The Grid Shared Desktop for CSCL

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Abstract:

The Grid Shared Desktop (GSD) is a collaborative environment that provides a multidimensional humans-to-machine-to-humans interface by the means of multiples cleverly intricated desktops. The GSD is a platform independent solution that benefits of the intrinsic advantages of the Grid technology such as scalability and security. In order to verify that our GSD solution meets CSCL requirements, we have conducted experiments in the context of the ELeGI project. As part of the project use cases, the scenario described here aims at using the GSD for the construction of a shared ontology for organic chemistry. This article summarises results from the first series of experiments aiming to evaluate subjective usability aspects of the GSD in a context of scientific collaboration. We assess the GSD prototype in order to extend its functionalities for other business perspectives.

1. Introduction

Nowadays, everyone is familiar in using a desktop to interact with a computer. Graphical user interfaces are designed to allow users to manipulate graphical representations of concepts. Although the idea of desktop is commonly established, the idea of sharing a desktop is having much less popularity for various reasons. Among these reasons, privacy and security are often seen as the major reason for people to be reluctant.

Therefore, the main requirement for accepting to share a desktop with others is to share an environment that is not private and does not require a personal computer. Or even better we believe that this environment should be ubiquitous and dedicated to the purpose of the community.

Furthermore, we adopted the Grid as underlying technology to provide such a pervasive environment. Amongst other advantages, Grid is the ideal technology that enables to achieve a scalable and secure GSD solution.

The GSD concept, as a collaborative learning environment, is inspired form the extensive work done in the area of Computer Supported Collaborative Learning (CSCL). In a paper we published in March 2005 [3], we summarise these ideas and we outlined our approach by defining the bootstrapping aspects of a collaboration. Then, we presented the original GSD framework end of last year [2]. Here, we explain, through experimental results, how our solution is resolving the core problem of remote collaboration among humans.

2. Objectives

Our objective in this scenario is to show how a collaborative environment supported by the GSD service can foster the collaborative modelling of shared knowledge in the form of an ontology.

One frequent goal of human collaboration is to define a common corpus of knowledge about a domain of expertise; when formalised and computerised, this knowledge representation artefact is known as an ontology.

We adopt an iterative approach. It consists of repeated short cycles of elicitation, specification, implementation, evaluation steps within a scenario: the collaborative construction of a shared ontology. Collaborative ontology construction however presents a certain number of challenges (such as explanation of viewpoints, negotiation of terms and meaning, decision among modelling options) that typically call for a set of interaction services.

The GSD may provide an engaging environment for helping users to formalise and capture knowledge that is initially informal and distributed in the minds and documents of several people, into a shared ontology.

3. Methodology

The design of the GSD prototype emerged originally from the collaboration requirement in one of the evaluation scenarios, as part of the European research project ELeGI[1].

This scenario involves a community of Chemists and experts in cognitive science. This community aims in constructing a shared ontology of organic chemistry, using the full potential of the GSD. This effort is part of the EnCOrE project (Encyclopédie de Chimie Organique Electronique) [5].

Analysing and experimenting collaboration among the participants of that project led us to a set of requirements that a collaborative environment should fulfil. This analysis further led us to the conceptualization and implementation of an ubiquitous, dynamic and shared environment for collaboration.

We adopted a service-oriented approach over a Grid infrastructure, in order to address generic needs and requirements of CSCL. The architecture of the GSD relies on the use of virtual desktops. The GSD represents one of the typical services identified in the context of the Semantic Grid. DeRoure called this type of service a Live Information System for Collaboration [1].

1 www.elegi.org: This project is concerned with the use of Grid technology for enhancing collaboration and learning in distant communities.

The Grid infrastructure offers a secure and reliable environment in which users may import new services and introduce new users dynamically according to the needs of the collaboration.

In the GSD we distinguish two levels of collaboration:

- **Virtual Community (VC)** using services that are mostly in asynchronous mode, such as file sharing, task scheduling, edition of documents, etc.
- **Collaboration Sessions (CS)** using synchronous collaboration mode, such as text chat, audio-video conferencing, white screen, white boarding, etc.

