An Outreach Effort - The Connections Program

Steven H. Chin, MaryJac Reed, and Ardoth Hassler
Catholic University of America/Catholic University of America/Georgetown University

The School of Engineering within The Catholic University of America (CUA) has an affiliation with the local high schools in the Washington DC 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 enrollment (two of the schools are all-girls). As part of this initiative, CUA is currently funded by the National Science Foundation on a 4 year project called "The Connections Program". Through this program, the affiliated high schools have access to the computing facilities of the University. This includes Internet access, use of CUA's scientific applications (e.g., math and science related applications such as Matlab and Mathematica), and on-line library catalog access. A crucial part of the project is multi-tiered training. An ethics statement and fair usage policy has been drafted to ensure that the provided resources will be used in the appropriate fashion.

I. Introduction

Connecting our schools, colleges, and companies to the Information Superhighway may be the single most important thing we do this decade to maintain this country's economic viability[1]. This statement, while dramatic, cannot overstate the need for our secondary schools to begin the process of connecting to the global networking infrastructure. Many publications are available which document the resources that are available on the Internet[2,3]. These publications provide a description of Internet tools (e.g., e-mail, gopher, web) and interesting educational sites. There are sites in many diverse curricular areas, including (but not limited to) the language arts, business, computers, mathematics, science, engineering, and social studies.

In concert with this effort, it is necessary to educate the populace on how to effectively utilize the capabilities. To complicate the situation, 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 students' interest in technology. At the same time, an "information revolution" has occurred which requires educators of all levels and disciplines to constantly upgrade their skills. These factors contributed to the need for the Connections Program, which provides network connectivity to selected area high schools.

The School of Engineering at The Catholic University of America (CUA) has a consortium with local area high schools. Through the consortium, many activities are being sponsored by CUA including Engineering 2000, Telecommunication 2000, Experiences in Engineering, High School Outreach Program, and the Connections Program. The purpose of the Connections Program, funded by the National Science Foundation, expands the successful consortium activities to include providing computer technology to selected high schools in the Washington, DC 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 modem 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 world-wide Internet through the campus network. When a high school is in the process of connecting, CUA's School of Engineering provides network consulting expertise, assisting them in getting proper hardware and communications connections. The Connections Program extends this benefit to a larger number of high schools and provides the capability to network seamlessly into CUA's networking infrastructure.

The Connections Program will promote engineering in the secondary schools by extending the benefit of sophisticated and networked computing resources to a larger number of schools and providing a much needed educational tool. Training is being provided to designated high school teachers within the consortium on specific engineering software applications and on general knowledge and use of the Internet. This project represents a modest beginning to what is a continuing effort in redefining the educational process in science and engineering.

II. Existing Programs

The Connections Program follows several initiatives sponsored by The School of Engineering and the Center for Planning and Information Technology at CUA, and was designed to complement them. A brief description of these initiatives is described below.

II.A. 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 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 strong mix of female attendees (approximately 50%) and a core of black, Hispanic, and native Americans.

II.B. Experiences in Engineering

 Experiences in Engineering is a four-week, day program specifically targeted at under-represented minorities. This activity is sponsored jointly by CUA Engineering and by the Society of Hispanic Professional Engineers, with partial financial support provided by NASA. Experiences in Engineering is intended to allow

multiple-year attendance. In addition to presenting an overview of engineering and of 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 to encourage mentoring. The targeted population is for 25 students in each of the three years.

II.C. 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 its programs. This Open House activity need not be restricted to affiliated High Schools.

II.D. Telecommunications 2000

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

II.E. High School Outreach Program

Students from selected high schools are invited onto campus and provided the opportunity to experience the Internet first-hand. They are provided the opportunity to "surf" the net as well as develop their own Web pages. This is a new initiative for 1996, and has been warmly received. A web site is available which fully describes the goals and activities of this initiative[4] .

III. Implementation

III.A. Overview

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 the two targeted applications. These software applications have gained widespread acceptance in the engineering community and thereby assure applicability in later engineering and science studies. A major component of the Connections Program is to provide expertise such that the high schools will effectively integrate these packages into their curriculum.

The connection via the Engineering network will also gives access through the campus-wide university network to the world-wide Internet. This emerging area of network communications demands that the

educational community understand it and teach effective use of the worldwide computer networks to its future populace.

