

LL2 (Learners Learn 2gether) - a P2P-based E-Learning System

Silvia Breu, Franz Lehner, Holger Nösekabel
University of Passau

Abstract: A traditional university provides a location for students and lecturers to meet but at the same time limits the mobility of both. E-learning can overcome this but places a huge burden on lecturers and tutors to provide material and infrastructure for remote students. Peer-to-peer (P2P) technology offers a chance to overcome the centralized distribution of learning material by leveraging students' computer resources: Given a P2P client, students may exchange material freely in a decentralized and unsupervised fashion, spanning courses, professors, and even universities all over the world. This paper describes the aim of the LL2 project, a P2P-based e-learning system under development at the University of Passau. Its focus lies in overcoming limitations of existing prototypes and systems, as well as putting e-learning in a strongly didactical context. We also give a short evaluating overview of existing tools.

1. Motivation

Educational institutes often operate in an isolated environment, a “walled garden”, with little or no exchange of students or instructors. As a result, identical courses need to be conceptualised, developed, and re-invented several times. Furthermore, the mobility of both students and instructors is hindered, because the participation of courses offered by other institutions is complicated by regulations regarding the accreditation of achievements, e.g., credit points or exams. Mobility (in several meanings of the term), however, is highly desirable to allow people to gain new insights and strengthen their flexibility. The initiation of the Bologna process in 1999 aimed at increasing the mobility in higher education, thus increasing employability and competitiveness of European graduates.

As a direct result of the Bologna declaration, universities are faced with the challenge to restructure and modularise study programs. In the case that physical mobility is not feasible due to time and cost issues, virtual mobility can be increased significantly. Virtual mobility in education is closely connected to the concept of e-learning: Computer-based technologies foster communication and collaboration between physically distributed persons.

But e-learning is not a magic bullet that can solve all pedagogical problems. Introducing and using an e-learning system can be a complex and costly task. We propose a P2P based approach that will animate students to become active in the learning process: Instead of students and lecturers being grouped around a course, both are encouraged to actively look for materials, build groups, exchange information and knowledge, and look beyond the classroom walls. In the remains of this paper we address what our goals are for the LL2 project (Section 2.1), describe the basic architecture and functionality in Section 2.2, and discuss related work in Section 3. Finally, Section 4 concludes the paper.

2. LL2—An E-Learning Application

E-learning is widely used and e-learning solutions are rather common in the meantime. A new technology creating new opportunities in the field of e-learning is peer-to-peer (P2P) which is not only a new technology but also a new paradigm within electronic communication. P2P refers to participants in a network which are “equal”, who conduct collaborative processes without the need for a central co-ordination, and who mutually allocate resources. It can be considered to be the counterpart of the client-server architecture of traditional e-learning-environments or learning management systems.

We already started the development of a new e-learning tool called Learners Learn 2 gether (LL2), addressing the problem of high entry barriers for campus-wide e-learning solutions. Furthermore, we try to meet the demands of modern educational systems; the aim is to develop LL2 as desktop as well as mobile solution. The system will interact with existing e-learning environments (e.g., Online Campus Passau) and shall be tested within an European partner network (including participants from Finland, Hungary, Czech Republic, and Austria).

2.1 Goals of LL2

With LL2, we focus on four major goals and research questions, and address problems that arise from a changing learning environment:

- globalisation of learning and “modern” learning,
- opportunities/challenges of new technologies as driving force,
- analysis of technology potentials in e-learning, and
- technology transfer to different application fields.

The internationalisation has not stopped in front of universities or any other educational institution. Instead, analogous to economics, learning and studying has become more and more global. More and more students spend some time abroad at universities all over the globe. This in turn had the consequence that courses offered at different institutions had to become comparable. Thus, identical courses and lectures need to be developed; this kind of re-inventing the wheel is cost- as well as time-consuming. On the other hand, with the increasing need of studying and working abroad, more and more mobility is required. That creates another special challenge: the possibility to attend courses over long distances. This overall mobility is also highly desirable as it offers people to gain new insights. Furthermore, it enhances the inevitable technology and knowledge transfer as well as the collaboration between the academical and more theoretical education and the practical application in real life.

