DOCUMENT RESUME

ED 452 811 IR 020 619

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TITLE Media-Rich Learning through Universal Computing and Wireless Thin Client.
PUB DATE 2000-10-00
NOTE 7p.; In: EDUCAUSE 2000: Thinking IT Through. Proceedings and Post-Conference Materials (Nashville, TN, October 10-13, 2000); see IR 020 605.
AVAILABLE FROM For full text: http://www.educause.edu/conference/e2000/proceedings.html. For full text: http://www.educause.edu/asp/doclib/abstract.asp?ID=EDU0050.html.
PUB TYPE Reports - Descriptive (141) -- Speeches/Meeting Papers (150)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS College Curriculum; Computer Assisted Instruction; Computer Networks; Computer Uses in Education; Higher Education; *Telecommunications
IDENTIFIERS College of Mount Saint Joseph OH; Technology Implementation; Wireless Cable

ABSTRACT

There is a whole infrastructure that must support a successful universal student computing requirement. Conventional approaches would have the students plugging into a wired network. That would necessitate network wires and hubs or many ports in each classroom. Students would need access to course-related software. Because the needs would change from semester to semester, there would be the constant task of installing and uninstalling applications on student machines that would be a support nightmare. This paper describes the approach the College of Mount St. Joseph (Ohio) used to implement universal computing using "wireless thin client," a merger of three technologies: large CE devices, wireless networking, and Terminal Server/MetaFrame. This approach is powerful, low-maintenance, and inexpensive. The new universal computing requirement, dubbed MERLIN (Media Rich Learning Infrastructure) became a reality for freshman entering in the fall of 2000. The technology was immediately integrated into two interdisciplinary courses that are part of a new core liberal arts and sciences curriculum at the College. Through MERLIN, students in these and other classes have access to class discussion lists, online pop quizzes, Web-based simulations and case studies, and class exercises. Much of the software in the student computer labs, library materials, and the resources of the World Wide Web are also available. Each year, a new freshman class will be added, along with additional wireless access points and MetaFrame servers. By Fall 2003, universal and ubiquitous computing at the College of Mount St. Joseph will be a reality. MERLIN will solve a number of problems for the College. Classroom scheduling will be much more flexible because of the ability to have impromptu computer labs in any room on campus. The College will not have to give up general classroom space in order to install new computer labs. The support issues of having more than 1400 additional devices on the network will be minimized, thanks to the use of CE devices without moving parts and a single software load residing on the Terminal/MetaFrame servers. (AEF)

Media-Rich Learning through Universal Computing and Wireless Thin Client

By
Mark Cain

For nearly a decade, the College of Mount St. Joseph has been aggressively implementing technology to serve learning. As a result, two thirds of the faculty use PowerPoint for presentations, create Web pages in support of their courses or use WebCT for course management. The College also has an active distance learning program. It will not be long before most courses will have a substantial multimedia component.

While technology now plays a substantial role in the College's educational processes, it has also posed several challenges. As the use of computers in the learning enterprise has increased, providing a sufficient number of computers for student use has been difficult. Teaching labs are near maximum capacity. We have too few general-purpose computers with which students can write papers, do homework assignments, check e-mail and surf the Web. In addition, students do not have remote access to the software that is in teaching labs. This is a particular problem for the College, because most of our students are commuters. In sum, the College has been building an elaborate media rich learning environment but has not possessed an adequate infrastructure to deliver it into the hands of students.

To address this shortcoming, the administration concluded that the College was ready for a universal student computing requirement. As we began to consider such a requirement, we realized that whatever we did must be affordable for our students. The College of Mount St. Joseph is a private institution, with tuition higher than that of its publicly-funded competitors, but its student body is not affluent. Many are the first in their families to attend college. Any technology fee necessary to support a universal computing requirement could not unduly strain the budgets of our constituents.

We also knew that we wanted our solution to provide for ubiquitous computing. Students should be able to access computer-based resources anytime, anywhere. As a corollary, the solution must provide for portable computing. It must be easy to access, easy to transport, easy to use. Whatever solution we came up with would need to work both on campus and off.

Certainly whatever we did would have to be functional. Students would need to be able to check e-mail, cruise the Web, take notes in class, complete homework assignments, write papers, and access the courseware that our faculty have been developing over the past few years. They would have to be able to access the software in the computer labs. This software directly supports class work and could range from programming languages to SPSS (statistical software) to Microsoft Project (project management) to FrontPage (Web page creation). The solution would need to allow the student easy access to library resources. (The College's library is heavily automated, with thousands of journal articles in full-text form, a large number e-books, and an electronic reserve system through which students can access images of reserve items. All of these are available through a Web

front-end.) Finally, the solution would provide access to other campus services, including web registration and student records, electronic bookstore, etc.

The characteristics above would, at first blush, dictate a solution using notebook computers. However there are problems with using laptops for a population composed of college students. For one, the machines are expensive. Even a modestly priced one typically costs $1,600 to $2,000. They are too heavy, weighing between five and seven pounds. They take too long to power up. (Imagine that you are a student coming into class five minutes late. Your classmates are already working on their machines but you lose another minute waiting for yours to boot and an application to launch.) Finally – and here is the deal breaker – is the issue of battery life. After two hours, many laptops start beeping at you to indicate that they are running out of power. Unless the College wanted to run an awful lot of power into each classroom, long battery life was a *sine qua non* for the success of the project.

