Franz Kurfess' Course at CalPoly

Note: The following is based on a proposal submitted to the NSF CCLI program in 2004. While the feedback from the reviewers indicated that they liked the overall idea, they suggested to broaden the participating institutions (we had a local community college as our main partner), and to improve the evaluation and assessment methods. Some of the material also refers to a colloquium course that I offered in the Spring 2003 quarter, see http://www.csc.calpoly.edu/~fkurfess/Courses/CSC-490/S03/Syllabus.shtml. Most of it is copied and pasted from a PDF file, and there may be some minor formatting issues; I tried to clean up the more significant ones.

This is intended as the starting point for a discussion among members of the Teaching and Learning SIG.

Proposal Summary: Using Internet2 for Teaching and Learning

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Co-PIs [...]  
The use of advanced technology enables teaching-oriented institutions to conduct courses on topics and in formats that are frequently difficult to offer in traditional settings. Our proposal here is to develop a course about Internet2 as an example of advanced computer and networking technology, and at the same time actively utilizing Internet2 capabilities and resources such as videoconferencing, virtual teamwork, archiving and streaming of course material, or the remote use of facilities. This particular proposal describes a one-year effort directed at the development of course material to be used in a prototype course in the Spring or Fall 2005 quarter. The emphasis for this prototype lies on the preparation of the main teaching material, and on gathering practical experience with the utilization of Internet2 capabilities in a teaching environment. It is our intention to submit a follow-up proposal with a significantly larger number of participating institutions, an expanded choice of topics, and a more careful consideration of the effectiveness of teaching and learning methods in such a context.

Intellectual Merit

This course is intended to enhance knowledge and understanding about advanced technology in the form of high-speed networking. Its main target audience are students and faculty from all disciplines. It is designed in such a way that it can be adapted to more technically oriented audiences (e.g. in engineering or computer science), or to the needs of a general education curriculum with less emphasis on the technology, and more on its potential uses in different disciplines. The core team members have been "Internet2 Champions" at Cal Poly SLO for several years. The principal PI, Franz J. Kurfess, taught an experimental version of a similar course in Spring 2003. The main resources required are access to Internet2 and rooms with videoconferencing capabilities, and are available at the partner institutions.

Broader Impacts

While the emphasis in the course itself is not on the development of new and original concepts, the distributed nature of the course in combination with the use of advanced technology enables participants to experiment with novel teaching and learning methods. In addition to the use of advanced technology during the course period itself, most of the course material can also be disseminated widely through established repositories, and allows other institutions to teach similar courses with very low overhead. This will be especially beneficial to two- and four-year colleges where instructors will be hard pressed to familiarize themselves with all the material. Colleges with predominantly underrepresented groups can obtain access to resources that would normally be beyond their reach. We believe that this course has the potential of very broad impacts on a very wide and diverse audience.

Proposal Description

1 Introduction
One of the challenges faced by institutions with an emphasis on teaching is to expose students to recent advances in research and technology. With the strong emphasis on teaching, instructors often have difficulties keeping up with these advances, especially in disciplines like computer science where the pace of change in technology and topics is relentless. In this proposal, we are suggesting to utilize the capabilities of the Internet2 high-bandwidth infrastructure to enable instructors to offer a course with the Internet2 (http://www.internet2.edu) both as a topic and as a medium for content delivery. While the primary targets are teaching-oriented undergraduate institutions, it can be utilized by a wide range of organizations, including high schools, two-year colleges, and research universities (Kurfess (2004a,b); Delaney et al. (2001); Ackerman et al. (2001); Internet2 (2001); Hughes (2000)). The course will be designed in such a way that it can also be offered in a distributed, team-taught manner, thus allowing multiple institutions to pool resources. While there is a technical section in the course discussing methods and technologies used in high-bandwidth networking, it can be targeted either to a more technically oriented population like computer science and engineering students, or to a broader student population in the form of a general education elective course.

2 Goals and Objectives

The purpose of this proposal is to enhance the utilization of Internet2 for teaching and learning purposes by developing a framework and specific course material for a course using Internet2 simultaneously as topic and as a support method for teaching this course. The course topics will range from the technological and engineering aspects used in the underlying infrastructure to the use of Internet2 in applications for various disciplines to the potential implications of high-bandwidth networking for society as a whole.

