Winter 2006

# ACUTA Journal of Telecommunications in Higher Education

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# ACUTA Journal

## of Communications Technology in Higher Education

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BROADBAND CONNECTIVITY TRIPLE PLAY FIBER OPTICS GIGABITS OPTICAL MESH NETWORKING WLAN

INFRASTRUCTURE ACCESS PROJECT MANAGEMENT MOBILITY BLENDED SERVICES RESOURCES WiMAX

This Issue: Broadband Access to Campus Resources

# Events Calendar

| Event | Date | Place |
|---|---|---|
| **Winter Seminars** | January 21–24, 2007 | Hilton Austin<br>Austin, Texas |
| **Summit on IP Communications in Higher Education** | April 1–4, 2007 | Baltimore Marriott Waterfront Hotel<br>Baltimore, Maryland |
| **Annual Conference** | July 29–August 2, 2007 | Westin Diplomat<br>Hollywood, Florida |
| **Fall Seminars** | October 14–17, 2007 | Minneapolis Hilton<br>Minneapolis, Minnesota |

**ACUTA's Core Purpose** is to support higher education communications technology professionals in contributing to the achievement of the strategic mission of their institutions.

**ACUTA's Core Values are:**

- Encouraging and facilitating networking and the sharing of resources
- Exhibiting respect for the expression of individual opinions and solutions
- Fulfilling a commitment to professional development and growth
- Advancing the value of communications technologies in higher education
- Encouraging volunteerism and individual contribution of members

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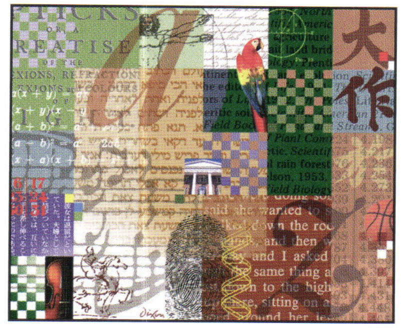
Broadband Access to Campus Resources:
Serving Students, Faculty, and Staff



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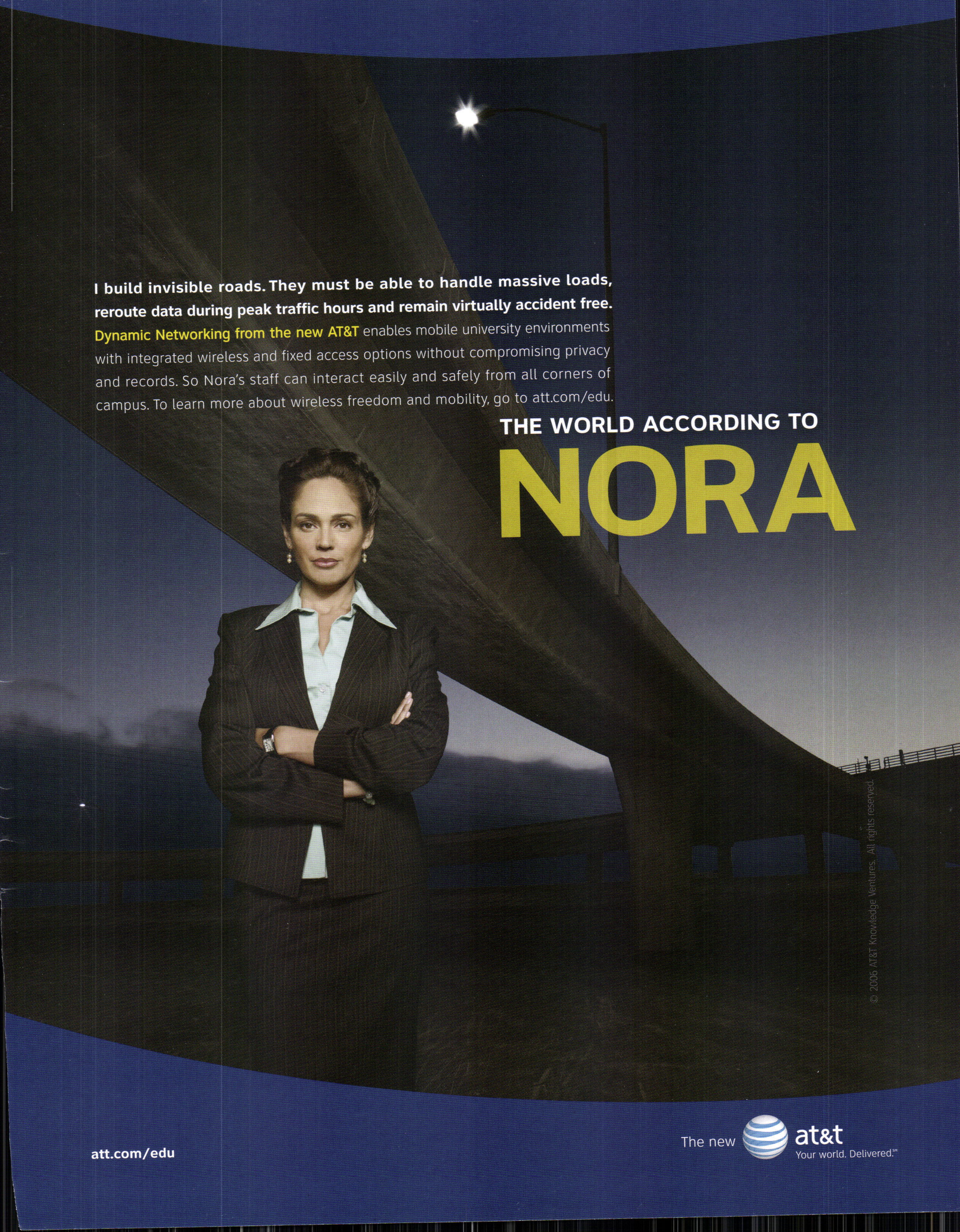

I build invisible roads. They must be able to handle massive loads, reroute data during peak traffic hours and remain virtually accident free.
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> It is ironic that universities have not seized information technology to reap the huge productivity gains that the business world has enjoyed. That must change.
>
> *B. Joseph White, President*
> *University of Illinois*
> *pg 28*

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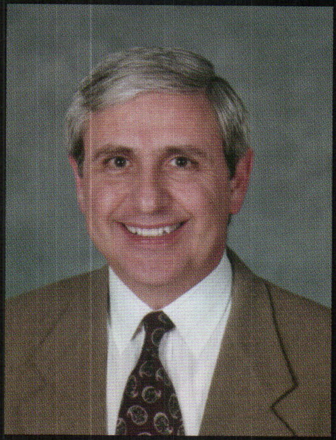
**President's Message**



Carmine Piscopo, RCDD
Providence College
ACUTA President
2006–2007

# Focusing on Infrastructure

As I'm writing this, in the middle of football season, I'm intrigued by the similarities between the duties of a leader of communications technology on a college campus and those of the head football coach.

The head coach brings together assistant coaches and players with one goal in mind: to win. Winning pleases senior management as well as the fans that attend the games and watch them on television. Communications technology leaders also have assistants and support personnel who wish to please senior management, faculty, staff, and students.

Both the head coach and we campus technology leaders have a set of finite resources within our respective budgets, and we both must make intelligent decisions about deploying these resources, often on very short notice. Our restricted funds leave little room for error.

Head coaches play their teams on a different playing field in a different city in front of different fans at least 50 percent of the time, and they deal with all the variables that present themselves. Decisions are often made on short notice with great hope for success. Assisted by our staffs, communications technology leaders play in many different products-and-services technology "fields," very often in the face of rapidly changing technology and with the same hope for success.

The coaches and athletes are well qualified, physically able to win in their sport; but as humans, they are subject to good days and bad days for a multitude of reasons. They still win. Our staff members are also well qualified, even though we all have some moments that we would rather forget. But students, faculty, and staff (our "fans") consistently look to us to deploy technology that will make them more productive, which in turn enables them (and us) to win. We must be doing something right.