The GSD focuses on the (i) white screen where each participant may alternatively broadcast a desktop to all the other participants of the CS and (ii) white boarding where each participant may alternatively act on a common desktop of the CS.

4. Technology Description

The choice of Grid technology is motivated by its capability for managing stateful resource in a flexible and secure manner. Describing all these mechanisms is out of the scope of this paper. However, we can briefly summarise the principles based on the OGSA (Open Grid Service Architecture) [4] and relevant for the GSD.

Grid is a service-oriented architecture in the sense that the end-user interacts with services or services interact between themselves. By opposition, in a system-oriented architecture such as client-server, users interact with a physical entity (i.e. a server). The Grid allows to abstract all resources and create a logical layer to virtualise these resources and reify them into service containers. The service containers enable security policies dedicated for a particular VC.

Then a VC may use or instantiate Grid services in its dedicated service container. Then members of this VC can instantiate a GSD service for a CS and begin the collaboration work. As CS is a kind of synchronous interaction, a new CS service container is created each time a CS is requested and destroyed at the end of the CS in order to free the Grid resource.

5. Developments

The GSD relies on a set of services that we call the bootstrapping services. At the initialisation of a CS, the resource is allocated for this CS by Grid mechanisms and seven bootstrapping services are instantiated. These services are stateful, in the sense of Grid. (i.e they are instantiated with their own running context).

These seven bootstrapping services are represented in figure 1

1. **Authorisation Service** for specifying the user rights levels to any particular service including the bootstrapping services.
2. **Notifications Service** to dispatch immediate change of state or information to VC members (e.g. who is online, a new CS is scheduled, etc.).
3. **Members Management Service** for introducing or removing dynamically users in a VC or a CS.

4. **Services Management Service** for importing or removing a service factory.
5. **Services Activation Service** to create or destroy a running instance of a service.
6. **CS Management Service** to schedule, manage and cancel CS.
7. **History Service** to capture events coming from the other services.

