

PROPOSAL TO THE INTERIM ASSOCIATE PROVOST FOR INFORMATION
TECHNOLGY
NOVEMBER 22, 2000

Ubiquitous Computing for Design Instruction

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1. *Increasing student computer access in all College courses*

This proposal suggests an alternative model of computing that dissociates the computers from a specific location in a computer lab and making them available in all courses and in all classrooms. By connecting notebook computers via a wireless Local Area Network (LAN), the College can encourage a new educational style that makes ubiquitous and pervasive use of computers throughout our curriculum. Within the College of Architecture, existing educational computing resources are concentrated in labs. Labs provide open access away from classrooms, occasional classroom use, and use by specific courses. By implementing a wireless LAN, the College of Architecture can dramatically realign its computing infrastructure to support truly universal and ubiquitous use of information technology for all students in all courses.

A wireless LAN coupled with portable computers can support several scenarios of use in courses within the College:

1. A design studio in architecture or landscape architecture could better combine computer methods with manual methods. Students could use existing studio spaces and check out a notebook computer when desired. Rather than limit computing use to students scheduled into computer labs, this solution would enable the incorporation of computing into all design studios as needed by students.
2. Students could check out notebook computers for homework, allowing groups of students to work in a seminar room with sufficient table space to spread out sets of blueprints or carry on discussions.
3. Students in seminar classes could check out a notebook computer for a presentation.
4. Faculty could check out a notebook computer for occasional demonstrations.
5. An instructor could occasionally pass a notebook computer out to each student for a special exercise. In essence, one can create a mobile computer lab that can be moved to any classroom that needs occasional hands-on computing resources.
6. A student could bring a notebook computer to class for note taking.
7. Notebook computers would be available for use on field trips.
8. Students could purchase their own mobile computing solutions and connect to the College wireless LAN as needed.

Implementing this proposal could shift the computing paradigm within the College of Architecture to include all courses, all students, all times, in all places. The resources requested in this proposal are insufficient to support all of the potential applications, but they will allow us to test this paradigm of ubiquitous computing. Follow-up proposals to other organizations can

then expand the program as warranted. This pilot program will also act as a seed to encourage students to purchase their own notebook computers.

2. Background on wireless LANs

Wireless LAN technology uses two-way radio signals to maintain communication among computer devices. A typical system includes one or more “access points” that provide a connection to conventional networks, such as those running Ethernet. Each computer, whether desktop or portable, is equipped with a wireless LAN card that maintains the communication. From the user’s point of view, the computer on the wireless LAN behaves in an identical manner to a computer on a conventional network. Roaming range varies depending upon conditions, but is generally between 100 feet and 300 feet.

The technology has been carefully designed to provide high performance and security. The spread-spectrum technique migrates the signal synchronously across multiple frequencies to balance load and increase security. Wireless LAN technology provides transfer rates comparable to conventional Ethernet connections, allowing for effective network computing in all but the most demanding applications. A system can automatically balance loads across multiple access points, and automatically switch from one access point to another as a computer is moved. The system can also track the location of computers on the network, and notify an administrator if a machine is removed from the network or is moved out of range. Thus, the wireless LAN has integrated security features that are in some ways superior to existing networked computers.

The technology has been widely implemented at other Universities, including University of Oklahoma, Wake Forest University, Cornell University and Prairie View A&M University.

3. Description of the wireless LAN

The concept of this proposal is to acquire a handful of notebook computers and field them on a wireless LAN. Computers will be available to any student in the College of Architecture on a checkout basis for use in lecture classes, laboratory classes and for studio projects. The notebook computers are intended for use in average applications. They will be capable of 3D modeling, drafting, medium-quality rendering, spreadsheets, Web access, e-mail, and word processing. For more demanding uses such as photo-realistic rendering, animations, and Internet-based collaboration, students will continue to use desktop computers in existing labs.

The project involves four parts:

- 1) Acquisition of 40 notebook computers for use in courses in the College of Architecture (20 machines will be provided by the University Equipment Access Fee Fund while 20 machines will be acquired by the College of Architecture).
- 2) Creation of a wireless Local Area Network (LAN) in Langford Architecture Center, that enables Internet connections for the notebook computers in any classroom or studio space in the Building A.
- 3) Implementation of checkout procedures by which students may obtain notebook computers for specific tasks.
- 4) Surveys to measure the results of the project.

The notebook computers will be acquired for use in the Fall semester of 2001. They will be loaded with software that is commonly used in the College of Architecture, such as Microsoft Office, AutoCAD Architectural Desktop, 3D Studio Viz, Autodesk World and Microsoft Internet Explorer. Texas A&M University has site licenses or very reduced licensing fees for these packages.

The wireless LAN will be installed as soon as equipment is acquired, targeted toward the second half of the Spring 2001 semester. All notebook computers will be equipped with appropriate wireless LAN adapter cards.

Maintenance and installation of the notebook computers and wireless LAN will be performed using current computing staff. Training of our staff is provided at no charge by the wireless LAN vendor.

The Computing and Media Center of the College of Architecture, which already handles checkout of cameras, video equipment, and projection devices, will handle checkout of portable computers. To promote broad use of the resources, checkout time will be limited to six-hour periods, subject to review as the project develops.

