New Collaborative Working Environments for Multiphysics Coupled Problems

Toan Nguyen, Jacques Périaux

Int. Conf. on Computational Methods for Coupled Problems in Science and Engineering
COUPLED PROBLEMS 2007
M. Papadrakakis, E. Oñate and B. Schrefler (Eds)

NEW COLLABORATIVE WORKING ENVIRONMENTS FOR MULTIPHYSICS COUPLED PROBLEMS

TOAN NGUYEN* AND JACQUES PERIAUX†

* INRIA
655, avenue de l'Europe
Montbonnot, F-38334 Saint Ismier, France
e-mail: Toan.Nguyen@inrialpes.fr - Web page: http://www-opale.inrialpes.fr

† Dept. of Mathematical Information Technology – PO Box 35 (Agora)
FI-40014 University of Jyväskylä, Finland
e-mail: jperiaux@gmail.com - Web page: http://www.icat-consulting.com

Key words: Collaborative Working Environments, Coupled Problems, Multiphysics Problems, Computational Science.

Summary. Because large scale multiphysics problems are expected to be orders of magnitude larger than current single discipline applications, like weather forcasting, environmental disaster prevention and emergency management, new computing technologies are required. Among these technologies are wide area grids and distributed computing, using cluster and grid-based environments. It is clear that large supercomputers, PC-clusters and wide area grids are currently used for demanding e-science applications, e.g., nuclear and environmental simulation. It is not so clear however what approaches are currently the best for developing multiphysics applications.
We advocate in this paper the use of combined Web and grid-based techniques that are combined for a seamless uptake by the users, i.e., the applications designers, and users running multidisciplinary codes and business software, e.g., decision support tools. This paves the way for New Collaborative Working Environments.

1 INTRODUCTION

Virtual environments are tools and facilities dedicated to the design, deployment execution, monitoring and maintenance of large applications on distributed resources [1]. These resources may be computers, file archives, sensors, visualization environments, etc. The users do not need to own any one of them. He or she may have access to and use any combination of them among a set of available resources whenever he or she is granted the appropriate rights to do so, using a simple laptop or sophisticated apparatus, e.g., an immersive visualization environment
He does not need any technical knowledge of the underlying software and hardware tools, except that one he or she is currently using. The technical infrastructure, may it be a state-of-

the-art middleware for grid computing or a large cluster of commodity PC connected to a broadband network, is made totally transparent to him/her.
In order to implement this approach, we need a software layer masking the underlying infrastructure. Because hardware, operating systems and i/o devices are sometimes referred to as underware, and because middleware is the de facto naming for grid management and interface software, we name this new layer the *upperware*.
The *upperware* is the generic service layer used to virtualize the resources used by the applications. It masks the actual hardware and software resources, making possible the design, management and concurrent use of dynamic, possibly overlapping and cooperating sets of private computing infrastructures. In this respect, the *upperware* enables secure virtual private computing environments to co-exist, in a way similar to virtual private networks (VPN) that are designed to co-exist over communication networks.
The *upperware* is built on top of existing grid middleware. It is therefore made compatible with current and upcoming grid technology standards (OGSA, WSRF, GT4).

2 COLLABORATIVE WORKING ENVIRONMENTS

From the user point-of-view, the interface with Collaborative Working Environments (CWE) is a high-level graphic interface that masks the resource distribution and technical definitions [2]. It is a set of dependent tasks connected by a workflow graph. This approach leaves all the technical aspects to a further step, while focusing on the application logic only. The tasks can be connected by a control flow graph formed by sequence, parallel, interleaved and imbedded loops.
The tasks correspond to executable codes that are located transparently for the users on remote sites. It is the responsibility of the application designers to define which resources the application needs, where they should be located if required, and which complementary properties they should exhibit (availability, QoS, etc). None of these resources are required to be local and to belong to the users and designers. Brokering protocols and usage grants are therefore supported by the *upperware*. Submission of such grants can be negotiated on a permanent or one shot policy. The *upperware* appears therefore as a general resource broker, negotiating with the remote systems the availability and use of resources, based on the local policies and granted access rights.

3 DEPLOYMENT OF CWE

The obvious advantages of the CWE are their ability to mask the technical aspects of grid technology to the application designers and users. The end-users never interact directly with the underlying middleware and networks. The application designers have to define the abstract tasks involved, the corresponding executable codes (by their name and access paths) and the resulting data files (by their names and access paths also).

