An Outreach Effort - The Connections Program

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Abstract

The Catholic University of America (CUA) School of Engineering and Computer Center are in the process of connecting 15 local-area high schools to the existing campus network to provide Internet access in a project called “The Connections Program.” This paper will discuss the partnering experiences, describe the technology used, discuss the development of an affiliation agreement between CUA and the schools, and discuss the importance of developing acceptable use policies. These experiences should benefit other institutions undertaking similar projects.

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Introduction

There has been a downward trend in engineering enrollment over the past few years. In today's high-technology environment, introducing scientific and engineering concepts early in a student's educational experience is critical in fostering interest in technology. At the same time, an "information revolution" has occurred that requires educators of all levels and disciplines to constantly upgrade their skills. These factors contributed to the need for the Connections Program.

The Catholic University of America School of Engineering has a consortium with Washington, D.C.-area high schools. Through the consortium, many activities are being sponsored by CUA including Engineering 2000, Experiences in Engineering, Telecommunications 2000, Discover Engineering, and The Connections Program. The purpose of The Connections Program, funded by the National Science Foundation, is to expand the successful consortium activities to include providing computer technology to selected high schools in the Washington, D.C. area via a high-speed communication network.

Prior to the inception of The Connections Program, a few local high schools were connected via high-speed modems to a high-powered workstation server located within the School of Engineering. This workstation provides access to a variety of computational resources used in the engineering curriculum, as well as access to the worldwide Internet through the campus network. Funded in part by a grant from the National Science Foundation, The Connections Program extends this benefit to a larger number of high schools. When a high school is in the process of connecting, the School of Engineering provides network consulting expertise, assisting them in getting proper hardware and communications connections.

The Partnerships

The Connections Program would not have been possible without partnerships. From the beginning it has been a collaborative effort between the School of Engineering, the Computer Center, the high schools, vendors, and the National Science Foundation.

Existing Programs for the High Schools

The School of Engineering has an affiliation with the local high schools in the Washington, D.C. area whose goal is to stimulate interest in engineering among high school students. There are currently 14 participating high schools, many of which include a student population with high minority and female enrollments (two of the schools are all-girls). The Connections Program follows several initiatives sponsored by the School of Engineering, and was designed to complement them.

Engineering 2000

Engineering 2000 is presented as a one-week tour of the engineering concepts of the twenty-first century as seen by some of the most exciting of today's practitioners. The program includes a live-in, college-like experience and is intended to attract capable high school seniors to undergraduate engineering curricula.
Attendance has grown from 80 (the target for the first year), to 160 (the maximum number CUA can handle with available facilities). The program draws students from all sections of the country, with a strong mix of female attendees (approximately 50%) and a core of black, Hispanic, and Native Americans.

**Experiences in Engineering**

Experiences in Engineering is a four-week, day program specifically targeting underrepresented minorities. This activity is sponsored jointly by the School of Engineering and the Society of Hispanic Professional Engineers, with partial financial support provided by NASA. Experiences in Engineering is intended to allow multiple-year attendance, up to three years. In addition to presenting an overview of engineering and the process of design, the program has an educational component for which CUA draws on experienced high-school teachers. Another critical component is the use of a high ratio of undergraduate students as teaching assistants to maximize hands-on activity and encourage mentoring. The targeted population is 25 students in each of the three years.

**Discover Engineering**

A three-hour evening program patterned as a "mini" Engineering 2000 is held specifically at the request of a high school at the CUA facilities. It provides an opportunity for a targeted group to visit the School of Engineering and meet with faculty and students and hear about programs available. This Open House activity is not restricted to the affiliated high schools.

**Telecommunications 2000**

This summer enrichment program provides a guided tour of the information superhighway and the many career opportunities in the telecommunications industry available to selected high school students. The program gives participants a diverse experience by providing seminars, hands-on laboratory work, and field trips to industry sites.

**Computer Center and School of Engineering**

Staff of the Computer Center and faculty of the School of Engineering worked together to design a relatively lowcost way to provide connectivity to the participating high schools. They have developed a plan for training faculty, network administrators, and students at the high schools. The result was a proposal that was submitted to and funded by the National Science Foundation. The final proposal and resulting grant were ones that neither group could have obtained on their own. Once the grant was awarded, work began on the building of a support system based on a DEC Alpha server and implementation of NT on servers, both funded by the grant. This involved systems programming staff from the Computer Center, the co-principal investigator in Engineering and two students in the School of Engineering. Originally, the Executive Director of the Computer Center and the Assistant Dean of Engineering served as co-principal investigators for the project. When the former took another job and left CUA, the Assistant Dean of
Engineering and the Acting Executive Director of the Computer Center, who had formerly coordinated the training, became co-principal investigators.