Security of the network and notebook computers will be managed by software that provides tracking of the units. Units may only be taken off the wireless LAN by special permission. Network access can be disabled for stolen or missing units so that the wireless LAN adapter becomes worthless. Students who damage or lose a notebook computer will lose their privileges to check them out. Stronger security measures will be instituted if required. However, the intent of the project is to encourage students to buy their own notebook computers. Check out of computers should be seen as use on a trial basis that leads to purchase of a personal computer.

The impacts of the project will be measured by conducting a survey in April of 2001 to establish a baseline and then a follow-up survey in April of 2002 to document change. The survey will document usage of computing in architecture courses and percentage of architecture students who bring personal computers to campus. The objective is to increase computing use among students and faculty and increase dissemination of computing to a variety of courses. Patterns of usage will also be documented by using a database to record checkout and check-in transactions.

4. Benefits and costs

The introduction of notebook computers on a wide scale in the College of Architecture will accomplish several objectives:

- 1) **Incorporate computing into studios.** Students will be able to undertake computer-intensive projects, such as 3D modeling and rendering, at their assigned desks. Students will be able to combine computing with manual methods. Computing will be available to students in any studio course rather than only the courses scheduled in the computer labs.
- 2) **Disseminate computer techniques to more classes.** More faculty members will have the opportunity to incorporate computer-based techniques not only into design studios but other classes in the College of Architecture.
- 3) **Encourage ubiquitous computing.** Students will be introduced to ubiquitous computing, in which all of their educational activities incorporate information technology.
- 4) **Encourage student notebook computer purchases.** The checkout system will introduce a large number of students to notebook computers. We expect that many students will purchase their own notebook computers and wireless LAN adapters to obtain 24-hour access.
- 5) **Establish the College as a leader in wireless computing.** The construction industry is a major market for wireless computing. This initiative will improve the research position of the College.
- 6) **Provide a test bed for other wireless computing initiatives.** The proposed project may lead to similar projects in other Colleges and throughout the University.
- 7) **Reduce security vulnerabilities.** In comparison to desktop computers, a notebook-based network has several security advantages. Unlike desktop computers in a studio lab, notebook computers can be locked in a secure storeroom when not being used. The wireless LAN provides powerful monitoring tools to track the location of all units.
- 8) **Simplify software distribution.** Implementing studio computing with student-owned computers requires resolution of software licensing issues. Can University-owned

software be placed upon personally owned machines? Using University-owned notebook computers avoids that question.

On the surface, costs of a wireless LAN with notebook computers appear higher than desktop computers networked with conventional Ethernet. However, when remodeling, cabling, cable management, and security issues are included, a wireless LAN is competitive in cost. Wiring all classrooms for network computer use will require installation of a very large number of network lines, many of which will never be used. Future needs must be anticipated by oversupplying network lines. In contrast, the wireless LAN is fully scalable; it can be increased in capacity simply by adding another access point and a single Ethernet connection. Using desktop computers, the adaptation of studio labs for computing requires physical solutions to security, such as secure cabinets, new walls, a door lock system, and surveillance. By implementing such security measures, students may acquire a false impression that the College is taking responsibility for security of their personal computers. Notebook computers, because they are portable, avoid a confusion of responsibilities. When these issues are factored into cost calculations, a wireless LAN and notebook computers becomes cost competitive in comparison to desktop computers. With the added benefit of mobility, notebook computers are clearly the preferred solution.

5. Courses

The initial implementation is targeted at upper level undergraduate design studio courses in the Department of Architecture, such as ARCH 306, ARCH 405, and ARCH 406, undergraduate studio courses in the Department of Landscape Architecture and Urban Planning, and lab courses in the Department of Construction Science. The computers will be reserved for use in particular courses during part of the time and available for open checkout at other times. The network is intended to serve approximately 160 students intensively through course reservations, and nearly 2000 students through open check out.

6. Project continuation

The project is intended as a trial program. If the trial proves effective, additional access points will be acquired to allow coverage of Building C, second floor and third floor. If demand is generated for increased use in classrooms in Building A, additional access points will be acquired on all floors of Building A.

After six months and after one year, the project will be evaluated to determine whether more notebook computers should be purchased. However, our intention is that students will become "hooked" on ubiquitous computing and will purchase personal notebook computers. An option to be studied is the establishment of a checkout system for the wireless LAN cards. Other Universities have successfully distributed wireless LAN adapters by a library check out.

7. Hardware and software configurations

Very intensive computing tasks, file serving and removable storage media can be supported on desktop machines in current computer labs. Consequently, the notebook computers do not need removable storage devices such as CD-ROM drives and floppy disk drives. Battery power is also not a major consideration, as we anticipate that the computer will generally be used near a power outlet. Notebook computers must have sufficient display quality, processing power, storage and memory to handle sophisticated 2D and 3D graphics applications. Thus, a minimum 500 mhz Pentium III processor and 128 mb of RAM is required.

Selection of specific products will be made after commitment of funds. However, candidate products include the Proxim RangeLAN2 wireless LAN technology (see <http://www.wirelesslan.com/> and <http://www.proxim.com/>), Compaq, IBM, Sony, Samsung and Dell computers.

8. Requested funds

Item	Qty	Unit cost	Item cost
Notebook computers	20	2,000	40,000
Wireless LAN access point	4	1,500	6,000
Wireless LAN adapters	20	200	8,000
Total			\$54,000

The College of Architecture will provide similar funds.