Our collective goals are to be able to win the gratitude and respect of our faculty, staff, and students by satisfying their desire to have a winning technology team and have their technological needs met within the limits of finite budgetary resources.

Finally, both the head coach and the communications technology leader must always have their eye firmly on how to improve next year's team with a different set of resources, technology, and support.

With this analogy (my apologies to non-sports fans), I have identified some similarities and some subtle differences between the technology professional and the team coach. But both of these figures have one overriding mandate, and that is to lead. Leadership defines our destiny and determines how our peers and constituency evaluate us. And although even the best leaders can't be expected to know everything about every product or service they encounter, successful leaders know three things: where to get reliable information, what questions to ask, and the appropriate people to ask without being embarrassed.

In this edition of the *Journal*, which focuses on Broadband Access to Campus Resources, articles cover a wide range of technologies at a level of detail that should be interesting and useful to our members. They contain reliable information, may stimulate a myriad of questions, and could offer new solutions to some of your most perplexing dilemmas. I hope you find them well worth your time.

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FROM THE EXECUTIVE DIRECTOR

Jeri A. Semer, CAE
ACUTA Executive Director

# Department of Education Commission Issues Report on the Future of Higher Education

In 2005, Secretary of Education Margaret Spellings formed a commission charged with the task of examining the future of higher education in the United States. The 19-member commission was composed of public officials, researchers, and leaders from the academic and business communities. The commission's final report was issued in late September 2006, and it contained a number of findings that are critical of the current system of higher education. (See the commission's website at http://www.ed.gov/about/bdscomm/list/hiedfuture/index.html.)

The report states that access to higher education is still limited by inadequate high school-level preparation, lack of information, and financial barriers, particularly for low-income and minority students. It criticized the current financial aid system as confusing, complex, and inefficient, and stated that there is a lack of clear and accessible data about colleges and universities, particularly about cost and performance.

The commission concluded that, "Too many Americans just aren't getting the education that they need. There are disturbing signs that many students who do earn degrees have not actually mastered the reading, writing, and thinking skills we expect of college graduates."

On September 26, 2006, following issuance of the commission's report, Secretary Spellings announced her plan for the improvement of the higher education system, based on the findings in this report. Technology plays a central role in the secretary's plan, so ACUTA members would benefit from being aware of new initiatives that may be taking place at your institutions based on the Department of Education's plan. Some of the components of the plan may require federal legislation, but others may be implemented through the administrative rulemaking process.

A fact sheet containing all of the secretary's action items is available at http://www.ed.gov/about/bdscomm/list/hiedfuture/actionplan-factsheet.html. While there are many action items, some would likely affect information and communications technology professionals at institutions more than others. This represents an opportunity for ACUTA members to have a voice in the direction their institution will take in the future. It is very timely that "Broadband Access to Campus Resources" is the focus of this issue of the *ACUTA Journal*, as it is sure to be an important aspect of this direction. Action items from the fact sheet that seem especially relevant include the following:

1. Under the category of affordability, the secretary's report states that, "Tuition continues to outpace inflation, health care costs. and family income levels. While funding for Pell Grants has increased nearly 50 percent over the past five years, the financial aid system remains in urgent need of reform. We must streamline the process to help students and families prepare, plan and pay for college." Action items involving information technology include:

- Simplify the [financial aid] process by partnering with states to use existing income and tax data to help students complete the free application for federal student aid (FAFSA) in half the time.
- Encourage organizations that report annual college data to develop consistent affordability measures.

2. Under the category of accountability, the secretary states that, "In the Information Age, it is essential that clear, comprehensive and comparative data about colleges and universities be collected and made available to students, parents, and policymakers." Action items include:

- Work with a consortium of states to build on and link together the 40 existing, privacy-protected higher education information systems.
- Explore incentives for states and institutions that collect and report student learning outcome data.
- Redesign the Department of Education's college search website to allow consumers to weigh and compare institutions based on their individual interests and needs.

Six presidential associations representing higher education have issued their own joint letter, outlining the steps that the associations will take and those that they recommend their institutional members take in a proactive effort to improve the higher education system. The full text of the letter is at http://www.acenet.edu/AM/Template.cfm?Section=Home&CONTENTID=18299&TEMPLATE=/CM/ContentDisplay.cfm.

The letter, entitled "Addressing the Challenges Facing Undergraduate American Education," calls on colleges and universities to take the following steps:

- Use new technologies to contain costs.
- "Make every effort" to calculate their "net price," the cost of attendance once financial aid is taken into account, and share that information with consumers.
- Improve their teaching by employing new research on student learning.
- Participate in a "coordinated national effort" to smooth the transition from high school to college.
- Pay more attention "to international issues in the curriculum, increasing proficiency in foreign languages, and expanding the number of students who acquire international experiences."

In the letter, the presidential associations state, "We must identify new approaches to contain costs using technology and other tools." In addition, the letter calls upon institutions to improve learning "by utilizing new knowledge and instructional techniques." Although technology is not specifically mentioned in this context, we know that the students of today and tomorrow are accustomed to using technology as part of the learning process. ACUTA members will be called upon to support the increasing use of technology in education.

ACUTA members have the vision and the valuable technical knowledge to support their institutions in these efforts. I would encourage you to become informed about these national initiatives and talk with your departmental and institutional leadership about how you can assist your college or university in moving forward in the quest for quality, affordability, and accountability that is being increasingly demanded by policy makers and the public.

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# New Bandwidth Boosts Opportunities at the University of Idaho

**Joni Kirk**
**University of Idaho**

The University of Idaho's reputation for leadership in information technology got a huge boost this past spring. Nestled in the rolling hills of the Palouse Prairie in northern Idaho, the university now has a direct on-ramp from its rural setting to the world's information highway with a new high-speed, fiber-optic, 2.4-gigabits-per-second network connection.

Even with its previous bandwidth of 45 Mbps, the University of Idaho ranked high among its peer institutions for its wide range of academic programs and global research activities. With its new capabilities, the university will continue to increase the work that earned it a Carnegie Foundation ranking for high research activity.

"This powerful new capability opens a number of doors for the entire university community and beyond," says Harvey Hughett, the university's chief information officer and director of Information Technology Services (ITS). "The University of Idaho now has an information technology system that has more bandwidth than some entire state university systems."

The Library Clock Tower is a campus landmark.

The University of Idaho was one of six grant beneficiaries to receive network upgrades. The new network connection was made possible by a five-year, $10 million grant from the National Center for Research Resources, a component of the National Institutes of Health. Awarded to Professor Gwen Jacobs of Montana State University and Professor Ron Johnson of the University of Washington and implemented by Mike Laskowski, Idaho professor of biological science and associate director of the NIH's Idaho IDeA Network of Biomedical Research Excellence (INBRE) program, the grant supports enhanced network access for biomedical researchers throughout the western United States. INBRE is intended to enhance the caliber of scientific faculty at research institutions and undergraduate schools and to attract promising students.

With its increased bandwidth, the University of Idaho plans to leverage this investment into a statewide cyber infrastructure initiative that will enable the university to use this network to enhance research, education, and economic development. In addition, the university can now become a full partner in the global "grid" of researchers.

### Making Connections

The new bandwidth and network connection were provided by the Pacific Northwest Gigapop, a not-for-profit organization that provides robust, highest-speed access to current national and international state-of-the-art Internet, next-generation Internet services and technology, and exclusive research and development test beds. The partnership enables Idaho faculty to instantly share their own research with others around the globe, collaborate interactively on projects, and use supercomputers remotely for specialized research.

Laskowski says that to remain competitive in cutting-edge research, the University of Idaho's researchers needed this bandwidth to establish and maintain collaborations worldwide. This new link is facilitating the implementation of reliable high-definition video, voice communications, remote instrument control, grid research, joint research initiatives with the world's best researchers and labs, and a myriad of other applications that are becoming an increasingly important part of the global research network.