3 Project Plan

The course relies heavily on the use of Internet2 itself. Experts in a particular area can deliver lectures via the videoconferencing capabilities of Internet2, presentations from repositories like the Internet2 commons can be streamed from a server, demonstrations of interesting applications can be given live or retrieved from servers, students can collaborate with other students or researchers via Internet2 in distributed or virtual teams, and instructors from different institutions can co-teach the course. In addition to more lecture-oriented course material, practical exercises and student projects directly involving various Internet2 capabilities will be designed. They are intended not only to be used directly in other courses, but can also serve as starting points for other instructors to develop their own activities that match their specific interests and the particular situation at the respective institutions.

The course is intended for a diverse student population, and not only for those with a specific interest in the technical aspects of high-speed networking. The course framework is designed in such a way that it can be adapted and enhanced easily by instructors from different disciplines at a variety of institutions. This proposal will concentrate on the development of core teaching material, and on gathering practical experience using the infrastructure and capabilities of Internet2 in a teaching-oriented environment (see Howell (2001); Ross and Schulz (1999)). We are planning a follow-up proposal with a larger number of participating institutions, an expanded range of topics, and a more elaborate framework for the integration of course materials such as (Peylo (2003); Weitl et al. (2002); Zhao et al. (2002); Broekstra et al. (2001); S. u6 and Freitag (2000); S. u6 et al. (2000); Decker et al. (2000); Levy and Weld (2000); DeRoure et al. (1998)). That follow-up proposal will also address the effectiveness of using the Internet2 infrastructure and capabilities in a teaching environment, and investigate the use of various methods and techniques for teaching and learning (see Aase and Kurfess (2004); Dogru and Tanik (2003); Kurfess et al. (2003); Ertas et al. (2003); Zhao et al. (2002); Burger and Rothermel (2001); Grasha (2000); Kemp et al. (1998); Kolb (1984)). An experimental version of a similar course was taught by the PI at California Polytechnic State University, San Luis Obispo (Cal Poly SLO) in the Spring 2003 quarter (Kurfess (2004a,b)). This course was rather experimental in nature, and essentially carried out as a seminar on top of the regular teaching duties without additional funding. Most of the course material is available on the Web at http://www.internet2.edu/ kurfess/Courses/CSC-490/S03/CSC-490.shtml.

3.1 Course Framework

While the development of actual teaching material within this proposal is limited to a prototype, it will be used to serve as a proof of concept for a framework that enables a variety of institutions and instructors to assemble similar courses that match their specific needs. It will provide a set of guidelines for the utilization and generation of course materials such that individual components can be combined with moderate overhead into lectures or sections. We are investigating the use of existing frameworks such as S. u6 and Freitag (2000); S. u6 et al. (2000), but our emphasis at this point is more on compatibility of components at the conceptual level (Weitl et al. (2002); Zhao et al. (2002); Kurfess et al. (2001); Chang et al. (2001); Jololian et al. (2000)), and not so much at the actual implementation level.

3.2 Possible Course Topics

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3.2 Possible Course Topics
In the following list, we describe possible topics for the content of the course. For this proposal, we will develop materials only for a subset, however. The specific topics addressed by the individual collaborators are indicated in the list. In addition to the formal team members, we will have guest lectures by experts from the Internet2 consortium, CENIC, companies with expertise in high-speed networking such as Cisco, and Cal Poly's Information Technology group.

Internet2 Overview

This topic will include a presentation by a guest speaker from the Internet2 consortium. In the Spring 2003 version, a similar presentation was given by Doug van Houweling, the president of the Internet2 consortium.

High-Speed Networks

An overview of existing and planned high-speed networks will be given. This includes of course the Internet2 itself, but also similar regional, national and international efforts. Most likely, this will be followed by a separate session on actual examples of such networks, subject to the availability of guest speakers. In another related session, the high-speed networking infrastructure here at Cal Poly will be examined. This will include presentations and demonstrations by experts from Cal Poly's ITS department, including a guided tour to Cal Poly networking "hot spots."

High-Speed Networking Technology Also coordinated by Hugh Smith, the focus in this session will be on the principles and technology of high-speed networking. Speakers from Internet2, CENIC, or companies will be invited to discuss the technology they are using or producing.