New technologies like P2P, mobile, and voice technologies offer challenges and opportunities to create user-friendly tools and systems that support the recent development and new demands in learning. These changing requirements to learning environments do not only affect traditional learning but even more e-learning. The primary focus in LL2 with regard to these new technologies will be in the area of peer-to-peer technology.

P2P systems are emerging; especially, as internet service providers offer more and more bandwidth to homes, peer-to-peer systems like internet voice telephony (e.g., Skype) and others become more and more common. Peer-to-peer computing is a technology that uses the resources of many connected devices to either distribute large computing tasks or content widely without the need for central servers. Till now, most P2P applications have been running on the fixed internet. But as mobile phones and other small devices such as handhelds get increasing computing power, some questions arise: How can peer-to-peer activities be scaled downwards to such devices, what is possible with the current state-of-the-art in P2P, and what are the most limiting factors that we have to overcome?

Therefore, a second focus will be set in the area of mobile computing. Besides a desktop solution, a mobile solution will be developed. As an example, Figure 1 shows how a possible LL2 interface could look like on a mobile device.

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Figure 1: Possible LL2 interfaces on a handheld.

The third major goal of LL2 addresses the assessment and the analysis of the potentials of peer-to-peer technologies in e-learning. This evaluation spans the whole development cycle and beyond. The specification phase includes thorough assessment and discussion of existing APIs to be used, as well as discussion of security and usability features. The implementation of the prototype will consist of two tailored peers, one for desktop PC usage, and one for mobile devices such as cell phones and handhelds.

However, the main part of the assessment and analysis lies in the evaluation of the prototype within universities' environments. This test splits into four parts: The general test checks whether LL2 meets the expectations in terms of globalised learning. The main part is the pedagogical evaluation. It looks at collaborative aspects and group behaviour, size and composition of groups, while taking cultural differences between participating countries into account. It also investigates if and how LL2 influences the learning efficiency as well as the usage of LL2. The economical test looks at the development costs of LL2, whereas the technical evaluation assesses possible open source development.

The fourth focus of the LL2 project will try to identify other fields of application and transfer the insights and acquired knowledge to those. This can also be considered as part of future work in the area of e-learning. The results of the realisation of LL2 and its evaluation, especially in terms of pedagogical influence and possibilities, can be used to be applied to other fields, e.g., to vocational training. Since LL2 aims at providing an open network, anyone can connect to it and use the provided resources. Thus, LL2's longterm goal also includes the support of lifelong learning. Besides, it can be applied to and assist knowledge management within international organisations.

2.2 Architecture and Functionality of LL2

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Figure 2: Possible LL2 functionalities

The concept behind LL2 aims at providing a highly modular and if possible device independent peer-to-peer network (see Figure 2). This has several advantages: The plugin approach offers easy update and replacement of single modules without compromising the integrity of the entire client. Furthermore, it is possible to develop modules for special teaching and learning purposes, and distribute them under the users of a group, e.g., a simulation program for participants in a lecture. But this module can also be made available to all LL2 users, especially other lecturers and instructors. Another advantage is the fact that by choosing a modular approach, the modules that are built can be realised device independent and thus, allow deployment in a variety of environments.

The modules will communicate with the LL2 network as well as with other plugged in modules via defined messages. The graphical user interface is also planned to be a module; this offers that existing modules from the desktop solution can easily be adapted for mobile devices with little additional effort.

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Figure 3: Communication of modules in LL2

Taking the example in Figure 3, an inter-module communication could be between an instant messaging module, a “who-is-online” module, and the LL2 network. The “who-is-online” module maintains a list of peer IDs that are regarded as “friends”. In certain intervals, it queries the network for the online status of each ID via the core. If the network reports an ID to be online, the core reports this result to the “who-is-online” module. This module can then instruct the GUI to display a notice to the user, who might then decide to send an instant message to the newly logged in user. The instant messaging module receives text input from the GUI module (via the core), checks with the “who-is-online” module if the conversational partner is still online (via the core), and then sends the text message (via the core) over the network.