The power of this expanded Internet link, and the campus network that backs it up, is one of the largest and best in the Northwest. Great care was taken when designing the network to ensure that it can be scalable upward to accommodate even more-advanced computing needs as they develop in the future.

### Educational Benefits

As a beneficiary of the NIH grant, the University of Idaho is expanding its biomedical research conducted by students and faculty. With the new bandwidth, faculty and students are able to work with other researchers and instructors around the world in real time, watch medical procedures with impeccable high-definition capabilities, and capture minute details. The university also is able to obtain current research in a timely manner.

James Foster, Idaho professor of biological sciences, says researchers are now able to update the university's bioinformatics databases nightly, rather than monthly, which gives Idaho researchers competitive access to research. "The new connection is essential to Idaho's scientists for conducting truly collaborative research projects with colleagues across the country and around the world, and shared access to the sophisticated instrumentation and high-bandwidth science applications is vital for the university to conduct current medical research," Foster says.

This immediate access to research has had a significant affect on the University of Idaho's ability to attract ▶

and retain faculty, says vice president for research Chuck Hatch. "Many requests for proposals announced by the federal government increasingly require broad bandwidth at the institution to be eligible for research program funding. Science programs are becoming increasingly interdisciplinary, allowing for more collaboration between faculty. To attract and retain faculty, one needs to have these capabilities."

While Idaho offers numerous recreational and lifestyle benefits to potential employees from around the country, the university's rural setting previously meant that collaborative projects could require extensive travel. "Faculty would fly to other locations for research," says Hughett. "Now they 'fly'—but they fly on the Internet. Our new bandwidth has removed geographic boundaries."

Foster says he now is able to have desktop-to-desktop videoconferencing with his colleagues around the world, which reduces his travel and the attendant costs by about two-thirds.

It has also removed another huge obstacle—limited access for students, faculty, and staff. At this university, brimming with students, the old network—with its much smaller capacity—was 100 percent full from 8 a.m. until 2 a.m. "Because of the demand on the system, people couldn't use it for anything more intensive than Google for research," says Tony Opheim, senior director of Idaho's ITS. "Now, any person on our campus can access the network 24 hours a day and be sure there is room for them to get on and do what they need to do."

Opheim says that top users began to increase their draws on the new bandwidth as soon as it became available. "Within the first 48 hours, some people were using the system at levels as high as what the whole university had before the bandwidth increase."

The new bandwidth requires a "cultural change" for some. "Many researchers accustomed to working in a narrow bandwidth 'tunnel' have not considered how the new capacity could enhance their research," says Laskowski. "We developed a 10-minute video with examples of how the new bandwidth has the potential for imaging, modeling, database searching, and accessing remote facilities such as supercomputers. The video is nontechnical so that it can be used for researchers, educators, and the general public."

Now that users are up to speed with the system and usage has surged, the system is working better than expected. "We are employing gigabit Internet access to the desktop for researchers and others with high bandwidth needs, says Opheim. " The only potential bottlenecks at this time are from an individual's computer, depending on how much information it can handle."

In addition, users may still experience some slowness on occasion. "It very much does depend on where users are on campus and whether they primarily use wired or wireless connections," says Opheim. "In particular, the student residence halls' wired networks can be quite slow, and it only takes a small handful of wireless users in a small area to slow each other down."

Overall, the new bandwidth, which is more than 50 times the previous amount, removes barriers that prevented research and other applications from accessing the Internet.

"Also important to our students is a new service brought on by the university—Ruckus—through which students legally can download music and, in the near future, video for free," says Opheim. "We couldn't have signed with Ruckus without the new bandwidth, as we wouldn't have been able to handle the demand."

While the new service takes up room on the network connection, it's just a fragment of Idaho's capabilities.

#### Protecting Its Investment

As for any other information technology system, the university's single largest challenge is security. "Our old pipe was so slow that we were able to provide comprehensive security with typical hardware and could analyze every bit that came in or out of our system. It was easy to catch breaches," says Opheim. "But initially, when we were redesigning our system to accommodate this new bandwidth, the level of security did not exist to protect our infrastructure."

The university had to be creative to ensure system safety and has quite drastically changed its security measures to keep up with the sheer size of the system and the continually increasing amount of users.

"The traditional security model of a border firewall with an intrusion-detection system simply could not scale cost-effectively to our new bandwidth levels, in my opinion. The University of Idaho also could not afford the investment in security staffing to support a nearly full rack of new hardware," says Opheim. "Instead, following recent trends in security, we are inverting our old strategy. Rather than focusing on the border, we are focusing on the edge—or access layer—where the users connect to the network."

The creative aspect is how we are assembling our solution. Rather than purchasing a single, monolithic solution from a single vendor, UI is going "best of breed" from commercial and open sources. Our internal development network management system (NMS) will tie it all together. Low cost of ownership, network vendor neutrality, and forward-looking flexible/modular architecture are as important as fulfilling basic operational security requirements.

#### Future Endeavors Require Collaboration

A huge boost in bandwidth would seem to hold the university over for a while, but that is not quite the case. "We've already started looking ahead to see what our needs are five years from now and 20 years from now," says Hughett.

A first priority is continued funding. Beyond the NIH grant, the University of Idaho's ITS provided an additional $700,000 for improvements to its Internet infrastructure to support the large bandwidth. These improvements included a new redundant core switch and high-speed border router. However, that's where current funding stops.

"I am very concerned that the state and the University of Idaho will not take the necessary steps to sustain and expand this bandwidth," says Foster. "It would be a terrible mistake to lose what we have or to neglect our planned expansions. My concern is that decision makers will be satisfied with the telecommunications infrastructure of the last millennia, which we have only just put in place."

Hatch says that Foster's concern is shared broadly around the university community, and Idaho is looking at multiple options to sustain the network connection after the five-year grant ends. "The university has several initiatives that we are considering that would allow us to sustain and increase our bandwidth," says Hatch.

After funding, the next priority is to connect to the Northern Tier Network, a high-Internet-bandwidth highway across the northern United States from Seattle to Chicago that is in initial planning stages. The university would connect to the Northern Tier via Coeur d'Alene, Idaho. Spokane, Washington, currently is working with the Northern Tier Network Consortium to obtain grants for financial support of such an endeavor.

Hughett says that to connect directly to the Northern Tier Network, a 10Gbps connection would be ideal, not just for the University of Idaho but also for its collaborative partners—other universities, government agencies and offices, the Idaho National Lab (INL), and regional partners that have high-bandwidth applications.

"As more research is being done on our new connection, we will saturate even this capacity in five years," says Laskowski. He concurs that the next step is a 10Gbps connection but believes an in-state connection—not just a line to the Northern Tier—is required, which means an investment of new fiber as state highways are being improved.

The state of Idaho is 14th in the nation in per capita research and development spending. As its research increases, access to research tools and other resources becomes vitally important. From both a geographical and a network pathway perspective, Idaho has barriers that make direct interconnects within the state difficult. While the University of Idaho, Idaho State University, and Boise State University each have excellent intracampus networks to connect researchers and labs, it will be more challenging to create an intercampus network linking them to one another than it will be to link those institutions to others around the country via network hubs.

Currently, most research centers in the state don't have the bandwidth capabilities or Internet access they need to connect to one of the hubs. The only other agency in the state with similar bandwidth to that of the University of Idaho's is INL. Other universities are undertaking their own efforts to increase bandwidth, but redesigning systems and making the connection to appropriate bandwidth takes time.

"We believe there is something wrong when we can connect to computers on the Pacific Rim and all around the world more easily than we can connect to Coeur d'Alene, Boise, and Idaho Falls—the big centers of Idaho," says Hughett. "We don't have a state network that meets our growing needs for research, and we desperately need it."

Hughett says it's critical that the state refine its statewide initiative in order to address the investment necessary to fully utilize this resource. "The University of Idaho is part of a global marketplace in research, education, and economic development. We must have the necessary telecommunications infrastructure to meet these opportunities and remain competitive."

