

# The Evolution of the Electronic Campus: From a Communication System To an Educational Delivery System

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## ABSTRACT

In 1987, Northwest Missouri State University implemented the first *comprehensive* networked campus in the nation at a public university in an effort to prepare its faculty, staff and more than 6,000 students for the emerging information-driven society. Northwest's Electronic Campus Program, which was heralded by the *Washington Post*<sup>[1]</sup> and *USA Today*<sup>[2]</sup> as innovative and exigent, provided networked computing stations in every residence hall room, faculty office and administrative office. In 1997, Northwest also began issuing a personal notebook computer to all of its faculty members and added electronic classrooms with audio and video projection systems. Since its inception 16 years ago, Northwest's Electronic Campus has evolved from an academic system with high capacity communication structures to a complex educational delivery system that has truly become an integral part of the university's daily living and learning experience. Moreover, that evolution has been filled with all the joys and headaches associated with the growing pains of nurturing and watching an infant develop into a rambunctious teenager. Northwest's *Information Systems* has had the responsibility of parenting this digital entity to help it cope with new and increasingly greater information and technology demands. These demands include, but are not limited to, the support for online degrees and courses in cooperation with the *Center for Information Technology in Education*. In this paper, the authors will discuss that development—its past, present and future—along with the costs

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of rearing such an entity, and how *Information Systems* is helping Northwest's Electronic Campus master the many technological challenges of the twenty-first century.

## Categories & Subject Descriptors

C. Computer Systems Organization - C.2 Computer-Communication Networks - *Network management*; K. Computing Milieux - K.6 Management of Computing and Information systems - K.6.1 Project and People Management - *Systems development*.

## General Terms

Economics, Experimentation, Management, Human Factors, Legal Aspects, Performance, Reliability, Security

## Keywords

Management, Customer Service, Communication, Performance, Reliability, Security, Human Factors, Economics.

## 1. INTRODUCTION – THE EVOLUTION BEGINS

Northwest Missouri State University has been directly and indirectly involved in computing technology since 1945 when Northwest alumnus Jean Jennings Bartik became one of the first computer programmers. Jean was one of six women involved in programming the ENIAC—the world's first Electronic Numerical Integrator and Computer. At the time Jean graduated from Northwest with a degree in mathematics, the United States Army was seeking young women to hand calculate the firing trajectories of artillery for the war effort. Jean was recruited as a human “computer,” which was actually the title given to these early, female programming pioneers. Jean and her fellow “computers”

helped develop a program on the ENIAC, which could add 5,000 numbers or do 14 10-digit multiplications per second. Jean would later go on to work with John Mauchly and Presper Eckert in programming the BINAC and UNIVAC I, the world's first commercial computer.<sup>[3]</sup>

During the decades following World War II, Northwest was typical of other educational institutions of similar size in introducing computer technology cautiously and primarily to aid administrative needs. However, sixteen years ago, Northwest unveiled its innovative Electronic Campus Program that was designed to enrich student learning and enhance faculty research and instruction by placing a terminal in every residence hall room and every office. The year was 1987 and the program was the first of its kind on a public college or university campus in the United States. As journalist Brit Hume noted, the Electronic Campus Program immediately saw enrollment at Northwest "rise steadily."<sup>[1]</sup>

In the fall of 1997, Northwest upgraded the Electronic Campus by providing a networked personal computer in every residence hall room and all offices, as well as providing a personal notebook computer for every faculty member.<sup>[4]</sup>

By 2003, a majority of the classroom course content at Northwest was online and web accessible. With the support provided by the *Center for Information Technology in Education* (CITE) Northwest faculty members have also been able to create a substantial number of quality online courses and online degree programs.

## 2. NETWORK DESIGN & EVOLUTION

In 1978, Northwest made the commitment to abandon mainframe computing and succeeded in replacing its mainframe with timesharing servers and a remote job entry system for batch computing within one year. The cost savings were dramatic and revised budgeting permitted the purchase of one or more powerful timesharing servers per year. Each new server was always networked with the others. These servers quickly changed the nature of computing for the entire campus. Computing became a communications tool. Email, instant text messaging (it was called PHONE), online schedules of events, online library services, file transferring and interactive word processing made computing attractive to the entire campus community overnight. With networked interactive terminal laboratories in every classroom building, access and usage of computing increased very rapidly. The number of terminals and networked PCs increased to about 600 stations by 1985. With funding for the Electronic Campus, the number of computing stations exceeded 3,000 in 1987.

