# Uni-Online - An Open Source Infrastructure for E-Learning

Firoz Kaderali, Gerd Steinkamp

*Abstract*— **At the FernUniversitaet Hagen, in the Faculty of Electrical and Information Engineering, an infrastructure for teaching and learning in the network has been developed and tested over the past five years. Recently, the software has been made available as an open source product. This paper concentrates on the system functions implemented.**

*Keywords*— **E-Learning, Virtual University, Open Source**

## I. Introduction

The University of Hagen (FernUniversitaet Hagen) is in a unique position in Germany, since it is the only university for distance education. The university is an integral part of the regular public higher education structure and offers german degrees in the fields of economics, law, human science, computer science, mathematics and electrical engineering. Students receive the printed lectures in a fortnightly rhythm and have to pass assignments in order to get access to final examinations. The university has built an infrastructure of study centers throughout Germany, Austria, Switzerland and Eastern Europe, where students can meet other students as well as their tutors and get access to small libraries, computers and video conferencing equipment. Besides the remote aspects of the study, the students have to spend several attendance days at Hagen to take part in seminars, laboratories and oral examinations. The university is determined to make best use of the vast possibilities which are offered by the information technology and new media. Diverse activities have been started in the university to evaluate the route from the traditional university for distance teaching towards a new media university.

The Uni-Online e-learning platform was developed during the project "Virtual University", funded by the state of North-Rhine-Westphalia. Uni-Online is a web-based system for the administration of courses, students, and educational staff. It is currently in operation at four educational institutions. Among these institutions is the faculty of electrical engineering at the University of Hagen, which developed the platform for its online service called "ET-Online" [7]. Uni-Online is a practical solution for all faculties that whish to quickly participitate in the e-learning community. While commercial providers for e-learning solutions keep their customers locked in rigid license agreements, Uni-Online gives them total freedom. Furthermore, often commercial solutions lack urgently required features while containing functionalities which are not needed in particular cases. Uni-Online provides the users with the possibility to adapt the software to their special needs.

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## II. CampusSource - An Acadamic Open Source Initiative

Uni-Online is part of the CampusSource initiative started by the state of North-Rhine-Westphalia. The goal of this initiative is to promote the development of Open Source software for academic and educational sector and to develop an infrastructure for Virtual Universities. CampusSource bundles the resources of several projects and provides a technical platform to all participating universities. The decision to openly release software which was financed with public funds is totally in line with academic tradition to publish research results. In the same way the iniative catches the spirit of early Internet which relied on open communication and free access to information among research institutions.

Open Source software is based on three principles:

- the software must be available without licence fees,
- the source code is available and may be adjusted to personal needs,
- modified software may be freely distributed.

CampusSource software is released under an open source licence which employs the copy left paradigm. This means that a user can change the source code, but is obliged to return all the changes made back to the community. The iniative chose the *GNU Public Licence (GPL)* [5] as the licence model. Nevertheless, the GPL had to be slightly augmented with German terms and conditions to conform with German law.

The initiative currently consists of eight (core group) members from several universities. One of the main task of CampusSource is to provide a portal [6] where all involved platforms are described and can be downloaded for free by registered users. Furthermore, CampusSource provides channels for feedback from users which are using the software. Another important function is the discussion and development of interfaces between existing and future e-learning platforms. Although the existing platforms have features that overlap, it is of great interest to find ways to seamlessly integrate these different platforms in order to combine their functionalities.

## III. History of Uni-Online

Uni-Online evolved from the project "Virtual University" which started in 1996 and ended in december 1999. It was carried out by the faculties of computer science and electrical engineering. Both faculties began with general considerations about which features the Virtual University would have to offer. It soon became clear, that the sketched "Virtual University" was actually less virtual than the traditional university for distance education. The reason for this is the following: in distance education there has always been a gap between teachers and students due to the geographical distance between both parties. Conversation and tutoring was carried out by conventional mail and telephone, the first being quite slow and the second being uncomfortable because of the shifted work rhythms of students, who normally work in the evening, and teachers who have a regular working day. Hence, the advent of the Internet brought completely new perspectives to the communication possibilities between students and teachers in that it introduced new asynchronous communication forms like email and newsgroups. Consequently, interaction between teachers and students, and also between fellow students, has increased enormously and thus the "virtual" part of distance education has been reduced.