**Vendor Partnerships**

In providing access to the School of Engineering's networked facilities via the Connections Program, the high schools are given access to sophisticated computing tools used in scientific and engineering disciplines, which can be incorporated into classroom activities and projects. Commercially-available packages in mathematics, such as Matlab by The MathWorks, Inc., and Mathematica by Wolfram, Corp., are two targeted applications. These software applications have gained widespread acceptance in the engineering community which thereby assures applicability in later engineering and science studies. A major component of The Connections Program is to provide expertise so that the high schools will be able to effectively integrate these packages into their curriculum. Both vendors have been supportive of the program by allowing their software licenses to be interpreted so that the high school students could use the software at no additional cost.

Another important partnership is with BBN Planet Southeast (formerly SURAnet), through which CUA receives its Internet connectivity. They have provided support to this project by considering the high school affiliates as one entity. Thus, CUA obtained one affiliate membership at a cost of $1,000 per year that covered all of the participating high schools. The project would not have been feasible had each individual high school been required to pay an affiliate membership. BBN Planet Southeast will also be providing training for the participants. This is discussed more fully later in the paper.

**The High Schools**

The participating high schools are expected to provide their own infrastructure in order to connect to CUA under The Connections Program. Expertise among the schools varies. Most use Intel-based MS-DOS/Windows equipment, however, one school uses Macintoshes. When necessary, the co-PI in Engineering and his students provide technical assistance as the schools move to build local-area networks.

**The National Science Foundation**

In August 1994, CUA was awarded a grant from the National Science Foundation. It provides for equipment to be purchased for the high schools, the purchase of the DEC Alpha Workstation in Engineering, an expansion of CUA’s backbone network to accommodate the school’s connectivity, funds to hire graduate students to assist with the implementation, and some operating monies. As in-kind contributions, CUA upgraded its 56KB link to the Internet to T1 and made other enhancements to its backbone network.

**The Technology Used**

The network architecture relies on the most up-to-date technology in order to achieve the necessary functionality. It consists of several workstations performing specific tasks. A Sun
SparcStation, named “Goofy,” is responsible for maintaining the yellow pages. The administration of databases that contain user ID's, passwords, group names and host names with their corresponding IP addresses is simplified using the yellow pages services. The configuration has one yellow pages server (Goofy) and each workstation is a yellow pages client.

A DECstation 5100, named “Pluto,” is responsible for maintaining the file system. All disks on the system are Network File System (NFS) mounted. NFS mounted disks allow users to access files in different systems as if they were local. The Internet AlphaServer 1000 4/200, running under the DEC UNIX operating system, serves the applications, including Matlab and Mathematica, for The Connections Program.

In order to provide remote system maintenance from the network site to the high schools, a Pentium PC is used as a Windows NT Server. This PC will also be used as the Web Server for this project, which is envisioned as the main tool for collaborating on the project and disseminating the results. Other conferencing tools, only now becoming available, are also being investigated. One CISCO router is connected to a bank of sixteen V.34 modems that are accessible to the participating high schools. The other CISCO router provides connectivity to the CUA Computer Center, which allows access to other resources crucial to this project such as the Internet connection and the library catalog. A block diagram is shown in Figure 1.
Achieving Self Sufficiency

The participating high schools typically could not have assumed the total operating costs from the outset of the project. Thus, a transitional funding plan, depicted in Figure 2, was proposed and accepted by NSF. In it, NSF pays 100% of the operating costs the first year for telephone line charges and the membership fees to the Internet provider. The second year, the participating high schools are expected to assume one-third of the operating costs. They assume two-thirds of the operating costs in the third year. It was expected that three years would be sufficient for the schools to plan and budget these operating costs. Further, the schools were advised to plan and budget for the replacement of the equipment necessary to support the connections within five years of its original installation. This approach represents an increasing commitment by the high schools each year. It is envisioned that as they realize the benefits of the new technology, there will be no reluctance in maintaining their resources as well as assuming the full cost.
**Training the Trainer**

A key concept of this program, critical to the high schools obtaining self sufficiency, is to “train the trainer.” A base of expertise must first be established at the high schools so that the tools available over the global Internet can be properly taught. A major investment must be made in “human capital” to ensure the success of this program. This is true for any initiative that relies on the participants keeping pace with technology.