Most all of the popular applications were communications based with email being the most used. There is no doubt that a threshold had been crossed for the number of nodes needed for a communication network to be functional. *USA TODAY* reported

on December 19, 1990 that the Electronic Campus was "communicating by keystroke" and "the library, faculty offices and administration ... were only a few keystrokes away for the college's 6,100 students."<sup>[2]</sup>

It is interesting to note that most of the popular applications we know today were all implemented within the initial Electronic Campus in a text mode. Educational videos were even available by online scheduling of a large videodisc player connected to the campus cable television network that was provided to each residence hall room. Online directories were available to check for scholarships and job openings. The school newspaper was even online.

In the mid-nineties, a test project was carried out to deploy active learning with notebook computers. Well over 300 students purchased notebooks and a select number of faculty were issued notebooks by the university. Selected classrooms were wired for student and faculty networking and video projection equipment was installed. Active learning instruction was offered in special sections of courses for about three years. Student feedback was strong for maintaining the desktop computers in the residence halls. However, there was little interest displayed by the students for notebook computers and the student notebook purchasing operations were terminated. In contrast, feedback was strong to continue notebook computers for the faculty and since 1997 every faculty member has been issued a notebook computer. It should be noted that since its inception in 1997, a policy has been in place to upgrade a third of all faculty notebook computers on a yearly basis. Additionally, nearly every campus classroom has Internet access and video projection equipment to aid educators in incorporating technology in a meaningful way into their curriculum.

The notebook project also required the advanced training of faculty in the use of web-based tools for instruction. The *Center for Information Technology in Education* was created and it has been responsible for major advances in the use of computing in classroom instruction. Since CITE emphasized the use of the web and presentation software for enhancing classroom instruction it was relatively easy for Northwest to convert enhanced courses to totally online courses. Of significant note is that faculty themselves create their online courses with assistance from CITE. Northwest currently offers 42 online courses and four online degrees that range from a Bachelor of Science degree in Business Management to a Master of Science in Education, Special Education.

In the late nineties, the growth of the World-Wide-Web once again revolutionized computing and the Electronic Campus had to change as well. Information retrieval systems were converted to the web and over 2,500 PCs were installed in 1997. Support costs increased with PCs but were controlled by the implementation of snap out hard drives, also known as removable hard drives. For

most software problems the software was not fixed but it was replaced by “snapping” in freshly reloaded software on a recycled hard drive.<sup>[5]</sup> This technique required a standard software set, which was loaded on every hard drive. Therefore, every PC and software load was identical making the technique especially quick and efficient. This technique is still in use and it is one of the principle reasons the university has received a number one ranking in residence hall computing facilities for 1998, 1999 and 2002, for the university’s *Carnegie Classification*<sup>[6]</sup>, in student satisfaction surveys conducted by National Educational Benchmarking Inc. More importantly, it allowed for a common expectation for utilization in courses across all curriculums. In short, faculty were able to tailor their curriculum accordingly

The current evolution of services is concentrated on converting custom-built student record systems with web access to SCT Banner software with web access. This effort should be completed in 2004.

### 3. FINANCIAL ASPECTS

A 1.2 million dollar special appropriation from the State of Missouri and matching funds from student room fees, as well as grants from corporations funded the initial installation of the Electronic Campus. The terminals cost approximately \$300 each and a large data switch, with 3,000 ports, connected users to multiple time-sharing servers. Since the \$25 equipment fee was built into the room fees, most students considered the system to be essentially free of charge. Usage was very heavy from day one and exceeded everyone’s expectations.

One of the first problems experienced with the Electronic Campus was the high volume of printing for which no fee was charged. Contrary to the popular campus belief that computers would lessen the volume of paper use, the ability to print off multiple copies free of charge resulted in a dramatic increase in printing. It also resulted in reduced usage of copier machines, for which we did charge a fee. As a result it was not financially feasible to continue the “no printing charge” policy for computer printouts, and the university decided that there needed to be an itemized billing system for printing. Therefore, an automated billing system was deployed, which allowed students, faculty and staff to log onto the network with their username and password and be billed for printing to their personal accounts. In addition, their detailed printing bills could be viewed online along with their long distance phone bill and all the other charges they might have incurred during the school year. A charge of ten cents per page for laser printing soon brought sanity to the use of computer printers on campus. Copy machines were again being used to make copies and were busy doing so at 5 cents per page.

