

A Collaborative Environment Integration Layer for Activity Orientation*

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Abstract— This paper proposes the creation of an architectural layer for integration of all the resources and members participating in a given collaborative activity into a unified framework which is referred as the Collaborative Environment Integration Layer (CEIL). This layer is considered a necessary step for integrating with open standards all the collaborative resources or components into a tightly coupled collaborative environment which implements activity orientation. The proposal considers two architectural elements. The first element is the Collaborative Environment Description Language (CEDL), which is the formal language for describing all the elements and associated parameters relevant for modeling and managing a Collaborative Environment. The second one is the Collaborative Environment Management Interface (CEMI), which is the unified interface which provides uniform management and configuration of the collaborative components of an environment. This layer includes accurate descriptions of the virtual organizations associated to collaborative activity, including participants, roles, rights, hierarchies, etc, being able to model the variety of existing virtual organization models.

Keywords - Collaboration; Collaboration Environments; CWE; CEDL, Collaborative Environment Description Language; Activity orientation; Virtual Organisation.

I. INTRODUCTION

Many standards exist nowadays which play a role in synchronous or asynchronous collaboration over the Internet, such as RSS, W3C standards [6] (plain Web standards, Web Services, ..) IETF standards [5] (RTP, SIP, Atom, Jabber, ..) and others (BPEL-WS, T120, ...). Those standards allow inter-working among collaborative tools and applications coming from a variety of vendors, at least in the core of the mandatory

functions. Collaborative sessions usually imply the simultaneous use of several tools inter-working by means of those standards, for example application sharing, audio, video, etc. Configuration of such sessions requires usually a significant manual configuration effort, especially in real time collaboration. Configuration can not be easily automated due to the use of proprietary interfaces by tool builders.

On the other hand “activity orientation” [1] is emerging as an important goal in collaborative working environments. Activity oriented collaborative environments should go beyond the actual tools tower of Babel and put the focus on providing a unified view of the activity context of a member where anything relevant for the progress of his work in the team is directly accessible, for example access to other team members; access to activity resources, planning or goals; requests, events or alarms; activity and data visualization; etc. The collaborative environment shall be responsible for configuring resources, select relevant information or being proactive in the progress of work, removing from the members the burden of configuration and integration of resources.

An activity includes various types of components which include usually online resources, online services or tools, but also individuals which interact and collaborate by means of those resources. To achieve activity orientation it seems therefore necessary to integrate all the information and data about the resources, tools, services and also individuals associated with the activity. Individuals participating in an activity have also an organizational structure which is very relevant for the activity. This structure is usually called a virtual organization. The virtual organization reflects the relations, hierarchies, rights and links among the individuals,

but also the relation with the tools and resources used by them. Therefore an accurate description of the virtual organization is of fundamental importance to properly describe a given activity.

Activity oriented integration enables a new vision for collaborative environments where the activity gets a unified virtual object which provides a natural interface to any person or resource related to the activity. In this approach a participant could access in one click (or very few) any resource or combination of resources associated to a collaborative activity with all the components properly configured and ready for use. Unique entry point and single sign-on for any interaction or access could be a reality. Activity wide functions and tools would be able to consolidate, use or visualize environment wide data and information, including members and resources.

This paper proposes the creation of an open architectural layer for automated construction, operation and management of activity oriented collaborative environments. This layer is inspired in the signaling and management planes existing usually in communication networks, which have the goal of automatically configuring the set up of communications functions in an open vendor independent context, i.e. the circuits of a telephone network. This layer should perform an equivalent function in creating CWEs as an overlay network over the Internet. It should allow remote configuration of any collaborative component with the purpose of automatically setting up CWEs properly configured for a given collaborative activity. The scope of a collaborative activity and associated CWE includes in our understanding not only the collaborative tools components use, but also the virtual organization with the profile and rights of participants in the activity. The main goal of this new layer is therefore to enable the creation of higher level functions which can operate on the complete environment as a unified entity in an open framework.

