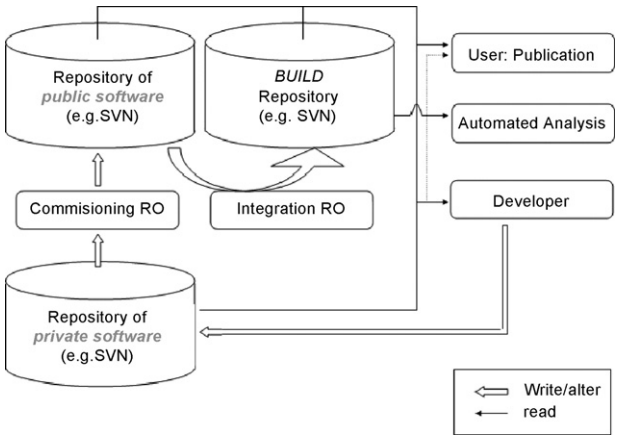

Fig. 1. Software commissioning and integration.

information describing the domain of each respective software component. In order to minimize the effort for the developer an automated documentation framework [3] is part of the concept. The framework generates a unified documentation on basis of in-code comments allowing an inclusion of any free configurable supplementary information.

In order to keep all the public software up-to-date, a special framework for a continuous build process is necessary. This is the domain of continuous software integration [4]. Continuous Integration uses a Build SVN repository to test the consistency of the whole software system. The process is supervised by an integration responsible officer (cf. Fig. 1). Currently, this workflow element is under assessment.

2. Versioning

At W7-X where software is developed by distributed groups of programmers it is inevitable to use a professional versioning system to manage all ongoing developments. The chosen open-source subversion (SVN) has been replacing previously applied CVS software due to several benefits important for W7-X applications, cf. [5,6].

There exist repositories for several subject areas, one of them is the W7-X software repository. Providing a correct Kerberos (network authentication protocol [7]) password the current status of the W7-X repositories may be viewed via URL given in [2]. The current structure of the repository is shown in Table 1.

Table 1
SVN repositories for W7-X software

Repository	Contents
3rdParty	Software components developed outside of IPP
data Analysis	Statistical and neural networks codes, information about data uncertainties
dataSources	Database software and definitions, e.g. for the Magnetic Configuration Database (MCDB)
gpurpos	General purpose software, like Programming Interface for Stellarator Application (PISA)
theory	Theory codes
w7xc	Data and software for W7-X control
xdiag	Diagnostic-specific software, as for tomography
xdv	Domain of the data acquisition group

The Rechenzentrum Garching (computing centre which offers services for Max Planck institutes all over Germany) provides user authentication, secure access and firewall. SVN is accessible on three access levels: administrator (superuser), repository manager, and user identified with an IPP Kerberos password. No access to SVN is possible without a valid Kerberos password.

3. Automated software documentation system

3.1. Motivation

At W7-X software developments take place in form of new developments, required enhancement of existing software, implementation of external software packages, etc. On the other hand, there exist many heterogeneous groups, as experiment control, data acquisition, or theory departments, involved in both software development and application. Documentations of used software, if existing at all, are available in very different forms reaching from personal notes on a sheet of paper to detailed information accessible in Internet. It turns out that many kinds of documentation can be automated. Therefore it seems to be possible to join existing software documentation tools and enhance the result to a uniform format, easy accessible for the users, preferably as a Web application. This would entail considerable advantages for the users

- Easy Web access (one URL to documentation of all W7-X software components).
- Unified documentation (same “look and feel”).
- All information (e.g. a reference) available with a simple mouse click.
- Automated API documentation, using source code documentation tools.
- Each single documentation can be individually supplemented with optional information.

Automation of the API documentation forces the software developers to use a software versioning software and to proper structure and annotate their source codes (maybe with the aid of available prepared templates). The success of a unified documentation system is strongly based on the convenience of its application. To gain acceptance by the users this convenience is the leading non-functional requirement.

A thorough requirement analysis indicated that existing documentation frameworks do not meet all requirements, therefore a specific solution was developed.

3.2. DocSys

The automated documentation system for W7-X software was implemented as a prototype under the name of DocSys [3].

A functional diagram of DocSys is shown in Fig. 2. According to defined metadata certain inputs are read and a documentation