Except for printing, “buffet” pricing has been the primary method of charging for the Electronic Campus services. The residence hall

fee was increased to \$50 a semester and a technology fee was initiated in 1997. This was to cover the increased costs associated with software and supporting personal computers. The technology fee was increased from \$3 per semester hour to \$7 per semester hour for the fall of 2003. Current funding permits a campus-wide upgrade of residence hall rooms and PC laboratories every 3 to 4 years with the latest upgrade occurring in the summer of 2001.

During the 2002-2003 academic year, concerns—similar to the inappropriate printing problems experienced in the 1980s—arose due to the high consumption of Internet bandwidth for non-academic activities such as music sharing. As with printing, discussions currently revolve around the creation of an automated billing system for recreational bandwidth usage. At least for another year the problem will be addressed by a continued effort to block music sharing ports with new high capacity firewalls and by restricting selected data flows through the use of a new packet shaper.

### 4. NETWORK FUNCTIONALITY

The networking of every client station has been a key feature of the Electronic Campus for its entire existence. Initially only the servers were connected by Ethernet using thick coax cabling and the clients were connected by serial lines to a large data switch with a star topology. In the 1990s, the data switch was replaced with Ethernet-based terminal servers in most buildings. Additionally, the buildings were connected with fiber. Shared Ethernet repeaters replaced the terminal servers in 1997. In turn, switches, which provided 10/100 Ethernet to each wall jack, replaced the repeaters in 2003. Also, the building connections were upgraded from 100 mbps links to gigabit per second links.

Campus network connection to the world started at 56kbps in the late seventies to support remote job batch entry computing and was increased to 1.5 mbps in the early nineties to support worldwide email. The Missouri Research and Educational Network (MOREnet) provided the Electronic Campus with a 20 mbps connection in the late nineties. Currently, MOREnet provides Northwest with a 30 mbps connection to the Internet. One of the major challenges facing the Electronic Campus today is to provide a reliable Internet connection for academic services, many of which have been out sourced to off-campus providers. The automated online library services have been out sourced, as have the digital periodical databases. The support of web enhancements to nearly every course has been outsourced using *eCompanion* and the support of totally online web courses and degree programs have all been entirely outsourced to *eCollege*. With the normal Internet activities, including web browsing and email, little bandwidth remains for recreational computing including instance messaging, game consoles and file sharing.

## 5. CHALLENGES OF SERVING & POLICING

As the United States pushes forward into the new Millennium, students entering the increasingly global and technology-oriented job market will need to possess a basic, if not comprehensive, knowledge of information technology. More importantly, students will need such skills to survive within the environs of their university or college prior to graduation. The ability to successfully navigate the World Wide Web has become as essential as being able to drive a car down a busy Interstate highway. This is particularly true since educators are now actively incorporating technology into their classrooms. With its commitment to the "Electronic Campus" concept, Northwest has made a concerted effort to provide easy access to the necessary hardware, software and Internet resources that will promote and encourage adoption of technology by students and faculty into their everyday learning and working experiences. Along with many other institutions of higher education, however, Northwest's Information Systems has been confronted with the challenge of serving the campus community with uninterrupted network services while at the same time "policing" that community in an effort to restrict recreational activities that put network availability and stability at risk.

One of the greatest challenges for an Information Systems Department is reaching incoming students with regard to acceptable use policies on the college campus network. Although, Northwest provides PCs in every residence hall room, students are more and more often bringing additional desktop computers and notebooks to campus, along with gaming equipment such as X-Boxes. More significantly, they also frequently bring the attitude of "I've done this for years at home. Why can't I do it here?"

Prior to 2002, Northwest required all students no matter what degree they were pursuing to take a three-credit hour, general education course entitled *Using Computers 44-130*. Designed as an interactive, modular learning experience and conducted by the Computer Science/Information Systems Department (academic), the course introduced undergraduates to microcomputers and basic software packages.<sup>[7]</sup> Additionally, it provided the means for Information Systems to communicate in a more comprehensive fashion with new students. Incoming Freshmen and transfer students are the most likely individuals to commit computer infractions. *Using Computers* was especially helpful in imparting what were acceptable and were not acceptable computing activities on the Northwest network. Although the *Using Computers* course was extremely valuable during its twelve years of implementation, concerns about not attracting transfer students caused the university's administration to reduce the number of general requirements for graduation and the *Using Computers* course fell victim to this reduction. Without the *Using Computers* course, the Information Systems Department has found it more

difficult to connect with incoming students as effectively as when the course was a requirement. This is unfortunate—and the Information Systems Department is currently looking for new ways to reach these once easily accessible students—because such communication is imperative in this digital age of file sharing and network gaming. Currently, the Information Systems Department is in discussion with the director of Northwest's *Freshman Seminar* course to implement some form of computer policy and ethics instruction. *Freshman Seminar* is a general education requirement designed to introduce new students to campus resources, expectations and experiences.