Internet2 Capabilities The goal of this session is to examine various ways of utilizing the high-bandwidth infrastructure provided via Internet2. At this point, the course participants will probably be already familiar with videoconferencing aspects, but it will be important to show that there is more to it. Collaboration among team members in different locations, the use of remotely available equipment, high-performance distributed computing, and distributed theatrical or musical performances are additional capabilities made possible by Internet2 and similar networks.

Internet2 in Various Disciplines

In the Spring 2003 version, Ann Doyle and Gary Yun from the Internet2 consortium gave overview talks of the use of Internet2 in the arts and humanities, and the sciences, respectively. We are planning to have similar presentations for different disciplines for this project.

Internet2 Application Examples

One example for such a session will be developed by David Gillette and Enrica Lovaglio, another by Randy Scovil. The first one is centered around a project currently under way at Cal Poly. It is a virtual environment developed in collaboration between people from Arts and Languages, Architecture, and Computer Science. Randy Scovil has an extensive background in radio, and is a radio sports commentator. Cuesta College also has an excellent program in radio and television, plus the corresponding studio facilities. A team at Cuesta College will investigate the use of Internet2 capabilities in this domain. In addition, we are planning to have guest lectures by outside speakers on applications that they developed or are using.

Internet2 Opportunities

In the Spring 2003 version, an introduction on this topic was given by Doug van Houweling, the president of the Internet2 consortium. In addition, the course participants engaged in a lively discussion, and came up with a wide variety of possible uses for Internet2 and high-bandwidth networking in general. Among the more predictable ones were sharing of music and movies, or video chats with buddies all over the world. One student actually tried to arrange a job interview with a large software company near Seattle using the Internet facilities, but the logistics turned out to be a little too challenging, and the risk of something going wrong was a little too great for such an important event.

Implications of High-Speed Networking

In the decade since the World Wide Web has been widely available, many aspects of our professional and personal lives have changed considerably. While shopping on the Web, email, instant messaging, etc. clearly have their benefits, phenomena like spam, viruses, and identity theft also point to a darker side of the Internet. This session will try to identify some possible benefits and problems of high-bandwidth networking, and its potential impact on individuals and society.

Future of Internet2

The future of Internet2 was the main theme in the talk by Doug von Houweling during the Spring 2003 version. It would have been nice to replay his presentation two years or so later, but unfortunately we didn't have the capability to capture video conferences at that time. We hope that he or somebody else from the Internet2 consortium will be able to offer us an updated view of the Internet2 from their perspective.
For each topic, our plan is to have the following components:

**Overview:** A high-level overview of the topic. In about 15 minutes, the main aspects, important concepts, and critical ideas are presented. This is intended for a general audience without a specific background in networking or computer science.

**Specific Content:** In a few modules of about 15-30 minutes, the main content of the topic is presented. By their nature, these modules may be more technical, but we will try to make them self-contained, and provide pointers to additional sources for further information.

**Demonstrations:** For most topics, it is possible to actually demonstrate the use of Internet2 capabilities in a particular area. Live music, theater, or dance performances in the arts, the remote use of equipment such as electron microscopes or shake tables in the sciences and engineering, or discussions with native speakers from another country in the languages are examples here.

**Practical Exercises:** True to Cal Poly's motto "Learning by Doing" each session will incorporate some exercises where the participants themselves utilize Internet2 capabilities. Some possibilities are virtual project meetings with participants at different locations, distributed performances of short skits or musical pieces, or scientific experiments involving remote equipment.

**Projects:** In addition to the short practical exercises, the participants will work in small on a larger project for the duration of the course. Ideally, these projects should be interdisciplinary in nature, and involve people with different backgrounds.

**Assessment and Evaluation:** Each session will include a component that allows the evaluation of the learning success. This may include traditional questions and exercises, demonstrations of skills by solving practical problems, short reports, or other methods that may be specific to particular areas.

If feasible, the material will be made available via the course repository in an appropriate format (see Sec. 4.2). All of the material developed by the formal project members will be made available, but some of the guest speaker's materials may be subject to limitations prohibiting this.