As we began to consider the limitations of the laptops, an alternative occurred to us. What if we could use large CE devices? The handheld PC pro line of CE devices are only slightly smaller than notebook computers, yet they offer advantages that laptops don't. First, they are relatively inexpensive; they can be purchased for under $1000 each. Second, they are light, weighing in at two to three pounds. Because they don't have a hard disk to spin up during a boot process, they are instant on and off. You can even shut them off in the middle of a file and not lose data. They also have a long battery life, typically eight hours.

A successful universal computing requirement, though, cannot just consider the device that is placed in the hands of the students. There is a whole infrastructure that must support it. Conventional approaches would have the students plugging into a wired network. That would necessitate network wires and hubs or many ports in each classroom, etc. Students would need access to course-related software. Because the needs would change from semester to semester, there would be the constant task of installing and uninstalling applications on student machines. This would be a support nightmare.

Taking all these factors into account, the College of Mount St. Joseph determined that a totally new model was needed for student computing. We call this approach wireless thin client. In the new model, each student would be equipped with a Windows CE-based hand-held PC pro. This CE device would have a monitor of eight to ten inches in diameter and an almost full-scale keyboard. Examples of such devices are the NEC MobilePro 880 and the Vadem Clio C-1050. On the CE device would reside basic productivity software, including pocket Office and a Web browser.

The CE device would have a modem for off-campus use. On-campus network connectivity would be via a wireless network card. In October 1999, Lucent WaveLAN came out with products based on the new IEEE802.11b High Rate (HR) wireless standard (11 Mbps). The College would blanket the campus with this technology. Wireless

connectivity would allow the students to roam the campus while still maintaining access to the network, the Internet and network software.

One challenge was how to address the functional shortcomings of a CE device. The software available for the CE operating system is limited in number and power. However, the CE device supports the Citrix Independent Computing Architecture (ICA), making it a natural thin client. The College decided to employ server-based computing, using Microsoft's Terminal Server for Windows with Citrix MetaFrame. The software in the computer labs would be installed on this server and usable by the students just as if it were running natively on the CE devices. With this model, software upgrades could be made at a single location on the servers, rather than having to constantly install and uninstall software on each client device.

In 1999, the College conducted a technical proof-of-concept. Staff evaluated several CE devices in the middle two quarters of 1999 and selected the HP Jornada 820 for the pilot. At the beginning of the fall, a wireless network was installed on the top floor of the Residence Hall and in a workspace used by network and PC technicians. In November 1999, the College installed a test server, running a beta copy of Windows 2000 and MetaFrame. Initial software applications included Office 2000, Visual Studio Pro, Project, Internet Explorer, Adobe Acrobat Reader, and Oracle client tools.

Getting the three technologies (CE device, high-speed wireless and MetaFrame) to work together was a snap. The system ran flawlessly and quickly over the wireless connection. In December, the College used twenty laptops and CE devices to simulate a classroom setting. Our objective was to "break the server" or "bog down the wireless network" if we could. We couldn't. Performance continued to be brisk. The only two slowdowns we could perceive were some visual effects, such as dissolves and wipes, in PowerPoint and a file download taking an unusually long time. That file, by the way, was a 500-600 page technical manual in .pdf format. The Web browser installed on the Citrix server took about 2 minutes to download the file when all machines were attempting it at once.

One concern we had was power consumption on the handheld PCs. The wireless network card consumes considerable power, substantially cutting into the normal 8-10 hour battery life of the CE device. Happily, after more than two hours of intensive classroom simulation, the handheld PC battery was at 58 percent. We judged that this was sufficient for a student to get through his/her normal school day, which would typically consist of attending two or three classes, accessing library reserves and other resources, checking e-mail, even cruising the Web. All without recharging.

Based upon the success of the proof-of-concept, we proceeded. The new universal computing requirement, dubbed MERLIN (for Media Rich Learning Infrastructure) became a reality for freshmen entering in the fall of 2000. The technology was immediately integrated into two interdisciplinary courses that are part of a new core liberal arts and sciences curriculum at the College. Through MERLIN, students in these and other classes have access to class discussion lists, online pop quizzes, Web based simulations and case studies, and class exercises. Much of the software in the student

computer labs, library materials, and the rich resources of the World Wide Web are also available. Each year, a new freshmen class will be added, along with additional wireless access points and MetaFrame servers. By Fall 2003, universal and ubiquitous computing at the College of Mount St. Joseph will be a reality.

MERLIN will solve a number of problems for the College. Classroom scheduling will be much more flexible because we will be able to have impromptu computer labs in any room on campus. The College will not have to give up precious general classroom space in order to install new computer labs. Yet the support issues of having more than 1400 additional devices on the network will be minimized, thanks to the use of CE devices without moving parts and a single software load residing on the Terminal/MetaFrame servers.

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Abstract

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ID Number:	EDU0050
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Author:	Mark Cain
Organization:	College of Mount Saint Joseph
Year:	2000
Abstract:	The College of Mount St. Joseph has implemented universal computing using "wireless thin client," a merger of three technologies: large CE devices, wireless networking, and Terminal Server/MetaFrame. This approach is powerful, low-maintenance, and inexpensive. The presentation will describe the project and the "media-rich learning environment" wireless thin client makes possible.

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