The proposed collaborative environment integration layer is a generalization of the XEDL/XLIM [8, 9] platform integration layer used for integrating the Isabel audio-video-data-conferencing application [2, 3, 4] with the EducaNext Educational Broker [8, 9]. Isabel multipoint sessions involve usually a large number of sites interacting in real time over the Internet. Managing the configuration of all the components of all the participating sites is a non trivial task which has been successfully automated with the XEDL/XLIM platform integration layer. The virtual definition of the Isabel environment of a given session is constructed in XEDL (XML Event definition Language) as the session participants register. This definition is maintained and managed by a session administrator. The XEDL definition is shared by all participants and contains information about resources used, access points, configuration parameters, connection topology, etc. XLIM services are implemented using XML-RPC and allow platform set-up and reconfiguration framework, where centralized and distributed operation procedures can be mixed in a natural way. The XEDL platform definition contains all the information to access a resource, it can be considered as a virtual access point to any resource of the collaborative environment. Any tool or user having access to this definition can use the environment according to the access rights given to him.

XEDL/XLIM has been designed to support only real time multipoint collaboration, but it can be extended to support collaborative environments with synchronous and asynchronous interactions and more sophisticated virtual organization models, as proposed here.

II. THE COLLABORATIVE ENVIRONMENT INTEGRATION LAYER

The collaborative environment integration layer can be seen as the integration glue for creating homogeneous and integrated collaborative platforms out of independent legacy components. It is therefore important to highlight that his role is the integration of already existing collaboration components into a platform and not the creation of new collaboration components.

The integration layer is therefore a signaling layer able to send the proper configuration commands to all the components of a given platform such that complex multi-component collaboration environment can be activated, reconfigured and deactivated automatically in a save environment where access rights are properly controlled. The main goal of the Collaborative Environment Integration layer is therefore the automated construction, operation and management of collaborative environments.

Collaboration platforms used within a given collaborative activity use a variety of collaborative components such as tools, applications or services used to communicate, interact or share information, such as Web groupware, digital libraries, repositories or brokers, blogs, workflow management, voice and video over IP standards, application sharing, etc. Those tools inter-work usually using some standards, for example RSS, Atom, Web standards, Web Services, RTP, SIP, BPEL, T120, Jabber, etc. Those tools have proprietary management interfaces which make very difficult, if not impossible, the automated configuration over the network of all the components of a collaborative environment, especially for synchronous components. This layer must standardize the configuration and management interfaces and protocols of collaborative tools in order to allow unified and automated environment construction and operation.

The development of two new architectural elements is considered necessary to achieve the goals of CEIL:

1. The Collaborative Environment Description Language (CEDL): the formal language for describing all the elements and associated parameters relevant for modeling and managing a Collaborative Environment.
2. The Collaborative Environment Management Interface (CEMI): the unified interface which provides uniform management and configuration of the collaborative components of an environment.

The main component of this layer is CEDL, the *Collaborative Environment Description Language*. CEDL is a formal language for describing all the elements and associated parameters relevant for modeling and managing a Collaborative Environment. CEDL must be able to model not only the collaborative components or an environment with the associated links and parameters for configuration, but also the virtual organization associated to the collaborative activity,

including all the members, roles and access permissions needed in a given collaboration. As a CEDL definition will be a public object, CEDL must have therefore proper encryption mechanisms where the pieces of non public information owned by individual members or roles of the virtual organization of a given collaborative environment are completely protected from unauthorized access and can be only accessed by the owners.

The second component of this layer is CEMI, the *Collaborative Environment Management Interface*. CEMI is a unified interface providing uniform management of the collaborative environment, such that tools can be created which allow complete environment set up or reconfiguration to be made automatically or with “one click”. This interface is considered necessary for the creation of higher level functions which can operate on the complete environment as a unified entity, in order to allow automation of complex configuration operations based on the configuration parameters gathered by the CEDL description of a given platform.

III. COLLABORATIVE COMPONENTS

Individuals, teams or organizations collaborate in a collaborative activity using collaborative tools, applications or services which we will call collaborative components. We call legacy component to any tool, application or service which can be used in such a context. Collaborative components use existing standards to inter-work. Standards are understood in a broad sense as any official or de facto standard which enables some kind of collaborative activity, such as the Web in general, Web groupware, digital libraries, repositories or brokers, blogs, workflow management, voice and video over IP standards, application sharing, etc. We call *Collaborative Interface* to the virtual interface used by a collaborative component to inter-work with his peers, such as RSS or Atom for Blog syndication, Jabber, SIP and RTP for IM or Voice and Video over IP, T120 or VNC for application sharing, etc.

Each collaborative component should have a unique address, i.e. a URL, which provides access to it over the Internet. A relevant issue is the granularity at which the collaborative components are partitioned. It is probably convenient from a practical point of view that groupings are allowed, such that several collaborative components can be grouped to form a new collaborative component. This will allow that a given platform responsible can decide the proper granularity of components he would like to have in his platform.