A statewide high-capacity fiber-optic network will be the single most important resource to bring Idaho into the global marketplace, and it is a prerequisite to compete for new federal research initiatives and programs, such as the Geosciences Network, the National Ecological Observatory Network, and the Collaborative Large-Scale Engineering Analysis Network for Environmental Research.

Funding for a high-speed network between Boise and Richland, Washington, has been proposed to Congress. If approved, the funding could bolster the state's economy through the resulting research. It also would allow the University of Idaho's Moscow campus to connect to its other locations in 42 of Idaho's 44 counties, expanding intellectual boundaries for the people of Idaho.

In the meantime, the University of Idaho will continue to improve lives around the world through its scholarly research, shared instantaneously with the click of a mouse.

**Joni Kirk is the media relations officer for the University of Idaho. Contact her at joni@uidaho.edu.**

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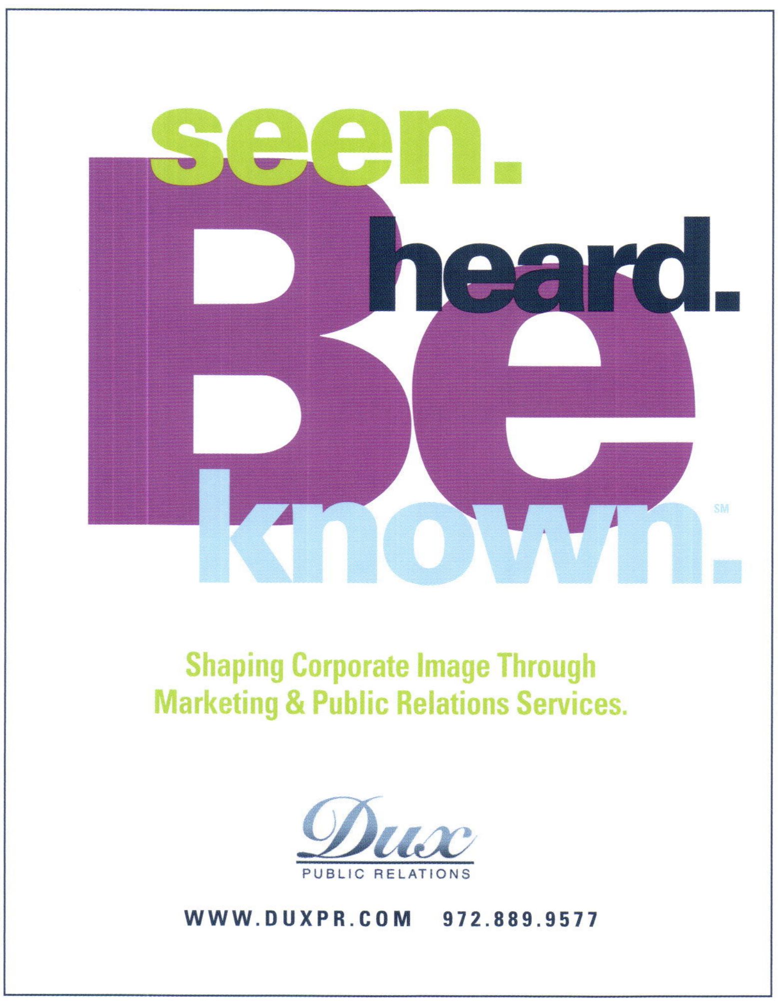

# Colleges Meld Data Functionality to Afford Larger, Better Facilities

**Curt Harler**
**Contributing Editor**

The trend today is for colleges to blend data and multimedia services to serve several populations: administration, research, and teaching. Schools such as Carnegie Mellon University and the University of Minnesota are on the leading edge of that trend.

Carnegie Mellon University (www.cmu.edu) researchers created a new Data Center Observatory (DCO), which opened this summer. The DCO is a dual-purpose facility that is both a working data center and a research vehicle for the study of data center automation and efficiency. Many departments at the school serve as real-life participants in the projects run there. These projects will define and streamline storage practices in the future.

The University of Minnesota has taken the multimedia plunge, moving to leverage multimedia features such as unified messaging, conferencing, collaboration, click-to-dial, click-to-conference, text-to-speech, and find me/follow me for faculty and students.

### Carnegie's Data Center

DCO is a collaborative effort between Carnegie Mellon's College of Engineering and its School of Computer Science.

"Our research addresses a broad spectrum of storage-related challenges, including storage security, emerging technologies, disk characterization and modeling, efficient storage access, storage networking, and network-attached storage clusters," says Greg Ganger, director of the Parallel Data Laboratory (PDL), a Carnegie Mellon organization specializing in the study of storage systems. The group comprises about 50 professors and researchers.

Carnegie Mellon's Data Center Observatory

The DCO's principal research goals are to better comprehend and mitigate human administration costs and complexities, power and cooling challenges, and failures and their consequences. It also aims to understand resource-utilization patterns and opportunities to reduce costs by sharing resources among users.

Administration costs are a major research thrust. Since administration and management of data storage costs four to seven times as much as acquisition of the computers, this is no trivial matter—both to the enterprise market and to the vendors who serve it. Data centers are complex to operate and require significant human administration support.

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"Anecdotally, we know that human costs are a dominant part of the total cost of ownership for data centers, but exactly where people spend their time isn't well understood," says Bill Courtright, executive director of the PDL.

"One of the things that makes the DCO so interesting is that, for the first time, university researchers will be able to study human costs and efficiencies in a working data center," Courtright continues. The goal is to deploy a live system and measure its consequences. Instrumentation is attached to each machine to record all of its activities.

While the storage networks are real, PDL is not. "PDL is a virtual entity," Ganger says. It was started in 1993 by Garth Gibson and today exists as a collection of people pushing the boundaries of storage technology. DCO is part of PDL.

No ivory tower, PDL has real-world impact. Gibson devised RAID storage levels, and others there did basic research on network-attached storage, which led to object-based storage, both part of enterprise networks today.

Currently, the focus is on administering the process of data storage. However, the lab uses the rest of the university's departments—those that are big users of storage, CAD, data mining, and similar activities—as part of their test bed.

One interesting project is called Self-* (pronounced Self-Star) Storage, with the star representing the traditional computer wildcard figure. It is a new storage architecture that integrates automated management functions and simplifies the human administrative task. Self-* systems are self-configuring, self-organizing, and self-managing. They all draw from real-life storage management challenges across the university.

"We need real experiences," Ganger says. "Trying to understand all about data centers is hard."

### How Much Time?

One day soon, Ganger hopes, a researcher will come to him with a pie chart showing how much time network administrators spend working on various aspects of storage functions. Sounds simple, but it isn't.

Right behind Ganger is a who's who of industry leaders who want the same answers: HP, IBM, Intel, Network Appliance, Oracle, Seagate, Sun, Symantec, and others. All support DCO. All realize the answers drawn from this true-to-life research project will have an effect on how they design next-generation products and systems.

That mythical pie chart might show that 30 percent of a storage administrator's time goes to one function, 2 percent to another. Saving just 10 percent of the 30 percent function has a better payback than totally eliminating the 2 percent function. But right now, nobody knows how the time is broken out.

So, everyone connected with DCO has to record all the time spent on every function they do ...every day, every machine. The data payback is just around the corner, and industry is eager to see what DCO finds.

"We are relying on the interest and tangible support of these companies," Ganger says. "Government has ratcheted back on its support for long-term research," he continues, noting that this lack of government funding is disastrous for researchers doing large-scale projects that promise to change the direction of an industry like computing. "So, we are doing it in partnership with a lot of industry people," Ganger says.

### Keep Your Cool

One of the first challenges was finding a site for the system. "Where do you put a large-scale storage system on a campus like this?" Ganger asks. "For a university, this is a huge amount of computers."

"Then, how do you connect the computers to the applications? You don't want a huge data bank with a tiny straw for connectivity," Ganger says.

Add to that the challenge of providing an energy-efficient environment. Energy efficiency is one of the center's major thrusts. For some time now, the amount of power consumed by commodity servers has been increasing, as has the number of servers placed in a facility. It costs as much to cool a data center as it does to buy the computers in it.