It remains to point out that “core” does not imply a distributable piece of software as the core itself is of very little use for a user. A typical distribution of LL2 thus consists of the LL2 core, a GUI module, and additional modules. The fact, that the necessary functionality is given by the additional modules, the distribution can easily be adapted to the needs of specific user groups. We consider this of high value in order to offer a tailored but yet easy customisable e-learning solution.

3. Related Work

P2P technology can be used in several areas, e.g., to support collaboration in workgroups. A well known groupware application with an underlying P2P network is Groove [gro]. It offers the usually required functionality for file sharing, coordination of meetings and projects etc. Some initiatives exist that try to combine e-learning with the new possibilities of peer-to-peer networks. Edutella [NWQ+02, EDU] deals with the development of a RDF based standard for e-learning content, concentrating on the exchange of metadata. However, there are no collaborative functions.

Apple [JYY+04, app], a project at the Huazhong University of Science and Technology, provides live video and audio broadcast of a classroom, synchronised presentation of lecture slides on remote computers, and chat functionality. Content and metadata is stored on a central index server. The project is based on Microsoft .NET.

S2S - Science-to-Science [Wer03, S2S] aims at promoting the information of scientists around the world by providing a document search. Knowledge exchange is fostered by an expert-matching platform, where each participant declares himself to be an expert in a specific thematic area. Questions, which can be entered by other participants, are then presented to the experts in the appropriate area. Answered questions are stored in the system for later reference.

Colloquia [LOBB00, col] (formerly known as Learning Landscapes [BL00]) is designed to support the management and the administration of learning groups and task groups respectively. It is a P2P learning management and groupware system, with no central instance. Participants in the network can create groups, tasks and learning resources. Colloquia seems to be abandoned since 2002.

SkillDog links learners with each other by use of a central index server. This P2P e-learning client is also built on Microsoft .NET technology and natively supports the Learning Resource iNterchange (LRN) reusable content specification. Unfortunately, SkillDog also seems to be abandoned since 2001.

SWAP [ETS+03, swa], a project funded by the EC, has implemented two different solutions which are combining P2P and semantic web technologies. The first solution is a P2P knowledge management tool which was applied in a tourism related context (XAROP [TEF+04]). The second tool, Bibster [HBE+04, bib], uses P2P for sharing bibliographic data.

SeLeNe [RS03, sel], also a project funded by the EC, aims to facilitate the formation of learning communities that require world-wide discovery and assimilation of knowledge. To achieve this, the project focused on learning objects and as a part of the research activities, examined how learning objects could be queried and distributed over P2P networks.

4. Summary

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Apparently the current state-of-the-art in P2P e-learning covers only part of the requirements and development is slow. Products which are currently supported and developed are SWAP, SeLeNe, Groove, Edutella, and S2S, where Groove is a groupware solution lacking educational functions and S2S focuses on scientific knowledge management, also missing educational functions. A major problem seems to be the size of the user base for each project. Few projects were able to create the required critical mass of users, which, as a result, hinders acceptance, growth and development. Besides, most do not offer all functionality and features related to e-learning. LL2 therefore aims at improving the state-of-the-art significantly by providing an active P2P e-learning solution and network. During the course of the project a critical mass of users need to participate in LL2, first to provide statistically valid evaluation results, second to build the user base which ensures continued usage, and third to develop and improve the software and optional modules. This will be guaranteed by many international participants in the project, including universities and groups not only in Germany but also in Finland, Hungary, the Czech Republic, and Austria. Embedding LL2 in existing learning processes, both in academic and industrial environments, by combining e-learning with classroom learning (known as blended learning) fosters usage even further. Within the LL2 project, we will also analyse benefits and challenges but also disadvantages of these new and promising technologies such as P2P and mobile computing for the field of e-learning.