On the other hand existing tools have usually proprietary management interfaces which make very difficult, if not impossible, the automated configuration over the network of all the components of a collaborative environment, especially for synchronous components. Therefore the CEMI is needed for enabling automated configuration of the environment. For example to set up a virtual meeting among members of the activity, many collaborative components have to be configured such that an audio/video/data conference is set up which connects all of them.

To adapt a legacy collaborative component to the new architecture a wrapper must be constructed, which creates a standard management interface (CEMI), which allows

component management according to the new architecture. The interfaces for accessing collaborative part of the components such as the shared resources, the shared applications or the voice or video conference calls will be called the collaborative interface. The collaborative interfaces will conform to existing standards and will be in a different plane than the Collaborative Environment Integration Layer. Collaborative components which do not implement CEMI can inter-work with components which implement CEMI, but using configuration procedures which could not be automated with CEMI.

The goal of the standard management interface is therefore to enable the integration of synchronous and asynchronous collaborative components into a coherent activity oriented collaborative platform which provides a unified support to a given activity or project. Examples of primitive operations over CEMI are Open-Component, Get-Component-Type, Configure-Component, Close-Component, etc.

Figure 1 depicts the structure of a collaborative component compliant CEMI. CEMI is created by enrichment of a legacy component with a wrapper which maps the new unified management interface into the already existing proprietary management interface.

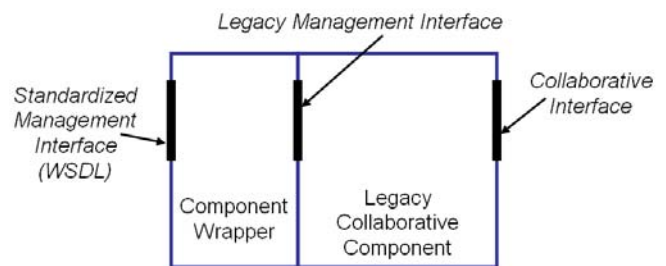


Figure 1

IV. THE COLLABORATIVE COMPONENT TAXONOMY

A first step for the creation of CEDL is the creation of a component taxonomy for classifying components into generic types. Each generic type must represent a family of tools for supporting a collaborative function, for example Instant-Messaging, Voice-Over-IP, Digital-Library, etc. The description of the generic type of each individual collaborative component must be enriched with the identification of the protocol used in the collaborative interface such that interoperability of components can be determined by means of this taxonomy, enabling management tools to know generic functionality and collaborative interfaces supported by a component in order to allow automatic set up of compatible components. For example

- WebSpace/WSDL+SOAP
- IM/Jabber
- IM/SIP+SIMPLE
- VoiceOverIP-Client/RTP+RTCP
- VoiceOverIP-MCU/RTP+RTCP
- VideoOverIP-Client/RTP+RTCP

- Application SharingClient/T120
- Application SharingServer/VNC
- SessionInitiation/SIP
- SessionInitiation/H323
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The taxonomy of interfaces to be considered for asynchronous collaborative components is still an open question because of the rich variety of interfaces existing. Probably some kind of Web Services interface which standardizes the main functions of asynchronous systems should be created.

V. THE COLLABORATIVE ENVIRONMENT DEFINITION LANGUAGE

The *Collaborative Environment Description Language* CEDL is the central element of the layer. It must be a formal language able to describe all the elements and associated parameters relevant for modeling and managing a Collaborative Environment.

Those elements must include at least

- The collaborative components used in the environment with all the necessary configuration parameters needed for automatic configuration of the component when the environment is set up or reconfigured.
- The topology, links and structure of the physical interconnections among the collaborative components of the environment, such that tools can be derived which can configure the environment automatically.
- The virtual organization associated to the collaborative activity, including all the members, roles and access permissions needed in a given collaboration. The information included should allow enable single sign on and allow a safe "one click" access to any resource in the environment by any authorized member.

As a CEDL definition will be a public object, CEDL must have therefore proper encryption mechanisms where the pieces of non public information owned by individual members or roles of the virtual organization of a given collaborative environment are completely protected from unauthorized access and can be only accessed by the owners.

CEDL must be a defined using an open format description language. The most straightforward approach is to define it as a sublanguage of XML using an XML Schema definition, but using RDF or RDF-S is another possible choice.