"These large clusters of power-hungry machines, along with rising energy prices, are generating huge energy bills, forcing data center owners nationwide to seek more energy-efficient solutions," says Ganger, who also holds a professor of electrical and computer engineering.

DCO participants include industry and government partners. The list of projects is a preview of tomorrow's world of computing. Among the more interesting are novel architectures and rapid prototyping for redundant disk arrays (RAID); work on MEMS (microelectromechanical systems), looking into new technology for nonvolatile storage technology by merging magnetic recording material and thousands of recording heads to provide 1–10 GB of storage in less than a single square centimeter (think the size of the fingernail on your pinky); attribute-based learning environments (ABLE), a method of classifying properties of existing files and predicting the properties of new files when they are created; and freeblock scheduling, a new disk-scheduling approach that can increase media bandwidth utilization by a factor of 10.

Squish all that computing power into a relatively small area, and it's obvious that DCO presents a significant cooling challenge. The 2,000-square-foot DCO can support 40 racks of computers, which would consume energy at a rate of up to 774 kW—more than the rate of consumption of 750 average-sized homes.

APC provided engineering expertise and its InfraStruXure system for powering, cooling, racking, and managing equipment in the DCO.

In addition to studying dense computing environments, the DCO will support a variety of Carnegie Mellon research activities, from data mining to CAD/architecture, visualization, and real networked services.

The DCO joins Carnegie Mellon's long tradition of weaving infrastructure research into campus life, which keeps the university at the forefront of technology. Each fall, for three days the storage industry troops to Pittsburgh to attend an interactive and often informal series of meetings that discuss the most recent findings. Attendees get a look at tomorrow's storage trends.

**What Did Minnesota Gopher?**

At the University of Minnesota, the needs were more immediate. Minnesota's new multimedia center offers state-of-the-art multimedia for 49,450 students and 2,300 faculty members.

U of M installed two Mereon 6000 Media Servers and Release 3.1 of the Unified Messaging and Conferencing enhanced services applications software for the Twin Cities campus. The U of M–Twin Cities is the second-largest campus in the United States. This large-scale deployment was awarded to IP Unity (www.ip-unity.com, Milpitas, California) in competitive bidding. The platform is fully installed and in operation with 18,500 users.

"We are pleased to roll out this state-of-the-art IP-based platform for service delivery to many of the faculty members and students living on campus," says John Miller, director in the Office of Information Technology at the University of Minnesota. "The Mereon platform will also serve the university as we scale to more users."

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"The University of Minnesota is in the vanguard of higher educational institutions," says IP Unity chairman and CEO Arun Sobti. "The Networking and Telecommunications Services Department has creatively leveraged the converged TDM and VoIP wave to offer new, appealing services. We know that the carrier-grade nature of the platform will support the university's projected high call volumes and provide the innovative features it needs for its research, instructional, and residential communities going forward."

The 6000 interfaces with the University of Minnesota's current Intecom Pointspan 6880 PBX with six IPNs. The system provides telephone service for the entire Twin Cities campus, including the geographically separated St. Paul campus.

In addition, a VoIP telephone system is being integrated into the university's voice infrastructure and will utilize the enhanced features of the new system.

Included in the university's initial deployment are unified messaging, auto attendant, fax, and text-to-speech. Additional features that have been purchased and that will be implemented include find me/follow me, Web conferencing, and collaboration application software.

Some of the advanced functional benefits of the implementation include:

- One-stop message access. All messages (e-mail, voicemail, faxes) are available via graphical and telephone user interfaces (GUI and TUI) as well as via webmail. Message delivery is also available to any phone or multimedia service (MMS) delivery device.
- Personalized availability. Find me /follow me allows subscribers to provide callers with the convenience of one number to reach their cell phone, desk phone, home phone, or any phone of their choice. With unique call screening, subscribers can select which calls they will accept and which they will choose to forward to the full-featured voicemail service.
- "Click-to-call" functionality. Click-to-call enables out-dialing controlled directly from a PC-based address book: with just one click, the system calls the subscriber's phone and then calls the destination number.
- "Click-to-conference" functionality. Click-to-conference enables instant Web/audio conferencing with multiple parties and is initiated directly from the personal distribution list in the subscriber's address book.

#### Sorting It Out

Almost no school can cost-justify for one use the kinds of solutions that administration, research, and teaching arms each demand.

Even with technology being pervasive on its 140-acre campus – and the reaction of most observers to its 10,000 undergraduate and graduate students is that the university is on the forefront of the engineering world — the truth is that Carnegie Mellon is distinctive among leading research universities also because of world-renowned programs in its College of Fine Arts.

This is typical of colleges today. Demands for sophisticated CAD/CAM come from unexpected places like anthropology. The music department wants to shift huge WAV files around at once. The nursing school demands instant hookups to drug databases. And education wants to be able to conference in speakers from anywhere in the world.

Add to that the demands of administration and faculty for technological excellence, and the solution becomes obvious: Offer the best, but spread the cost of acquisition and maintenance over a myriad of departments. It is working at Carnegie Mellon and the University of Minnesota. It is a template that can work at other universities as well.

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# Focusing on Video Demands

**Paul Korzeniowski**

Broadband connections are becoming more common on college campuses. As these network links are put into place, users, who seem to have an insatiable appetite for bandwidth, quickly pursue activities and install applications that push the system to its new limits. Video transmissions that come with distance learning and videoconferencing account for some of the hunger for bandwidth, but individuals are also tapping into these new features as video is pushed down onto laptops and handheld devices as well as onto desktop computers and departmental servers.

"Video has emerged as the latest killer app, something that just about every organization is deploying in some fashion," says Peter Sevcik, president of market research firm NetForecast.

### The Challenges of Video

The new broadband video applications can deliver tangible benefits, such as more efficient use of academic resources, more options for delivering academic services, and more satisfied students; however, they also can have a detrimental impact on the academic network. Video applications are bandwidth hogs, often transmitting multiple thousands of bits of information each second. The influx of these applications is straining a growing number of campus networks. As a result, colleges are examining three options to ease transmission bottlenecks: upgrading their networks, putting monitoring tools in place to curb video usage, or implementing a combination of the two.

"Until recently, collegiate IT departments have been a step or two ahead of bandwidth requirements, but that may no longer be the case as video applications become more common," says J. Jeffrey Nudler, a senior analyst at market research firm Enterprise Management Associates.

The incursion of broadband video transmissions is coming from many fronts. Teachers are introducing video content into their coursework. Professors now click on a link and download a five- to ten-minute video presentation as part of their lectures. In addition, many are incorporating longer-playing items, such as short documentaries and even full-length films, into the classroom.

Another factor is the growing number of classes that are being videotaped and transmitted. Students who are not present for class are able to download the lecture at their convenience. Students who were in class can review individual presentations and reinforce key concepts.

For a number of social and economic reasons, distance learning is becoming more popular. Rather than require that students drive to campus, new virtual campuses bring the information to them.

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## Vendors Take Different Tracks to Solve Video Bandwidth Challenges

Many academic network managers are now thinking about deploying new monitoring tools to control the growing volume of broadband video traffic. These managers will find a bevy of choices; identifying the one that is best for their organization can be a challenge.

IP management vendor eTelemetry sells a network appliance, dubbed Metron, that uses its *locate* feature to passively monitor network traffic and associate traffic patterns to individuals. The software dynamically collects a network user's name, contact information, IP address, MAC address, and switch port. The product includes a database that imports data from corporate directories to help identify individuals within an organization. Metron then uses that information to identify top bandwidth users by name, ultimately giving communications managers the information they need to better manage bandwidth consumption.

Companies such as Evident Software, NetQoS, and NetScout include features in their products that help customers determine usage and develop an enterprise chargeback system. Individual departments are charged for how much bandwidth they use. Such systems help to develop more network accountability when groups are thinking about deploying video applications.