3.1 Industrial aspects

Among these aspects are the legacy applications and procedures which are among the constraints that hamper the wide dissemination of new technology and business opportunities. Legacy aspects are essential for knowledge and investment preservation.

It is of utmost importance that research and FP7 projects take into account the running applications and procedures to enable their seamless integration within future platforms and research. Otherwise, de facto standards based on widespread commercial products will continue to impose next generation environments, e.g., CATIA.

Also, currently implemented procedures for project management and development require a careful attention for inclusion, and possible evolution within next generation CWE.

3.2 Technological aspects

A number of technologies are emerging today with great potential for industry competitiveness and technological independence in Europe.

Among these are: grids, CWE, Virtual organizations, and Web-based platforms.

This sometimes precludes further breakthrough in industry with the related impact.

For example, grid technology advertises "Virtual organization", "Virtual workspaces" and "virtualization of resources" as novel concepts and functionalities to support user, data and application software integration. The corresponding technologies can improve CWE support.

This has given rise to the *upperware* concept, advertised as a frontier set of new services. This is not however clear cut and should be refined in more detail.

The way to do this should also clarify the starting points and goals addressed. Is it to adapt existing procedures and tools to include new technology barriers, e.g., cooperation among worldwide distributed teams using grid technologies? Or evolve existing CSCW concepts to include generalized distribution and dynamicity of users, data and applications in project management? Another issue is the milestones that would define the roadmap to future CWE.

Indeed, existing grid technologies potentially include several functionalities that could support next generation CWE: virtualization of resources, virtual organizations, virtual workspaces, etc.

The advertised convergence of grids and Web technologies, via web services and WSRF in Globus for example, may confuse the users with the emergence of Web 2.0, which tends to transform the current Web technologies into a generalized application platform.

Because CWE might benefit from both the grids and the Web 2.0 technologies, which do not overlap, a clear examination of both should be engaged to fertilize on the best available aspects offered by each one.

The conclusion here is that CWE research in FP7 must include (or be supported by) novel aspects from grids, Web2.0 and communication technologies.

It must also include support for the seamless inclusion of legacy applications and procedures.

It should finally answer the fundamental question concerning the opportunity to define and prototype new concepts, e.g., the *upperware*, which must be discussed to extract a proven adequacy, after a clear definition of their functionalities and interfaces with existing and upcoming technologies.

Because no prototyping can yet play the role of proof of concept, a first step should be to support the development of an experimental *upperware* platform.

3.3 Societal aspects

The societal aspects include a better support for users which are not experts in the technologies they use. This is a clear constraint for example for grid technologies, the uptake of which is hampered by the technology burden they put on the industry and on the users.
The societal aspects include also the support for dynamic and evolving partnerships on collaborative projects.
This include management of security, confidentiality, authorization, IPR management and other technologies supported basically by all computerized techniques today. But they must be adapted and evolved to support adequately new CWE.
Another question is to what extent are the current Web2.0 concepts compatible with the corresponding very stringent constraints of contracting industries, and how to evolve it to fulfill these requirements?

4 CONCLUSIONS

Although the goals mentioned apply to CWEs and are borrowed from the Web 2.0 description by O'Rilley, it is clear that CWEs are not amenable to the sole Web 2.0. Why is this so?
- The first reason is that the Web 2.0 still lacks a common definition, standardization and understanding.
- The second reason is that CWEs have specifics, operational and industrial constraints that do not implement seamlessly (so far) within Web 2.0. For example a huge stack of existing application software and proprietary resources will have to be hooked to future CWEs.
- Third, because CWEs will also be supported by evolving technologies such as grids.

The development, uptake and dissemination of grids will necessarily impact on future industry, not only in engineering projects. This is because there is currently a vast ongoing driving force in grid communities to incorporate sophisticated resource management features (actual and virtual resources), with the corresponding distributed support (resource discovery and allocation, workflow management, security and confidentiality support, e.g., authentication and authorization). Further, grid communities also work hard on "virtual workspaces" that go beyond the original "virtual organizations". The maturing of these technologies will impact on CWE and *upperware* development and adoption.

REFERENCES

[1] Nguyen G.T. *Aeronautics multidisciplinary applications on grid computing infrastructures*. Invited lecture. Second Grid@Asia Workshop. Shanghai (2006).

[2] I. Laso-Ballesteros and L. Karlsson, Proceedings of the 1st Conference on Collaborative Working Environments for Business and Industry. Brussels (2006). www.cwe-europe.org