An important feature of CEDL is the support of modular and incremental construction of platform definitions. The language should allow the definition of individual items, such as

- Personal collaborative interface profiles

- Generic platform profiles
- Collaboration components profiles
- Etc.

Generation of collaboration environment definition by composition of profiles, parameters and partial definitions should be supported, such that a platform definition can be easily updated with new member inclusions or exclusions, new collaborative component registrations or removals, reconfigurations of existing set ups, etc.

As a CEDL definition can be a public object accessible over the Internet proper trust and protection mechanisms must ensure that third parties can verify the authenticity of a definition and are prevented from unauthorized access to the proprietary data.

A CEDL definition should be therefore able to include the signature of the owner or responsible of the collaborative environment which guarantees the authenticity of the definition.

The CEDL definition of a given collaborative platform will contain all the parameters, keys and access permissions of all components needed to access and configure components. CEDL must therefore guarantee the confidentiality of any proprietary or sensible information by supporting a strict encryption policy which avoids unauthorized access.

The virtual organization (VO) definition must explicit all access rights and the protection policy must ensure that the rights and roles established by the VO are not violated.

The general rule for access control should be that access to a given resource or information of a platform definition must be granted only to members which have the right to access it. As a CEDL definition can be a public object accessible over the Internet the protection mechanism must ensure that third parties have only access to the public parts of the definitions if any.

A simple rule which assures that the rights established in a given virtual organization are not violated is to encrypt the information according to the ownership of the information, according to the following rules

- Each member of a VO will have an identity. After authentication the member will have access rights to all the access information he owns or which is owned by any of the roles he has in the VO.
- Each role in the VO will have a given set of associated access permissions to the components of a given environment. When a member is assigned a role, he inherits all the permissions of the role.

CEDL should be based on a generic role definition which can be instantiated in any particular role existing in a virtual organization. Each particular collaborative environment would instantiate the particular set of roles of the virtual organization associated to his activity.

The access permissions are usually attached to the individual operations performed on a given collaborative interface. For example typical operations for accessing a Web repository are usually: create, open, close, read, write, modify, etc. Access permissions should be assigned with a granularity associated to the operations of a particular collaborative interface.

Collaborative activities use typically a variety of virtual organization models. The generic role definition mechanism of CEDL shall allow any of those models to be created by using different mappings of roles and members into the components. For example, a very simple VO with a plain structure with only one type of members and maybe administrators as in wiki like communities should be possible, even containing anonymous members. Hierarchical organizations with several types of members with different access rights should be also feasible.

VI. CONCLUSIONS

This paper proposes the creation of an architectural layer or plane for integration of all the resources and members participating in a given collaborative activity into a unified framework which is referred as the Collaborative Environment Integration Layer (CEIL). This layer is considered a necessary step for integrating with open standards all the collaborative resources or components into a tightly coupled collaborative environment which implements activity orientation. The proposal considers two architectural elements.

The first component is the Collaborative Environment Description Language (CEDL), which is the formal language for describing all the elements and associated parameters relevant for modeling and managing a Collaborative Environment. CEDL is a protected formal representation of the virtual organization associated to the collaborative activity, which can be adapted to a variety of collaborative activity structures. CEDL is an evolution of XEDL/XLIM platform integration layer used in the Isabel application, which has been successfully implemented and used in Isabel platform management.

The second component is the Collaborative Environment Management Interface (CEMI), which is the unified interface which provides uniform management and configuration of the collaborative components of an environment. This layer must include accurate descriptions of the virtual organizations associated to collaborative activity, including participants, roles, rights, hierarchies, etc, being able to model the variety of existing virtual organization models

The implementation of this proposal would provide a unified entry point into the collaborative environment allowing a much higher degree of automation of the configuration of a CWE.

The creation of an integrated access and management framework for collaborative environments is the first step for achieving activity orientation, because it provides unified view and representation of all the resources of the environment allowing.

More specifically, the unified representation and management framework would facilitate the following advancements in the functionality of open collaborative environments

- Collaboration aware platform creation where the team members, collaborative applications and resources needed in a given project or activity are integrated together into a unified platform with standard management interfaces
- Single entry point and authentication for accessing the collaborative environment and any associated resource or member
- Unified and integrated global visualizations of the ongoing tasks or of the components of the activity
- Collaborative assistants which can extract global views of the activity to detect problems or malfunction or make suggestions to team members
- Unified context management of the collaborative platforms of projects or activities which would lead to reduced management effort

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