Cyberoam's user-based bandwidth management prevents bandwidth abuse and resultant pipeline bottlenecks through bandwidth scheduling. It provides individuals or groups with committed bandwidth rates, so they can be sure that video transmissions are not interrupted. The product features business policies that are created and linked to network usage, which help to protect organizations from having their network taken over by a small group of users.

NetEqualizer provides turnkey bandwidth control systems that are deployed in large organizations. The company focused on ease-of-use functions—the product installs in minutes and intelligently delegates bandwidth without requiring network administrators to build and manage extensive policy libraries.

Computer Associates' Network Performance Management helps companies proactively manage the performance of their LANs and WANs. The product is designed to enable companies to pinpoint areas of service degradation across a network.

Viola's NetAlly product takes a holistic approach to network management by utilizing active network testing. It concentrates on helping network managers isolate any source of impeded network function.

The NetIQ AppManager Suite is designed to help IT organizations meet their service-level commitments.

"The bandwidth management market is still emerging and therefore subject to a lot of innovation, leaving users with a lot of options," notes Peter Sevcik, president of market research firm NetForecast.

"We have been looking for ways to make it easier for students to take classes," says David W. Fleig, program manager for network services at Wayne State University, which has 33,000 students, 5,000 faculty and staff, and 18 distance-learning centers on its campus.

Significantly, in addition to these issues, nonacademic uses of video are also on the rise. Consumer goods manufacturers are increasingly using short video clips to market some of their products. Market research suggests that video clips help reinforce brand identity and enhance customer loyalty.

Movie companies are also using broadband connections to download their products directly to consumers, a change that raises a couple of potential problems for academic institutions. First, while there are legitimate movie-downloading services, there are also instances where students illegally download these items. A university needs to take steps to avoid any legal responsibility if a movie company goes after a problem user on the school's network.

Second, these individuals often are network abusers and think nothing of repeatedly tying up network resources. "We don't want large file downloads to prevent the university president from getting an important e-mail message," says Fleig.

The problems from video transmissions are becoming more pronounced. High-definition TV (HDTV) is becoming a popular option with video content (in movies, IPTV, and short video clips for items such as video games), and that means much more information is sent over network links. In fact, HDTV content generates 10 times as much data as do typical video transmissions. "HD content can quickly saturate the bandwidth available on a network," states Enterprise Management Associates' Nudler.

### Revving Up the System

As more information flows over academic networks, communications managers need to determine how to deal with the demands. Many universities did a major overhaul of their network infrastructure when the Internet boom occurred several years ago. In some cases, they find themselves with sufficient bandwidth—at least for the moment. "We do not envision video transmissions having a significant impact on our network," states Don Rollen, network manager at Syracuse University, which has 18,000 students and 3,000 faculty and staff members.

In other cases, the first round of Internet network upgrades have been paid for, so an institution may contemplate another round of upgrades. The easiest way to fix the emerging problem is often to add more bandwidth. In these instances, a university may monitor bandwidth usage with the tools that come with products such as routers and switches.

At the desktop, most organizations have deployed 100 Mbps, which is sufficient for most transmissions, and some are moving to 1Gbps links on heavily used connections. Bandwidth saturation typically arises on the campus backbone network, which links different groups of users. When that occurs, universities could add bandwidth there, upgrading to 10 Gbps connections or adding more 1 Gbps and 10Gbps links.

### Bandwidth Management Tools

For universities that want to make sure they are using their broadband bandwidth efficiently. A new crop of tools, dubbed bandwidth management systems, enables network managers to closely monitor what is happening on their networks and determine if there are ways to increase network efficiency through configuration changes.

Currently more than a dozen vendors offer bandwidth management tools (see sidebar on page 20). Their marketing promises tend to be similar: Buy our products and reduce transmission latency and avoid unnecessary network upgrades. However, the tools take a variety of approaches to delivering that functionality, so it becomes difficult for users to make apples-to-apples product comparisons.

This issue arises because unlike other networking areas, there are no clear-cut standards for gathering bandwidth performance data. The reality is that there are many different network protocols running on most campus networks. In addition to IP, universities support other protocols, such as TCP, FTP, HTTP, DNS, SSL, XML, and SIP. Because many of these protocols are tightly tied to the underlying applications, it becomes difficult to quickly and easily determine how information moves over network links.

In the long term, many universities are moving to service-oriented architec-

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ture (SOA) applications, which are based on Web services. A major benefit of SOA is the decoupling of application business logic from underlying layered network services; so performance data can be captured more easily. This makes designing and building applications easier. However, in the short term, network managers need to extend their monitoring tools in a noninvasive manner so they can capture performance data from these new services.

Typically, the products station specialized software at different points in the network (access point, server, router, desktop computer), and these agents examine how data move from place to place. In most cases, the tools track items, such as the time needed before a transaction is completed or the volume of data that moves across a link at any moment. The products then produce a series of reports that illustrate how the network is functioning.

Recently, these bandwidth management products have become more sophisticated and better able to track all of the moving parts found in large, complex campus networks. Many of the tools can dynamically identify the bandwidth usage of a person, department, office, or campus—in fact, an individual's bandwidth usage can be tracked even when he or she changes IP addresses or moves from PC to PC. These enhancements help organizations tie network activity back to individual users.

A network manager can monitor bandwidth usage and then make appropriate adjustments. After identifying a user, or even a department, who works with a large volume of video data, the manager can put limits on how much bandwidth is available to the person or group. In other cases, the manager can develop network policies, such as prohibiting users from downloading information from specific sites, so the academic institution can protect itself against transgressions, such as illegal downloads and individuals overloading a network link.

While the products offer various benefits, they also have some shortcomings. For example, the monitoring functions available with video applications are often limited.

"The industry has developed good metrics for measuring how well data are being transmitted and how well voice communications are working; but because companies are just beginning to deploy video applications, similar measurements for analyzing video transmissions are not in place yet," explains Enterprise Management Associates' Nudler. These functions are needed because issues such as network latency or jitter can affect what a user sees on a screen. Many, but not all, computer data applications are tolerant of latency, error, and loss, as there is time to wait for packets and even to retransmit them to fill in the blanks. Real-time voice, however, is not tolerant, as it is stream-oriented and isochronous. Human beings are intelligent enough to fill in a few blank spots in a voice stream, but there are limits to that. VoIP uses predictive algorithms to fill in many of the blank spots for us, but there are limits to that as well. Like voice, real-time video is stream-oriented. Video streams, however, are much more complex.

Pricing is another issue with the video-monitoring tools. The products tend to start off at a price of $10,000 to $25,000 and rise to $100,000 or more, depending on how large the network is and how much data an institution wants to monitor. In addition, the tools have to be configured to run in each institution's network, which means they come with additional system integration costs.

Finally, network technicians need to be trained to use the tools. In some cases, institutions determine that adding more bandwidth is a more cost-effective option than deploying these tools.

Despite the limitations, the use of bandwidth management tools is expected to rise in the coming months. "There is no doubt that the volume of video traffic will increase, so universities will need more network bandwidth," concludes Nudler. "The issue is how will they address that problem, and bandwidth management tools offer them one viable option."

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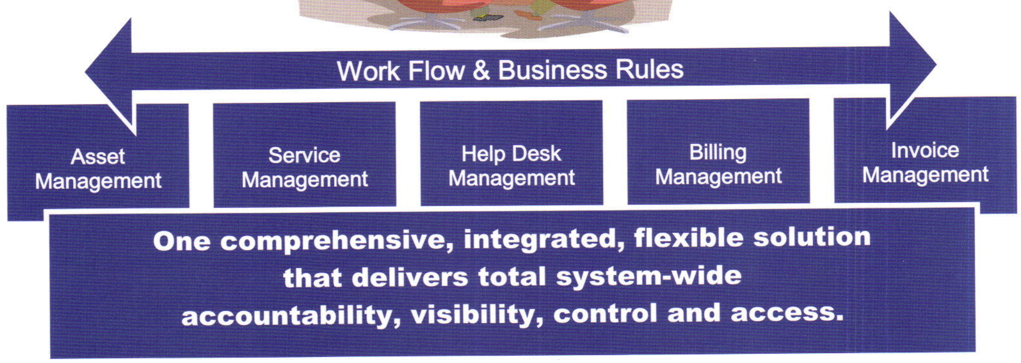


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# Wireless Optical Mesh Networking

**Fima Vaisman**
**ClearMesh Networks**

Technology in the 21st century is expected to provide access to information from anywhere on the globe at any time. Making this happen constantly challenges the creative genius of engineers and others who struggle to give students, researchers, and others access to resources from remote locations—whether they be across the street or on the other side of the world.