The ability to perform database searches, execute remote applications, transfer files, and effect personal communications are powerful operations. Database searches on library catalogues and on a variety of other resources, as well as setting up and maintaining personal databases are essential computing skills for today's users. With network navigation tools such as Gopher and Hytelnet, these Internet resources are laid at the feet of even the novice network user, making access immediate, useful, and personal. Both the mechanics of 'how' and the ethics of 'when' and 'when not to' need to be firmly instilled in the minds and computer practices of the high school user. The appropriate resources and teacher training programs will be provided to the educational institutions to promote meaningful participation in the entire program, by both the teachers and their students. This program ensures that the resources will be used properly and effectively.

III.B. Network Architecture

The network architecture relies on the most up-to-date technology in order to achieve the necessary functionality. A block diagram is shown in Fig. 1, and a brief description follows thereafter.

Engineering LAN (Ethernet)

goofy
Sun Sparc
-runs yellow pages

pluto
DecStation
5100
- file server

Internet
AlphaServer
- application server

Windows NT
Server
- system mngment
- Web Server

Cisco Router — M O D E M — 1, 2, 16 — TO HIGH SCHOOLS

Cisco Router — TO CAMPUS NETWORK
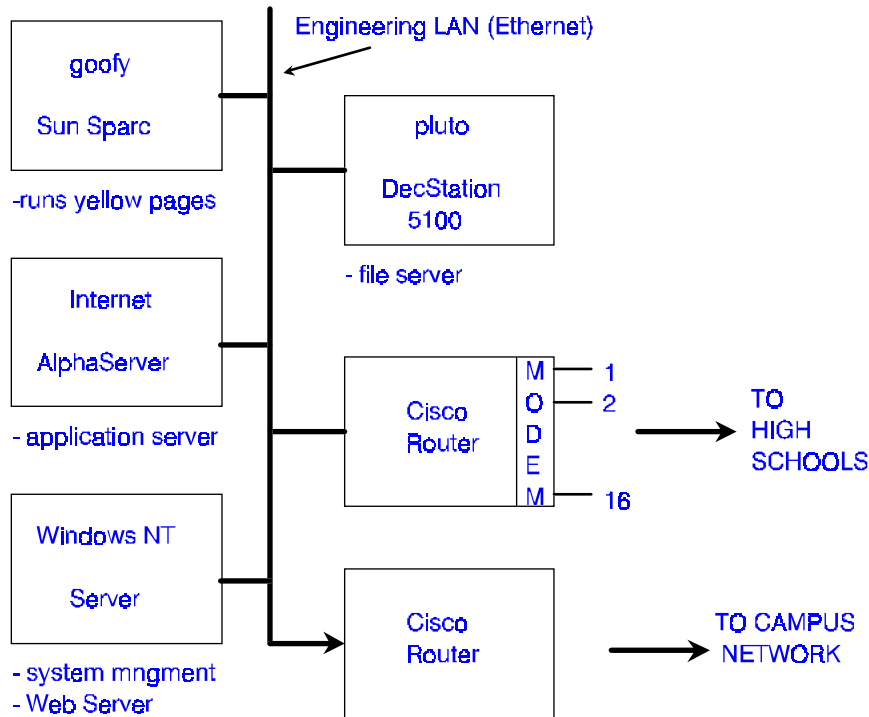
Figure 1 Connections Program - Network Architecture

Our network architecture consists of several workstations performing specific tasks. A Sun SparcStation (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. Our system has one yellow pages server (goofy) and each workstation is a yellow pages client. A DecStation 5100 (pluto) is responsible for maintaining the file system. All disks on the system are Network File System (NFS) mounted. NSF 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, performs the necessary applications serving for the Connections Program, including Matlab and Mathematica.

The original design consisted of a CISCO 2511 router connected to a bank of sixteen (16) V.34 modems at the CUA side. The connection to the participating high schools would be over the "Plain Old Telephone System (POTS}". At the high school side, a V.34 modem connected to a CISCO 1020 router would be used in the connection. This would have provided a 28.8KBaud information rate. However, it was realized very early in the project that this approach would not provide the necessary bandwidth that the high schools need. It is not possible to base a remote laboratory consisting of more than 2-4 computers/workstations on such limited bandwidth. In addition, a 28.8KBaud information rate is relatively slow for many developing applications of interest on the Internet (especially Web cruising). Based on these considerations, a design based on digital data services was proposed. Several options are being explored: 1) ISDN, 2) Frame Relay, and 3) dedicated 56Kbit/sec digital data lines. The use of dedicated 56Kbit/sec digital data lines has already been successfully implemented at two high schools. We have experience with ISDN, and are examining its cost implications, both hardware and recurring line costs. Frame Relay would provide a reliable digital data connection in addition too the possibility of introducing more "value-added" capabilities. Bell-Atlantic can easily set up for more connections and bandwidth via software (through Private Virtual Connections, PVCs) and allow futuristic capabilities such as teleconferencing between schools. Some high schools in the country are using Intel's ProShare teleconferencing system on Frame Relay to accomplish this. The best option, based on functionality and cost, will be implemented.