The online service within the "Virtual University" which is offered by the faculty of electrical engineering is called "ET-Online" [7] which is a german acronym for "Electrical Engineering Online". Uni-Online is the technical platform which provides the basis for ET-Online. In the remainder of this paper we describe the technical features of the Uni-Online platform.

## IV. Features of Uni-Online

Uni-Online comprises the technical platform and all associated components. It is a software package that can be used by other educational institution as a basis for their own e-learning services. Uni-Online provides functionalities for the web-based administration of courses and students. All important features relevant to students and faculty staff can be accessed with a standard web browser. Uni-Online presumes that learning material is created with standard authoring software. This has the advantage that the system virtually supports any kind of course material that can be served from a web server. Uni-Online provides the flexibility that is essential in today's e-learning community which is still lacking commonly accepted standards.

Because of the huge amount of diverse information to be administrated in the "Virtual University" there is a need for a system that organizes the data in a very structured way. It would be impossible to manage students, courses, learning units and many other items comprising the university with a simple set of lists or tables. To efficiently access data a relational data base management system (RDBMS) was embedded into Uni-Online. In Uni-Online many web pages are built dynamically with information from this database.

Uni-online is a two-tier web application consisting of an Apache web server with a PHP extension module and a PostgreSQL relational database. All of these components are available under Open Source licences. These technical components are renowned in the IT-world for beeing robust and widely supported.

Uni-Online can be separated into four distinct modules:
- a view on personal information for students, the Uni-Online Assistant,
- an independent download tool for course contents, the Offline Navigator,
- an easy-to-use administration front-end for the faculty staff, and
- an extension module for the web server to allow automated periodic release of course material, the "automatic release module".

### A. Uni-Online Assistant

The Uni-Online Assistant offers students an individual personalised view of relevant information and data. Of course, all private student data is encrypted before it is sent through the Internet (SSL encryption). The students have access to the following features:
- Access to personal data: Here the students can specify private data, like address, telephone number, email address, etc. This information is essential for university staff who want to contact a student. The students can also choose if they want to be included in contact and mailing lists for their enrolled courses.
- Results from assignments: The students can check the points they received for their individual assignments.
- Course list: The students get a personal list of their courses, including information about the tutor and the possibilty to directly go to the homepage of the course.
- Contact list: The contact list allows students to see if any fellow students live in the same geographic region. This allows the students to build work groups.
- List of tutors and mailing lists: Here the students get a list of all their tutors and their email addresses, as well as all course specific mailing lists.
- Personal dates: University staff has the opportunity to enter course-specific dates into the database (e. g. deadlines). The students get a personal list of dates which are relevant for them.

### B. Offline Navigator

In the concept of the "Virtual University" the distribution of learning material via communication networks plays an important role. To receive learning units students can use two different approaches. They can work with the materials online or offline.

Online learning offers several advantages: students can directly access the services of the "Virtual University" such as the library, so that they can search for further literature directly from the learning environment. In case of an arising question a student can have a look into the newsgroup or into the online FAQ (frequently asked questions) to find an answer to his problem. But this online form of learning implies transmission costs all the time which is hardly acceptable for most students. A solution to minimize these

online costs is the offline learning. Students can download learning units on their private personal computers in form of compressed packages. The download of compressed learning units requires only a short transmission duration and afterwards the course material is available all the time the student needs it. He does not have to connect to the university again if he wants to repeat the subject matter. The learning process itself then takes place offline. In this way the transmission costs for the students are reduced considerably (about 75%).

The Offline Navigator is a tool for the automated download and organisation of course material. After startup and authentication the students get a list of all courses enrolled by them. Each course comprises several components which can be downloaded separately. Typical course components are weekly lecture scripts in HTML and PDF format, weekly assignments and their solutions, exercises, multimedia elements, etc. The students can select the components they wish to obtain from the list and then initiate the download process. The Offline Navigator decompresses the incoming components and stores them on the local hard disk of the student's PC. Furthermore, a table of contents is created that can be used to navigate through the different courses. Since the Offline-Navigator is a Java Application (not a Java Applet!) it can run on diverse operating systems. A more deailed description of functionalities and design of the Offline Navigator can be found in [3].

