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Build grid-enabled large-scale collaboration environment in e-Learning grid

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Abstract

As a new branch of grid computing, e-Learning grid is emerging as a nationwide e-Learning infrastructure, which can provide innovative learning experience for learners. In such a grid environment, collaboration services will be the key elements due to the pervasive requirement for cooperative work and collaborative learning. Although there exist enormous research efforts on grid-based collaboration technologies, most of them have many limitations. In this paper, with the findings from the computer support cooperative work (CSCW)/computer support collaborative learning (CSCL) and advantages provided by grid, we propose to build grid-enabled large-scale collaboration environment (GLCE). GLCE focuses on distributed, large-scale, and cross-organizational collaboration through creating group-centered next generation collaboration environment, where both intra-group and inter-group collaboration could be supported. With this idea in mind, we present a grid-based cooperative work framework (GCWF), which aims to implement GLCE with an ''upper layer'' collaboration middleware based on the special-purpose grid infrastructure designed by our team. The preliminary results of our research on GLCE have been applied to build the learning assessment grid (LAGrid). The goal of LAGrid is to support the formative assessment business in China Radio and TV University (CRTVU) and large-scale collaboration within virtual organization (VO) has been realized.

Keywords: Learning assessment grid; Grid-enabled large-scale collaboration environment; Grid-based cooperative work framework; CSCW; CSCL

1. Background

Grid can resolve the drawbacks in existing e-Learning platforms, such as scalability, interoperability and availability, and that is why e-Learning grid is emerging. Furthermore, e-Learning grid provides new possibilities for further development of e-Learning, and among them, cooperative work/collaborative learning is the most exciting one for innovative learning experience.

1.1. e-Learning grid

Grid infrastructure is built with a set of grid middleware, which work together to provide transparent resource sharing environment for upper application. There have been many distinguished middleware platforms, such as Globus Toolkits (Foster & Kesselman, 1998), Legion (Grimshaw, Wulf, & James, 1994) and Condor (Litzkow, Livny, & Mutka, 1988) etc. The success of these platforms makes it possible to build new grid infrastructure for more wide resource sharing, and results in the establishment of global grid forum (The First Grid Forum, 1999) for grid technology standardization. As a result, OGSA/OGSI (Foster, Kesselman, Nick, et al., 2002) specifications and its successor, WSRF (Joseph, Emest, & Fellenstein, 2004) came into being, which make grid computing converge with Web services, and this service-oriented grid architecture represents the new generation of grid towards the open grid services available anywhere.

In e-Learning field, there have many isolated e-Learning platforms, in which learning objects/functions are platform-dependent and can not be used outside the system, and the collaboration between actors of different systems

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became more complicated. Therefore, e-Learning has met challenges nowadays, which increasingly addresses learning resources/services sharing and reuse, interoperability, and this is where grid technology comes up (Capuano, Gaeta, Laria, et al., 2003). Today, grid is evolving from its original concept as computing resources sharing to a means of supporting enterprise computing across distributed virtual organizations, which can provide support for both distance and traditional learning process, and there have researches on e-Learning grid, such as the works by LeGE–WG (Dimitrakos, Randal, & Ritrovato, 2002).

Until now, much grid development has not yet been exploited widely in e-Learning context. e-Learning community should address technical issues and move actively into e-Learning grid service design and implement phase, and there have some efforts in this direction, for example, European learning grid infrastructure project (EleGI, 2004.2.1–2008.1.31) aims to "address and advance current e-Learning solutions through collaborative use of geographically distributed computing and educational resources as a single e-Learning environment" (Gaeta, Ritrovato, & Salerno, 2003).

1.2. Collaboration requirements in e-Learning grid

e-Learning grid will facilitate the evaluation of new learning approaches and provide innovative learning experience for learners, and collaboration technologies are the most promising approach for this direction.

First, lifelong learning (Longworth & Davies, 1996) has brought the need to support a broad community of learners throughout their lifetimes to learn together, and learning from others enables them to acquire new knowledge in a fast and efficient way. In this new environment, learning activities are aiming to aid the learner to construct knowledge other than to memorize information, and collaborative learning can be used for the requirements to enhance the learning experience and improve the learning results (Slavin, 1995).

Second, computer supported collaborative learning (CSCL) is regarded as a new paradigm for collaborative learning (Koschmann, 1996), and there have research efforts towards the development of platforms for CSCL applications (Ana, Bacelo, & Karin, 2002; Asensio, Dimitriadis, Heredia, et al., 2004). In fact, CSCL is a sub-field of computer supported cooperative work (CSCW) and it inherits findings and fruits from CSCW. Many groupware systems in CSCW were used in CSCL directly with minor modification (Appelt, Ruland, Skarmeta, et al., 2002). While CSCL pays more attention to the technologies suitable for collaborative learning scenarios, CSCW is an interdisciplinary research field for general collaboration technologies, and both of them are needed in e-Learning environment by teachers, administrators, and learners, etc. Therefore, both of cooperative work and collaborative learning environments should be provided for various groups in e-Learning grid.

Nowadays, there have many research efforts on grid-enabled collaboration technologies in worldwide gird research community (Atkins, Droegemeier, Feldman, et al., 2003; Bote-Lorenzo, Vaquero-González, Vega-Gorgojo, et al., 2004; Corrie & Leigh, 2003; Neal, Kunori, Bunn, et al., 2003; Shum, Roure, Eisenstadt, et al., 2002), for example, Caballe proposed to develop a generic CSCL platform with grid technologies (Caballe, Xhafa, Daradoumis, et al., 2004), which aimed to provide collaborative learning purpose library (CLPL) and grid-enabled collaboratory for scientific research (GECSR) is a project which plans to integrate existing collaborative tools and build next-generation collaborative framework (Neal et al., 2003). However, most of these efforts are just developed for quick prototyping, which result in the difficulty for creating natural collaboration environment. On the other hand, while considerable work has been done on collaborative tools to assist in performing collaboration, little has been done on the mechanisms for establishing/maintaining the structure of collaboration, which is the key for large-scale collaboration. In this paper, we argue that the endeavor for grid-enabled collaboration technologies should focus on large-scale collaboration environments, which aims to bring the full potential from grid for collaboration and create natural next generation cooperative work/collaborative learning environments, therefore, the collaboration of large number of participants who perhaps belong to many different organizations can be enabled.

The rest of this paper is structured as follows. In Section 2, we analyze the development of collaboration technologies in the field of CSCW/L from holistic perspective, and summarize the inherent requirements of cooperation based on the state of practices in CSCW/L, and then we study how grid computing technologies can be used to satisfy these requirements, which result in our viewpoint of grid-enabled large-scale collaboration environment (GLCE). Afterwards, we propose grid-based cooperative work framework (GCWF) to realize GLCE, and describe the framework in detail. In Section 3, we first introduce learning assessment grid (LAGrid), which is designed with the idea of GLCE, and then describe how the large-scale collaboration environment is implemented in LAGrid. LAGrid is the initial results of our long-term efforts on GLCE. In Section 4, we compare our work on GLCE with some other research efforts, and also compare the work of LAGrid with existing e-Learning platforms in China Radio and TV University (CRTVU). Section 5 draws the conclusion and discusses future directions.

2. New approach for grid-enabled collaboration technologies research

Current learning platforms do not support all requirements of collaborative lifelong learning, therefore, it is valuable and necessary to find appropriate solution for how to build such platform in grid environments.