## 6. THE EVOLUTION CONTINUES

The evolution of the Electronic Campus from a communication system to an educational delivery system has been an educational and technological adventure and will no doubt continue to be so as refinements of existing technology are implemented and new hardware, software and Internet resources are adopted. Moreover, it is anticipated that online education and virtual classrooms will dramatically increase in the coming years. In fact the "growth of online courses over the past several years has taken many people in the higher education establishment by surprise."<sup>[8]</sup> A majority of administrators see this escalation as a good way of "expanding campus enrollments while greatly enhancing campus coffers."<sup>[8]</sup> Instructional technology expenditures in higher education are expected to increase dramatically and reach "\$9 billion by 2005."<sup>[9]</sup> The strategic management of instructional technology on a university campus is largely determined by how it is utilized and such usage "will only increase the cost of instruction" when it is employed to "supplement existing activities."<sup>[10]</sup> This situation is quite common at many of today's universities and colleges. However, instructional technology infrastructure implemented to support fully online courses has the "potential to replace existing activities and their associated costs, such as the traditional lecture, laboratory or other classroom activities (and the classrooms themselves!)."<sup>[8]</sup>

With the continued growth in the popularity of online courses, Northwest has also started work on new online advanced degrees in GIS and education, and a plan to change online course tuition. Northwest has charged a premium for online courses and it appears this is becoming an issue for many students. At Northwest, a formal study to compare the costs to offer an online course versus the costs to offer a traditional classroom course showed that they were very similar. In fact, online courses were slightly less expensive if they were not competing with one another and causing classes to not be fully populated. Current thinking is that online course tuition should be changed to be more competitive with other online course providers as well as traditional courses and ITV courses.

Managing network traffic will continue to require more attention, and costs will increase to detect and deal with problems associated with recreational computing. Bandwidth will have to be insured and protected for academic use even in the residence halls so that students can complete their course work. Northwest has a plan to implement a new system of separate firewalls for administrative buildings, non-administrative facilities and residence halls. Student expectations for enjoying recreational computing on campus will no doubt continue to increase. According to the latest statistics, 70% of today's college students play computer games at least once a day.<sup>[11]</sup> Therefore, the Electronic Campus may need to consider charging students for bandwidth usage on an itemized basis rather than a "buffet" basis in the residence halls if the academic, administrative and residence hall networks continue to be integrated and compete for the same internet access connection.

One of the most significant changes to the Electronic Campus that may occur is a proposed merger of Northwest with the University of Missouri System. Of course, change is nothing new to Northwest. It has had a long history of initiating and managing change academically and technologically. Northwest started as a Missouri Normal School, District Five, then became a Missouri State Teachers College and finally a state university. Such a merger—if it takes place—could, over time, potentially change many aspects of Northwest's computing environment. If the merger does become reality, one of the primary concerns of the Northwest Board of Regents would be to ensure that the Electronic Campus be permitted to continue to evolve to better meet the ever-increasing expectations of students and faculty in the future.

## 7. CONCLUSION

Over the decades the use of electronic computing has been one of constant change and innovation. In the 1940s, computing was designed for defense purposes as in the case of Jean Bartik and her work with the ENIAC. Following the war, computing was used primarily in the scientific community for feasibility studies and modeling, including the prediction of election outcomes. In the 1960s and 1970s, computing was embraced by big business for accounting and commercial applications. In the 1980s, computing became interactive and transformed again with expanded networking capabilities to become a communications tool. In the 1990s, computing was welcomed by a receptive public with the advent of the graphical point and click interface and increased accessibility to the World Wide Web. Finally, with the arrival of the new millennium, computing literally exploded as the masses quickly adopted the new network based technologies for educational and recreational usage.

Northwest Missouri State University has been involved with computing in almost every stage of its development since the creation of the ENIAC, and that involvement has been intensified

for the last 16 years with its Electronic Campus Program. This intensity has greatly helped Northwest to differentiate itself from many other institutions in recent years. However, it will be increasingly difficult to maintain this identity as computing totally inundates every aspect of society. In short, the evolution of the Electronic Campus is far from over. Like other institutions of higher learning and every instructor committed to educational excellence, Northwest will continue to make the challenging trek through the digital opportunities and hazards of the twenty-first century.

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