### C. The administration frontend

The administration frontend is used by the faculty staff like professors, tutors, secretaries, system administrators. It allows to search for and enter student and course data like registration numbers, addresses, email addresses, points for assignments, course modules, etc. The frontend is completely based on HTML which allows the staff to access the database from any web browser. This frontend is

- comfortable and equipped with context sensitive help,
- easy to use (nearly all of the users are familiar with HTML browsers),
- personalized (the system offers only the functions to the user which he needs in his position).

### D. The automatic release module

It has been found, that it is advantageous to keep all students who are working in the same online course in a mutual study rhythm. Otherwise, a common basis for learning and discussion would eventually start to fade because some students would advance faster in the learning material than their fellow students. Technically, a mutual learning rhythm can be enforced by dividing lectures into components and releasing these components in periodic time intervals. This process can be automated in Uni-Online by configuring the automatic release modul.

## V. Experiences

The University of Hagen is currently making a decisive move towards e-learning, to transfer the experiences made in several projects into daily routine. Uni-Online has been employed at the faculty of electrical engineering of the University of Hagen since 1996. After the end of the "Virtual University" project (1999) Uni-Online was taken over by the faculty into regular service. During the four years of the project lifetime, experiences in many aspects of Internet-based teaching have been made [1], [2], [4]. These include experience with authoring tools and diverse electronic formats, communication, tutoring, and special virtual events like online laboratories, virtual seminars and online oral examinations.

Uni-Online has become an integral part of the faculty of electrical engineering. At the moment, the faculty is moving from traditional German diploma degrees to international bachelor and master degrees in English language. The courses offered in these study programmes are completely "virtual", in that they are no longer distributed through traditional channels like postal services but are completely disseminated and tutored via the Internet. The experiences made during the project "Virtual University" helped to accomplish this task.

From a technical point of view, the seamless integration of Uni-Online into the campus IT-infrastructure became a problem. Based totally on open source software and running on a combination of Linux and standard PC hardware (which is totally appropriate for a research project), the computer center was reluctant to take responsibility for the operation of the system. Hence, the faculty itself took the responsibility and currently operates the platform for its own use. Further problems which had to be kludged around arose from the lack of standardized interfaces to the university's main database system.

Besides the deployment in the faculty, Uni-Online is currently successfully operated at three educational institutions. These institutions provided first feedback and extensions for Uni-Online.

## VI. Summary and Outlook

The first generation of e-learning platforms and environments are in use today, Uni-Online is one of them. In contrast to many existing commercial solutions, Uni-Online was released as free software under an Open Source licence. It is part of the CampusSource initiative which advocates the use of free software at universities to help bundle resources and reduce costs.

From a technical point of view, Uni-Online is a typical client-server application integrated into the Campus IT-infrastructure. As pointed out, the task of integration of the novel e-learning platforms with legacy systems is not always trivial.

It will be interesting to see how emerging technologies in the fields of networking (e.g. wireless networks, ad-hoc networks), business models (ASP, open source, electronic payment) and student equipment (e.g. hand helds, flexible displays) will change the way e-learning environments are deployed and used at universities. It is obvious that not only universities for distance education will make use of e-learning, although for them it is especially useful, since e-

learning has the potential to improve virtually every aspect of distance learning.

## References


[1] F. Kaderali, G. Steinkamp, B. Cubaleska, *Studying Electrical Engineering in the Virtual University*, The International Journal of Engineering Education (IJEE), Special issue on Virtual Universities, Vol. 17, No. 2, 2001.

[2] F. Kaderali, O. Sans, S. Schaup, D. Sommer, *Experiences in Online Tutoring of Multimedia Courses in Distance Education*, Proc. IFIP Teleteaching, Vienna-Budapest, 1998.

[3] Thomas Demuth, Dagmar Sommer, Andreas Rieke, *Conception and Realization of the Offline Navigator in the Virtual University*, Proc. IFIP Teleteaching, Vienna-Budapest, 1998.

[4] Thomas Demuth, *Tools for Teaching and Learning in the Network*, Proceedings of the 20th World Conference On Open Learning And Distance Education, 2001.

[5] Free Software Foundation, *GNU GENERAL PUBLIC LICENSE*, http://www.gnu.org/copyleft/gpl.html

[6] *CampusSource initiative*, http://www.campussource.org/

[7] *ET-Online*, http://www.et-online.fernuni-hagen.de/etonline.html