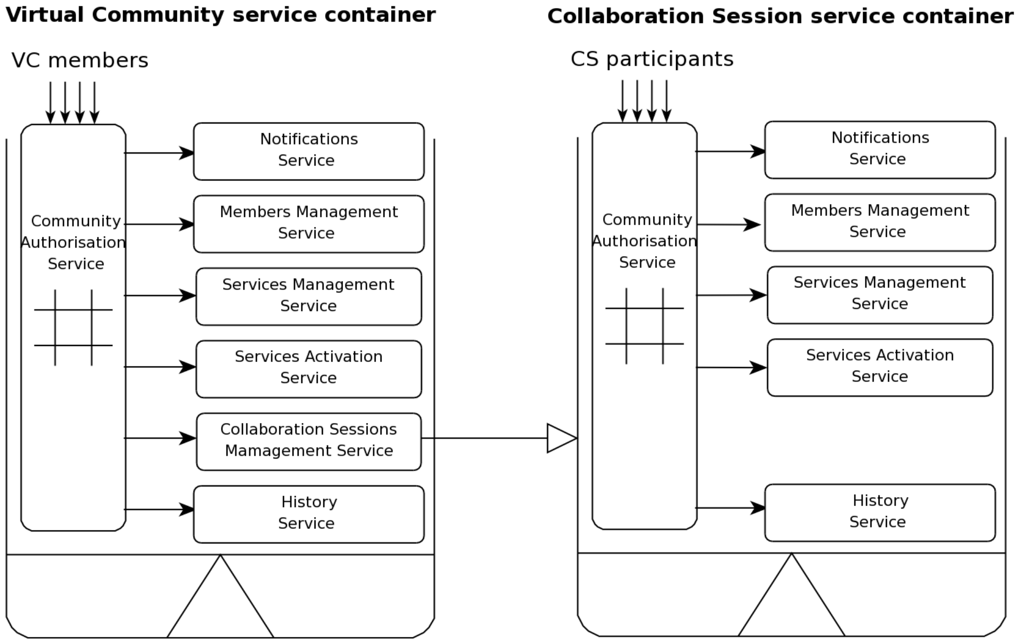

Figure 1: bootstrapping services in both VC and CS containers

6. Results

In our experiments, our main interest was to assess the subjective aspects of usability of the GSD in different collaboration modes. We adopted the screen sharing as the main collaboration mode. Motivations behind this choice were: (i) at any time during a CS, participants could present their own view, using their own tools, on a particular issue, (ii) make modifications to the shared ontology in parallel, hence fostering participants' initiative; (iii) participants could work on their own pre-broadcasted desktop, when they needed to do isolated work or try out ideas, either on the common ontology or on a local copy of the files; (iv) according to a floor control (i.e. turn-taking) mechanism, participants could each broadcast their actions, ideas or work to the community once they were ready to do so. This collaboration mode was appropriate both for a learning and a production phase.

Within five CS we observed the gradual transition from a learning phase of collaboration to a more productive phase, by which the role of participants evolved.

Figure 2 shows the different phases in a CS during the explanation of viewpoints and terms. Here, the chemist argue on the synthesis of the molecule "carpanone". One chemist introduce a new tool Resyn Assistant developped by his institution (Ecole Nationale Supérieure de Chimie de Montpellier). Immediately in the GSD, the Service Management enables all participant to activate an instance of Resyn Assistant in their own pre-broadcasted desktop and follow the live instructions from the tool instructor.