### 4 Collaboration

4.1 Experience and Capabilities of Investigators

[Text omitted at the request of Co-PIs]

4.2 Dissemination of Material

It is our intent to make all of the course material available to others. At this point, it is not clear what the best model for this is, both due to conceptual as well as technological constraints (e.g. the amount of storage space and bandwidth required). Initially, we are planning to use local resources at the partner institutions. We will also investigate other options such as the talks and videos repository maintained by Internet2 (http://apps.internet2.edu/talks/), the ResearchChannel (http://www.researchchannel.org/), or the Merlot educational resource repository (http://www.merlot.org/).

4.3 Time Line and Management Plan

[Text omitted at the request of Co-PIs]

### 5 Summary: Significance of Proposed Work

5.1 Intellectual Merit

The proposed activity provides access to experts in various fields, enables instructors to easily share course materials or pool resources, and allows students to explore areas of interest where no guidance from local instructors is available. This is especially relevant when offered to a broad student population, where students from different disciplines are brought together through technology in order to enhance their understanding of their own as well as of other fields. We believe that there is considerable intellectual merit in a course that allows institutions to substantially improve access to advanced knowledge and understanding both about the technologies used, and in a large variety of fields that can benefit from the capabilities provided by Internet2. Especially with the wide acceptance of high-speed communication networks among students, and their curiosity to explore novel tools and technologies, we believe that the adoption of Internet2 as a course topic while simultaneously using it to augment teaching is a reasonably novel idea. It offers an opportunity for students to explore topics beyond the expertise of their local instructors, and enables instructors to offer a course on advanced technology that would be very labor-intensive to prepare in a traditional setting. It allows instructors to gather experience with novel technology with substantially lower overhead and risk, enabling them also to experiment with novel teaching methods, such as team teaching with distributed co-instructors and classes, or the incorporation of remote facilities and resources. The core of the investigators consists of several Cal Poly SLO "Internet2 champions," who have worked for about three years on raising the awareness of Internet2 at an institution with a strong emphasis on undergraduate teaching. The team is augmented by investigators from different types of institutions, one of them being a two-year college that just recently gained access to Internet2 via optical fiber networking.

5.2 Broader Impacts
This proposal addresses the need of higher education institutions to expose their students to recent advances in technology, and the impact they have on teaching and learning, communities, professional activities, and society as a whole. Without relying on instructors to personally acquire the necessary knowledge, it enables students to utilize powerful methods, tools, and technologies that are completely out of reach in conventional classroom settings. It can be especially valuable for students at smaller or remote institutions, such as community colleges or smaller campuses. The course provides a vehicle for institutions and instructors to provide their students with access to advanced research and education facilities, and encourages the establishment of networks and partnerships, e.g. between teaching-oriented and research-oriented institutions, or among institutions with similar profiles. By utilizing Internet2 both as topic of discourse and as a tool, it is very easy to make the outcomes of classes, be it course material or student term projects, available to a wide audience. Students participating in such a class will have a better understanding of the technology and infrastructure for advanced communications networks. They will be better prepared for a broader use of similar facilities by commercial organizations or government, and some may find widened opportunities to pursue their personal or professional goals. This course has the potential for much broader impacts than courses focused on a single discipline. In addition to students, this course will be of value for technicians and technologists, and for faculty professional development. Technicians and technologists, either from centralized Information Technology groups, or located in specific departments, will have an excellent opportunity to enhance their knowledge about Internet2, and at the same time practice their skills utilizing the respective capabilities and tools in a realistic setting. Of particular value may be the opportunity to collaborate with their counterparts at the other institutions, and from the Internet2 consortium. In the Internet2 course taught at Cal Poly in Spring 2003, we also integrated presentations and demonstrations by various people from our ITS group. This was very informative for the course participants, and offered them a look behind the scenes. The ITS docents also enjoyed the opportunity to talk about their work, in particular the exciting (and sometimes frustrating) aspects of utilizing cutting edge technology. For faculty members, such a course offers an opportunity to learn about new technology in a teaching environment. During our Spring 2003 version of the course, we had several faculty participants, although most of them attended only those parts that were of specific interest to them.

In total, we believe that this course can greatly benefit students, faculty, and staff by offering them an opportunity to learn about and at the same time utilize cutting-edge technology in combination with new methods to utilize high-bandwidth networking for novel approaches to teaching.

References


