Integration of Distributed Design Tools Based on Web Services

A. Pawlak, P. Fraś, P. Penkala
Institute of Electronics
Silesian University of Technology,
Gliwice, Poland
Adam.Pawlak@polsl.pl

1. Introduction

Distributed collaborative design and development is a new paradigm of engineering work that integrates widely distributed engineers for virtual collaboration based on the Internet. It has become feasible due to dynamic progress in information and communication technologies. This new engineering paradigm can be enabled with innovative infrastructures, net-aware tools, and new design methodologies based on re-use in combination with advanced security of network operations, and distributed tools management. Many research efforts were directed towards collaborative infrastructures and working environments during recent years. However, a few research groups have targeted research on applications in electronic system design automation (EDA) only, like WELD [1], REUBEN [2], and ASTAI(R) (C-LAB Univ. of Paderborn).

Existing distributed collaborative engineering environments do not support adequately the integration of tools of dispersed design groups, and do not consider distance-spanning related issues, like: firewalls, security (including user authorization, data and transfer encrypting), distributed inter-organization workflows, and remote administration of users and tools.

The paper presents the Tool Registration and Management Services (TRMS) developed within the EU 5th FP E-Colleg project (*www.ecolleg.org*) [2], and further extended during the EU 6th FP MAPPER project (*mapper.eu.org*). The TRMS environment offers to dispersed engineers some innovative features that enhance existing distributed collaborative engineering infrastructures. Easier integration with other collaborative environments and conclusions from its use [5] have been a reason for reorganisation of the TRMS architecture towards a Web Services based solution.

The short paper is organized as follows. Firstly, requirements on TRMS are shortly explained; secondly, the overall architecture and TRMS services-based functionality are described. Finally, we conclude on the experiences relevant to the Web Services based architecture of TRMS.

2. Towards Internet-based remote tool integration

Remote tool integration is one of central the problems of distributed collaborative engineering. Although this is a problem with a history of many international efforts, like CAD Framework Initiative, interoperability of design tools dispersed in the Internet still is a challenge. Engineers working in distributed groups need a technology for remote tools integration that will enable them to search for available Internet-based engineering tools, integrate them into a distributed collaborative environment, and perform a design task through invocation of an appropriate workflow. The whole process should assure security and integrity of design data and that authorised users have access to selected tools only. Only tools registered in the central tool register can be made available. Information on available tools is available to authorised and authenticated users – designers from any Internet site.

3. Architecture of the TRMS2

TRMS has been developed as a classical distributed architecture [4]. In a frame of the MAPPER project we are turning into the services-based architecture (TRMS2) which in the simplified perspective includes three kinds of basic components: Global Tool Lookup Service (GTLS), Tool Servers (TSs), and Client Applications. TRMS enables secure data transfer with authentication and authorization of users, as well as it includes security management mechanisms that allow an administrator to monitor users' activity and to execute a proper security policy. TRMS uses the HTTP SSL channel (by default) for communication between components. In addition, all sensitive data can be encrypted and digitally signed by a sender for an improved security level.

GTLS – Global Tool Lookup Server is the main component of TRMS that is responsible for registration and modification of data on users and their privileges, elements of the system, as well as, information on accessible tools and machines that make them available.

GTLS is also responsible for the security policy of the whole system, registration of user activities and of access to tools, maintaining statistics, identification of an intruder attack. GTLS, as the only component of the TRMS environment should be accessible from the Internet. Networks protected by firewalls and using NAT enable communication that is initiated from the internal network only. GTLS plays the broker's role and a temporary repository in a communication between a client application and Tool Servers.

GTLS has been implemented as a set of Web Services (Apache/AXIS). The use of Java enables operational system independent installation.

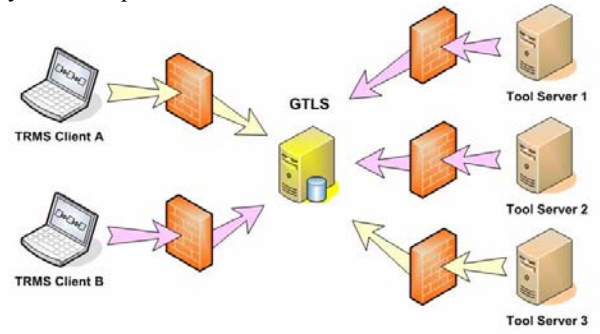

Figure 1. General architecture of the TRMS environment.

Tool Server (TS) is responsible for controlling users' access to tools. A client invoking a tool does it through the Tool Server. The Tool Server enables sharing of the particular tool through the Internet. Its additional task is brokerage in user authentication. The Tool Server communicates with GTLS in order to update its task queue. If a new task has been added to the queue then TS retrieves all data required for tool invocation. The task is executed in the following, and all input data are returned. As soon as the tool completes its work, all result data are sent back to GTLS, where they wait for retrieval by the Client application.

The **Client** application has a simple GUI which allows for login to the system, its administration and usage of available tools. It enables a full control of the environment, management of users, tasks and workflows. Each task needs to be registered by the Client application. Upon an invocation by a user, information on a particular task is placed in a task queue on GTLS and awaits there for its retrieval by an appropriate Tool Server.

4. TRMS2 services

All services in the TRMS environment are invoked in a safe way by authorized users and with encryption of data. Selected services have been shortly explained.

Authentication - Access to the environment is possible upon a positive authentication of a user on the GTLS server. This authentication process is based on a user key and a password.

Tool registration - Each tool needs to be registered in the GTLS data base. Registration requires definition of data necessary for remote tool invocation.

Tool search - Registered tools may be „discovered" as a result of a search process that used certain criteria.

Tool invocation - Firstly, the Tool Server retrieves from the GTLS server data on the tool and input data. Secondly, the tool is being invoked and information on this reaches GTLS. During the process of tool execution information being brought to the console is transmitted to the Client application through the GTLS server. Due to that a user can monitor progress of tool execution.

Administration - Management of users and tool servers is conducted through the TRMS Client with use of the appropriate Web Services. The Client may be used also to define tool access rights.

5. Conclusions

TRMS2 based on Web Services enables easier integration with other collaborative environments. Additionally:

– GTLS as a communication broker enables use of tools that are installed in local networks on machines that are not visible from outside,
– The new architecture supports also tools that require long computation times,
– The environment is more robust for transient problems in accessing the network.

Further R&D related to TRMS2 includes enhanced workflow management and improved support for engineering teamwork with support for both synchronous and asynchronous collaboration.

References

[1] Chan F., Spiller M., Newton R.: *WELD- An Environment for Web-based Electronic Design*, Proc. Design Automation Conference 1998, San Francisco.

[2] Lavana H., Khetawat A., Brglez F., Koźmiński K.: *Executable Workflows: A Paradigm for Collaborative Design on the Internet*, Proc. 34th DAC, 9-13 June 1997.

[3] T. Schattkowsky, W. Mueller, A. Pawlak. *Workflow Management Middleware for Secure Distance-Spanning Collaborative Engineering.* In L. Fischer (ed.) The Workflow Handbook 2004, WfMC, USA, 2004.

[4] P. Fraś, *et al.*: *Collaborative infrastructure for distance - spanning concurrent engineering,* PRO-VE'04, in Luis M. Camarinha-Matos (Ed.) "Virtual Enterprises and Collaborative Networks", Kluwer Academic Publishers, Boston, Dordrecht, London, 2004.

[5] K. Siekierska, *et al.*: *Distributed collaborative design of IP components in the TRMS environment*, Microelectronics Reliability, Elsevier Journal, vol. 46 (2006), 5-6.