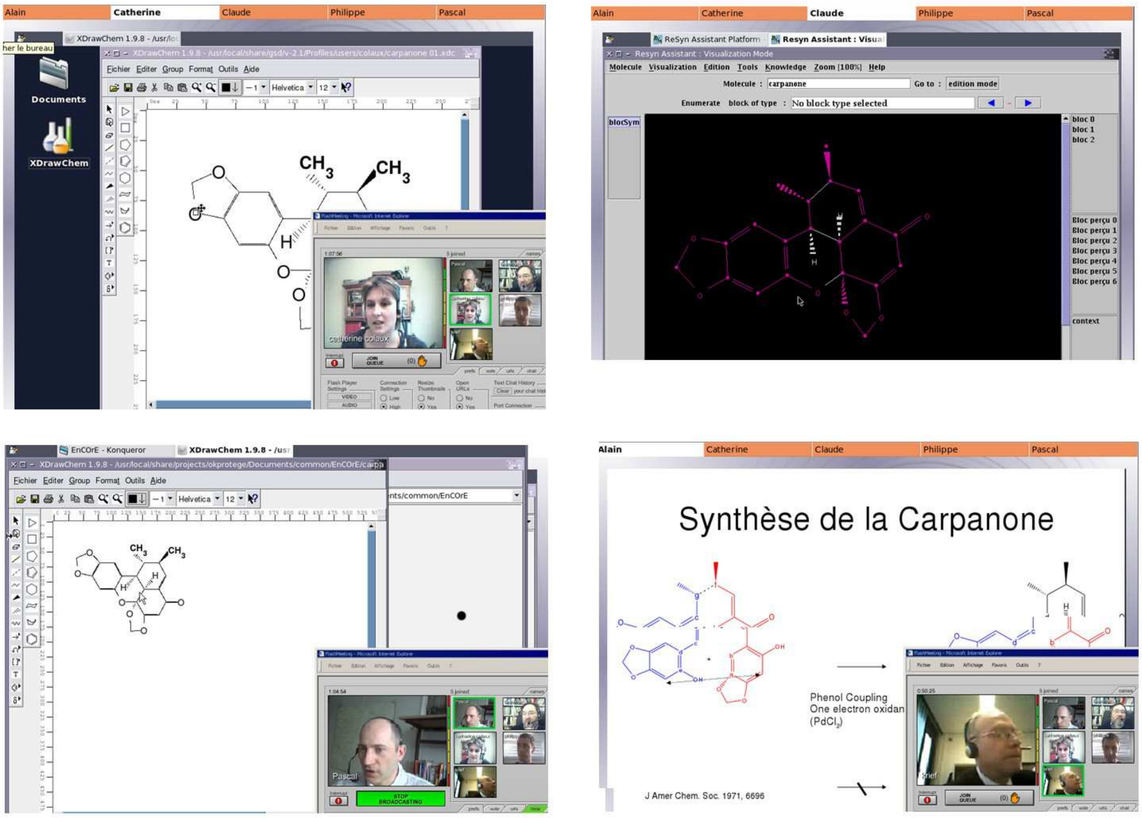

Figure 2: Different phases in a Collaboration Session (CS)

On figure 3 the CS focuses on ontology editing with the Protégé tool. This tool is a widely used ontology editor. In this CS, the tool instructor (Monica) broadcasts her desktop, demonstrating how to use Protégé and explaining ontology-building principles along the way. The instructor also guided other participants into trying simple exercises in front of others, by taking their turn on the broadcasted desktop.

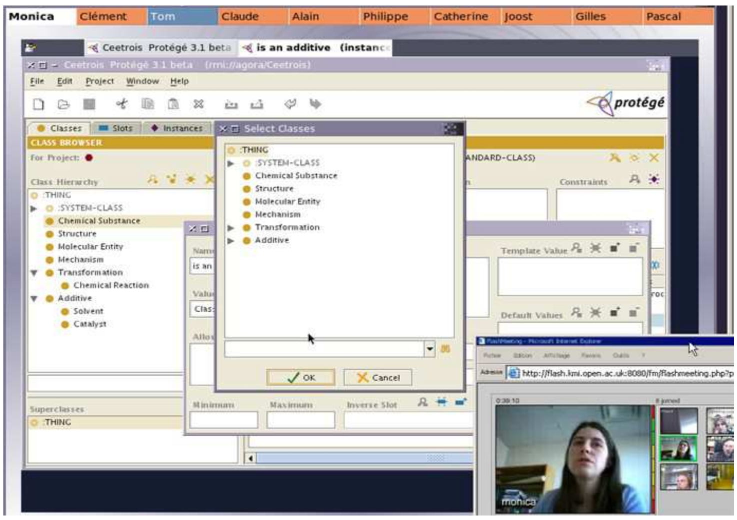

Figure 3: A CS using the Protégé tool

7. Business benefits

The immediate benefit of the GSD is to confine the collaborative working time and space into a shared environment.

The results of the usability subjective experiments are encouraging to proof the GSD concept. Here, the Grid takes a significant importance to operate the GSD in a larger scale and in a secure environment. The scalability is ensured by the dynamic aspects of the Grid services. A GSD instance as a Grid service occupies the resource only during the duration of a CS. The secure environment in Grid includes privacy but also data integrity and high service availability.

As the GSD offers the ability to virtualise a powerful and complex computing infrastructure into a user-friendly shared graphical environment, the potential of the GSD goes further than just the scientific perspective. A lot of other business cases could be considered as it opens the path towards an economical large scale solution. The cost of equipment and service maintainance can be tremendously reduced by mutualising the physical resource and distributing the aggregate computing power everywhere.

8. Conclusions

We conducted initial experiments using the GSD in the context of scientific collaboration.

We achieved a GSD solution with high acceptance for non-literate computer users. The bootstrapping and CSCL support made the technology fully transparent and the assessment showed a rapid take off of the collaboration.

However, we are not fully satisfied with the currently implemented mechanisms of authentication, floor control, synchronous full-duplex audio channel, and enhanced-presence services. We intend to explore these issues and perform more validation experiments. Also we are investigating issues for optimising the resource allocation for the CS and improving the service availability by providing a more distributed Grid architecture.

The GSD illustrates that Grid has a high potential to become an enabling technology that allows CSCL to break the barriers between the end users and the technology. Unlike current web technologies or other client-server ad-hoc solutions, Grid allows to manage stateful interactions in a service-oriented manner. This aspect is fundamental for a fully technology-transparent and ubiquitous GSD solution.

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