Training is aimed at three target audiences: selected students, teachers, and network system administrators. A maximum of 15 students per session (two or three from each high school) are to be selected and given training on Internet resources at the introductory and advanced levels. These students will act as mentors and guides to other students at their high schools, assisting other students in discovering the Internet resources. All teachers involved at each of the high schools will be trained at both the basic and advanced level of Internet resources. A training course specifically geared to network administrators as an introduction to networking basics will be offered and open to the designated network administrators from each of the participating high schools.

The students and teachers will attend hands-on workshops provided by BBN Planet Southeast’s staff members. The workshops are 1) Introduction to the Internet for K-12 Teachers and Librarians, 2) Introduction to Internet Technology for K-12 staff, and 3) Introduction to Internet Technology for K-12 Students.

The training seminars are offered throughout the year. Training is available to new participants and to continuing participants who are connecting to network resources at a more advanced level.

**Responsibilities**

An Affiliation Agreement was developed to define the partnering inherent in The Connections Program and to help assure that the schools were aware of not only their opportunities but their responsibilities. In the Affiliation Agreement, the duties and responsibilities of the university and the high schools are defined. The document serves as a written memorandum of understanding so there will be no misunderstandings of expectations by either party. A sample copy of the Affiliation Agreement has been submitted to the CAUSE Exchange Library and is also available on the World Wide Web at: http://www.cua.edu/www/cc_acs/project.

Among the items included in the Affiliation Agreement are a statement of CUA’s hours of operation and when staff will be available should assistance be required with a connection. CUA currently staffs its computer operations area from 8A.M. to 12A.M., Monday through Friday. There was concern that the high schools would have the expectation of coverage and support 24 hours a day, seven days a week.

The Agreement further defines what software the students are permitted to use. The university was particularly sensitive about this as many of its license agreements restrict usage of software to current students, faculty and staff. It also stipulates that students are expected to use the
facilities at their schools. They are not entitled to use the facilities on the CUA campus without explicit permission or invitation.

Each high school is made aware that the Internet is a compendium of computers and networks worldwide that are linked together electronically and that there is no person or organization that coordinates or manages the Internet. The majority of these materials would be considered scholarly works; however, pornographic and other materials deemed unlawful and unsuitable for anyone under 18 years of age are accessible over the Internet. The University cannot prevent a user from seeking out these materials. Although there is software commercially available that can “filter” unwanted material, it is certain that developers of unsuitable material will find ways to defeat these countermeasures. The Agreement states that the university will assume no responsibility for materials available on the Internet.

Acceptable Use Policies

An extremely important part of the Agreement from the university’s perspective is that it spells out the high school’s responsibility to educate students and their parents about responsible use of computers and networks. A sample statement of legal and ethical responsibilities is provided via the Affiliation Agreement to each high school participating in the program. There has recently been a flurry of activity in this area, as exemplified by numerous articles dedicated to this subject in the popular press. The schools are encouraged to tailor these materials or develop their own specific to their needs. Included is the suggestion that they obtain parental awareness of these issues for students participating in The Connections Program. One high school has already drafted a consent agreement that must be signed by each student and parent before access to the Internet via this project is permitted.

Summary/Conclusions

The Connections Program addresses a wide range of issues involving computer networking at the high schools. The implementation of the technology is an obvious consideration, but only one of many. The training being provided to designated high school teachers within the consortium on specific engineering software applications and on general knowledge and use of the Internet will hopefully work to enhance these benefits. Other equally important considerations are the investment of human capital, proper training, understanding the ethical issues involved in accessing the network, and a financial commitment to keep a modern networked computer facility-benefits obtained from the many partnerships inherent in this project.

The Connections Program is already promoting science and engineering in the secondary schools by extending the benefit of sophisticated computing resources to a larger number of schools and providing a much-needed educational tool. This project represents a modest beginning to what is a continuing effort in redefining the educational process in science and engineering. It is a given that use of these resources will soon extend to students and faculty in other disciplines.