Some see wireless optical mesh (WOM) networking as an excellent choice for meeting this challenge. What is this technology, and could it effectively and efficiently meet your campus's needs?

WOM integrates the core characteristics of several key technology components: wireless deployment, optical transmission, and integrated mesh networking.

In a wireless mesh network, the network dynamically routes packets from node to node. A few nodes have to be connected directly to the wired network, but the rest share a connection with one another over the air.[1]

### A Number of Advantages

Deployment of wireless network infrastructure brings a variety of inherent advantages, such as the following:

- Facilities on a budget can get broadband connection without trenching or other fiber or cable deployment.
- Installation times are typically within days, not weeks or months.
- Cash flow is optimized. The technology is license-free, so there is no up-front capital investment, even for large deployments.
- On-demand extension of the mesh infrastructure as customers sign up creates a pay-as-you-grow business paradigm.
- Flexible end-to-end path selection provides high service resiliency that is extensible across external LAN switching elements (metro LAN).
- WOM offers seamless integration with service-provider networks and end-to-end services with support for certified MEF services. It also offers centralized, end-to-end mesh visibility via open SNMP-based CMS Management System.

Wireless optical transmission links provide fiber-grade service capacity distribution. The absence of interference provides guaranteed service quality—even in very dense deployments.

In addition, fine-grained CoS support provides negligible transmission loop delay (microseconds—just like fiber) and low jitter, which enables digital voice and video quality (also just like fiber). To keep costs relatively low, it uses off-the-shelf, high-powered LEDs.

WOM integrates standards-based LAN switching technology with wireless optical transmission and is capable of distributing gigabits of business-grade LAN service capacity across metropolitan areas. Wireless optical transmission does have a dependency on weather conditions, as dense fog can limit the

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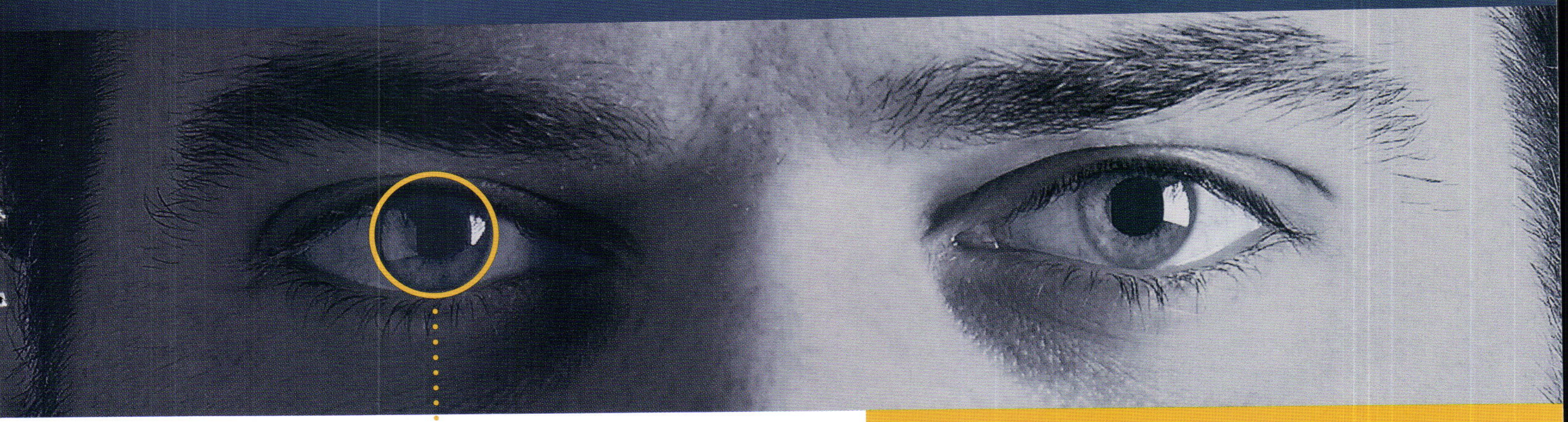
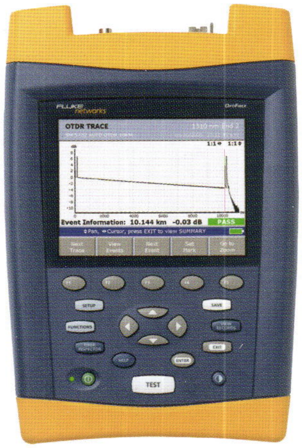
# Campus networks see more change than any other network



**Change the way you look at your campus network.** Constantly evolving to support new users and multiple facilities, campus networks require more than their share of network moves, adds and changes. Not to mention a steady stream of trouble tickets to look into. And in a place where the free flow of information is critical, you can't afford problems that affect network performance. You need an extra set of eyes into the network to help you spot problems and solve issues faster than ever. Whatever challenge you face on your campus network, Fluke Networks has a Network SuperVision Solution™ to give you better vision and control of your network and cabling infrastructure. Change the way you look at your network. See our solutions for yourself on our website.



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reach of light transmission paths. Proper network design is required in order to maximize link availability in adverse weather conditions. Transmission is high capacity—currently full-duplex 100 Mbps per wireless optical link.

WOM is purpose-built to work in dense urban or metro areas and business parks where license-free RF technology fails to deliver. Typical distances between buildings in these areas range between 100 and 300 feet, with an entire street block usually running at 500 feet—all well below the 800-feet link length supported by wireless optical mesh.

To further enhance the reliability of the network, WOM provides a resilient mesh topology with many alternate paths across an established wireless optical mesh. Thus, the service availability is higher than the availability of any individual link.

In short, WOM technology retains the flexibility and cost-efficiency of license-free wireless deployment while maintaining the high service capacity and the fiber-grade service quality of optical transmission.

### Practical Considerations

What kinds of next-generation equipment are campuses considering? And what about the campus that has to watch its budget very closely?

There are several technologies that campuses are considering. In particular, many WiFi deployments are being installed all over campuses—classrooms, dorms, common areas, and everywhere.

Challenges frequently associated with WiFi come down to capacity, interference, and security. WOM is particularly useful in places where there is a need for lots of bandwidth aggregated back to a central network operations center or where applications requiring extremely high bandwidth need to reach buildings throughout the campus.

Take, for example, video surveillance. With huge technical strides in cable TV, campuses everywhere now have the ability to stream high-resolution video feeds from all over the campus: dorms, parking lots, ATMs, classroom buildings, and so on. The limitation with wireless CCTV is the bandwidth requirement.

> WOM technology retains the flexibility and cost-efficiency of license-free wireless deployment while maintaining the high service capacity and the fiber-grade service quality of optical transmission.

With a WOM network, campus IT can use the downstream bandwidth for Internet, VoIP, and other applications and the underutilized upstream bandwidth for centralized video feeds.

Budget-conscious campuses are relieved to find that typical deployments can start with a minimum of three WOM nodes placed on buildings throughout a campus. Each node has a cost of approximately $6,000. Typical costs to trench and lay fiber to extend high-capacity bandwidth runs at $30 to $100 per foot.

### To Mesh or Not to Mesh

Few technologies—including WOM—are right for everyone, but WOM does have certain benefits for campus environments. Any manager worth his or her salt will consider all the options before making a recommendation. Where does WOM fit into this list of options?