IV. The High School Connection

The high schools have already established an Internet presence, as CUA has made its Web Server available to them[5]. Thus, the high school participants are well on their way down the Information Superhighway. Even so, the resources that are provided to the high schools will have no educational benefit unless they are used responsibly. The Connections Program is designed to ensure the proper use of the resources through proper training, statement of ethical use, and responsible budgeting.

IV.A. Training

The key concept of this program 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 which relies on the participants keeping pace with technology..

Training is aimed at three target audiences: selected students, teachers, and network system administrators. A limit of 15 students, 2 or 3 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 opened up to the designated network administrators from each of the high schools involved.

IV.B. Ethical Usage

A great emphasis has been placed the ethical usage on the Information Superhighway. As more users enter this medium, there is greater possibility for abuse. This issue is being hotly debated today among high school educators, who sees the potential problems that can occur. Issues involving "rules of then net" and "netiquette" have been the subject of much discussion[5]. Even though much of the material is presented with a humorous undertone (e.g., there are 12 commandments, which include "Thou Shalt Not Steal", "Thou Shalt Not Be A Bandwidth Pig", "Thou Shalt Not Blatantly Seek Profit"), it has a clear message that one should be aware that ethical usage is a serious issue over the Internet.

A statement of legal and ethical responsibilities is provided to each high school participating in the program via the Affiliation Agreement. There has recently been a flurry of activity in this area, as exemplified by numerous articles dedicated to this subject in the popular press. Each high school is made aware that the Internet is a compendium of computers and networks world wide that are linked together electronically. There is no person or organization that coordinates or manages the Internet. Thus, individuals world wide make any and all types of materials available. The majority of these materials would be considered scholarly works; however, pornographic and other materials deemed unlawful and unsuitable for anyone under eighteen (18) years of age are accessible over the Internet. The University cannot prevent a user from seeking out these materials.

Although there has been recent activity in developing software which can "filter" out unwanted material, it is certain that developers of unsuitable material will find ways to defeat these countermeasures.

IV.C. Responsibility and Cost Sharing

In order to reduce the financial burden of setting up a networked computer resource at the high school, the network server is provided. In addition, a decreasing cost share arrangement for establishing the digital data connection to CUA's network was implemented. It is a four year plan, based on greater self sufficiency at the high school as the project proceeds. The high school must be self sufficient by the 4th year. This approach represents an increasing commitment by the high schools's 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.

V. Conclusion

The Connections Program addresses a wide range of issues involving computer networking at the high schools. There have been many lessons learned to date, as well as needed changes to the project implementation based on emerging needs and technological advances. The implementation of the technology is an obvious consideration for a successful connection, but only one of many. 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 (and viable) networked computer facility. A full description of this project can be found on the World Wide Web, which includes a bibliography of available educational material on the Internet[7].

References

[1]   E. Gagnon, What's on the Internet, Peachpit Press (Division of Addison-Wesley), Berkeley, CA, 1995.

[2]   R. Place, et. al., Educator's Internet Yellow Pages, Prentice-Hall, New Jersey, 1996.

[3]   D. Campbell & M. Campbell, The Student Guide to Doing Research on the Internet, Addison-Wesley, Reading, MA. 1995.

[4]   World Wide Web site - http://www.cua.edu/www/cc_acs/project/outreach/

[5]   World Wide Web site - http://www.ee.cua.edu

[6]   T. Mandel & G. Van Der Leun, Rules of the Net, Hyperion, New York, 1996.

[7]   World Wide Web site - http://www.cua.edu (under Library and Information Resources...Computing and Communications...NSF Grant: High School Affiliates Connection

Biography

STEVEN H. CHIN is the principal investigator on the Connections Program. He has been with The Catholic University since 1988. He is an Assistant Professor in the Department of Electrical Engineering and serves also as the Assistant Dean in the School of Engineering. He has been active in various outreach programs, whose goal is to spark interest in science and mathematics in the high school community.

MARYJAC REED is the co-principal investigator on the Connections Program. She has been with The Catholic University of America since 1992, and is the Director of Academic Computing Services in the Center of Planning and Information Technology. She is interested in the application of multimedia technology, especially in the area of faculty development tools and authoring.

ARDOTH HASSLER is currently the executive director of Academic Computing and Information Technology at Georgetown University. She was with The Catholic University of America from 1979 to 1995, and served as the director of the Connections Program. She is especially interested in ethics issues as related to the high school connection.