5. References

[app] Apple homepage. <http://grid.hust.edu.cn/apple/>.

[bib] Bibster homepage. <http://bibster.semanticweb.org/>.

[BL00] Sandy Britain and Oleg Liber. Learning Landscapes. In *UCISA User Support Services Conference*, University of Lancaster, UK, April 2000.

[col] Colloquia homepage. <http://www.colloquia.net/>.

[EDU] Edutella homepage. <http://edutella.jxta.org/>.

[ETS+03] Marc Ehrig, Christoph Tempich, Steffen Staab, Frank van Harmelen, Ronny Siebes, Marta Sabou, Jeen Broekstra, and Heiner Stuckenschmidt. SWAP: Ontology-Based Knowledge Management with Peer-to-Peer. In Ebroul Izquierdo, editor, *4th European Workshop on Image Analysis for Multimedia Interactive Services (WIAMIS 03)*, London, pages 557–562, London, April 2003. World Scientific.

[gro] groove homepage. <http://www.groove.net/>.

[HBE+04] Peter Haase, Jeen Broekstra, Marc Ehrig, Maarten Menken, Peter Mika, Michal Plechawski, Pawel Pyszlak, Björn Schnizler, Ronny Siebes, Steffen Staab, and Christoph Tempich. Bibster - A Semantics-Based Bibliographic Peer-to-Peer System. In Sheila A. McIlraith, Dimitris Plexousakis, and Frank van Harmelen, editors, *Proceedings of the Third International Semantic Web Conference, Hiroshima, Japan, 2004*, volume 3298 of LNCS, pages 122–136. Springer, November 2004.

MICROLEARNING 2005 DRAFT

[JYY+04] Hai Jin, Zuoning Yin, Xudong Yang, Fucheng Wang, Jie Ma, Hao Wang, and Jiangpei Yin. APPLE: A Novel P2P Based e-Learning Environment. *Lecture Notes in Computer Science*, 3326:52–62, December 2004.

[LOBB00] Oleg Liber, Bill Olivier, Sandy Britain, and Phillip Beauvoir. Colloquia: a Distributed and Conversational Learning Environment. In *Proceedings of ALT-C 2000, University of Manchester, UK, September 2000*.

[NWQ+02] Wolfgang Nejdl, Boris Wolf, Changtao Qu, Stefan Decker, Michael Sintek, Ambjörn Naeve, Mikael Nilsson, Matthias Palmér, and Tore Risch. EDUTELLA: A P2P Networking Infrastructure Based on RDF. In *Proceedings of 11th International World Wide Web Conference, Hawaii, USA, May 2002*.

[RS03] Philippe Rigaux and Nicholas Spyratos. Metadata Management and Learning Object Composition in a Self e-Learning Network. In *Proceedings of 1st Franco-Japanese Workshop on Information Search, Integration and Personalizaion, Sapporo, Japan, July 2003*.

[S2S] Science-to-science homepage. <http://s2s.neofonie.de/>.

[sel] SeLeNe homepage. <http://www.dcs.bbk.ac.uk/selene/>.

[swa] SWAP homepage. <http://swap.semanticweb.org/>.

[TEF+04] Christoph Tempich, Marc Ehrig, Christiaan Fluit, Peter Haase, Esteve Llado Marti, Michal Plechawski, and Steffen Staab. XAROP: A Midterm Report in Introducing a Decentralized Semantics-based Knowledge Sharing Application. In Dimitris Karagiannis and Ulrich Reimer, editors, *Proceedings of the 5th International Conference on Practical Aspects of Knowledge Management (PAKM 2004), LNCS, Vienna, Austria, December 2004*. Springer.

[Wer03] Ronald Wertlen. DFN Science-to-Science: Peer-to-Peer Scientific Research. In *Proceedings of the 8th Trans-European-Research and Education Networking Association (TERENA) Networking Conference (TNC), Zagreb, Croatia, May 2003*.