Basically, there are three alternatives to wireless optical mesh:

1. WiFi: This is an excellent solution for campuses that are just providing basic Internet access throughout their campus. Access points and switches are fairly inexpensive and easy to deploy. One of the key issues with WiFi is that as you add more end-user devices, the quality and available bandwidth decrease exponentially at a certain point.

2. Fiber-optic cable deployment: Most universities now have at least one fiber connection to one or several of their buildings. However, as applications become more Internet-based and bandwidth-intensive (i.e., for VoIP or videostreaming), almost all buildings within a campus will need fiber-grade connectivity.

3. Other point-to-point free space optics (FSO) solutions: Point-to-point FSO solutions allow remote buildings to establish fiber-grade connectivity from one building to another. If one building needs connectivity and it is anywhere from 500 meters to 2 kilometers away, then this is an excellent solution. However, costs for these FSO solutions run from $10,000 to $50,000 per link, depending on the distance to be covered—a strain for many (if not most) college budgets.

### WOM: Past and Future

WOM grew out of point-to-point FSO technology. There was a lot of promise with FSO several years ago, but the manufacturers of FSO refused to acknowledge its limitations. Many improvements to the deployment of WOM technology have been made, including, for example, these four:

1. Lower cost. Traditional FSO utilized expensive lasers; WOM uses inexpensive LEDs that keep unit costs drastically cheaper.

2. Wider optical beam. Traditional FSO used a thin beam, which could often lose tracking with other point-to-point solutions. WOM uses a wide beam, so that if the wind blows or the building shifts, the beams still see each other.

3. Reliability. A mesh network provides full redundancy, so if a link does go down, there is automatic fail-over.

4. Distance limitations. WOM is a great solution for dense metropolitan and campus environments, where the distances between buildings are limited. We recommend a distance of 250 meters, so that weather and other environmental factors do not affect performance of the network.

How is WOM technology likely to change in the next five years? We'll see improvements on both the design side and in network management. The product is designed to be carrier grade, so extending and enhancing a holistic network management platform is important. We'll also see variations on the number of supported links.

As applications and the Internet become more content rich, the need for higher bandwidth will outpace current college campus connectivity. Some will be trenching fiber from building to building—and some will be installing wireless optical mesh solutions.

**Fima Vaisman is senior vice president of ClearMesh Networks. Contact him at fvaisman@clearmesh.com.**

[1] Carmen Nobel. "Wireless Mesh Passes Test," *Light Reading*, June 20, 2006

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Prior to becoming president of the University of Illinois in 2005, B. Joseph White was interim president of the University of Michigan. He served as dean and professor of the University of Michigan Business School from 1991-2002.

White also has been a corporate executive, serving first as Cummins Engine Co. Inc.'s vice president of management development and then as the company's vice president for personnel and public affairs. White is also a member of several corporate and nonprofit boards of directors.

At the University of Illinois White has been an advocate for using information technology to improve higher education productivity and make university education more accessible to more students.

White received his bachelor's degree magna cum laude from Georgetown University, his MBA with distinction from Harvard and his doctorate from the University of Michigan. He is a member of Phi Beta Kappa, Beta Gamma Sigma and received an honorary doctorate of humane letters from Wabash College.

## Interview

# B. Joseph White, Ph. D.

University of Illinois

**ACUTA:** Many universities are educating an increasing number of nontraditional students. Is that the case at the University of Illinois? Are you using computer technology to meet the needs of this group of students?

**White:** The University of Illinois includes three campuses: Urbana-Champaign, Chicago, and Springfield. Each has a distinctive character that has evolved out of its history, traditions, and place.

The Urbana-Champaign campus is historically a residential land-grant public research university. The University of Illinois at Chicago, which has the largest medical school in the nation, is an urban university. Many of its educational and research programs grow out of the needs of Chicago, an economically and ethnically diverse living laboratory. The University of Illinois at Springfield, the state capital, is a public, liberal arts university with strong political science and public affairs programs and institutes and internships in state government and related agencies.

At Urbana, Campus Information Technologies and Educational Services (CITES) has been for more than two decades a key strategic strength for world-class research in the sciences, engineering, agriculture, and the environment. The library has the largest book collection of any public university in the nation and is committed to making its resources digitally available. The National Center for Supercomputing Applications is a national resource, but it is also part of the rich computing environment at Urbana.

Both our Chicago and Springfield campuses have traditionally attracted a large number of nontraditional students, so we've developed communications technology to meet their needs. One third of the faculty at our Springfield campus teach both in the classroom and online. We currently have about 7,000 online students at the University of Illinois. In a decade, I'd say that should be 30,000.

**ACUTA:** Are there plans in place to make more online educational resources available?

**White:** I began talking about using technology to broaden access to higher education at the University of Illinois in my inauguration address when I came to the University of Illinois in 2005. I expressed the view that higher education in the future will be a "rich mix" of in-person and online experience. I still believe that.

In my view, it is just not acceptable for a society in the highly competitive global economy to have 85 percent of its students graduate from high school and less than 30 percent receive a college degree. That ranks us seventh in the world in percentage of college graduates.

We must do better to compete as a nation in the global economy, and we need more high-wage college graduates to power our enterprises and drive the consumer economy at home. The long and short of it is that students have to persevere to graduation, and universities have to graduate more students.

Our research has shown that today's online communications technology is robust enough to enable a broad and strong distribution system of our faculty's expertise and significantly increase access to higher education for more students. Not having to be physically present on a college campus for four years also makes cost savings possible.

I come at these questions from the perspective of a former business school professor and dean. The bottom line comes down to educating more students, more efficiently, with existing resources and facilities. What we're talking about here is increasing the productivity of our colleges and universities.

In the contemporary business world, increasing productivity means working smarter, employing teams, and using information technology wisely and appropriately. It is ironic that universities have not seized information technology to reap the huge productivity gains that the business world has enjoyed. That must change.

**ACUTA:** Do you look at higher education in business terms?

**White:** In one sense, education is the biggest business in the world. But I've argued that while we can't run our universities like businesses, we do need change-oriented and tech-savvy leadership — the kind now commonly found in corporate America — to recast American higher education to provide more prosperity and social mobility to individuals and a global competitive edge for the nation.

The new market reality in education is that it is now a lifelong, not a four-year, endeavor. Adult learners are motivated not by degrees but by new knowledge or skills to get a competitive advantage in the workplace, an opportunity to change careers, or just to learn something new or enriching. Startups such as the University of Phoenix, whose parent company is traded on the New York Stock Exchange, are responding to educational needs not met by traditional universities. Let's call this for what it is: a loss of market share due to a failure of innovation.

Teaching is education's equivalent of manufacturing's product costs, i.e., where the beef is. The ivory tower ideal of the 25-student, professor-led course is not a one-size-fits-all higher education product, but one part of the new blend of in-person and online education. Our goal is to be the national leader in online virtual education in areas of high-demand for nontraditional students — baccalaureate completion, business, nursing, and education. To accomplish this successfully, our offerings must be high quality, highly affordable, and highly accessible.

We can't ask our university faculty to take on all of this new teaching by themselves. Other fields have developed highly competent paraprofessionals — paralegals and physician's assistants, for example — who have raised productivity and quality. Universities already use a large number of what I call "supplemental faculty," non-tenure track and adjunct instructors. So why can't we extend this idea on our virtual campus and have our master teachers design classes and lead teams of supplemental faculty? This approach provides high-quality online university-level course work and degrees to students who can't, due to geography, finances, job, or family obligations, join us on the main quad.

**ACUTA:** Do you think universities have used information technology well?

**White:** Information technology is essential to the contemporary university's teaching and research missions. IT tools also are embedded in the management of exceedingly complex organizations of smart human beings.

Today's students are so comfortable in virtual environments. Think of the online component of contemporary higher education as enriching the process by adding a new medium for students. They e-mail questions to their

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professors, and professors post lectures and auxiliary material online for their students. Some research shows that online class "discussions" attract different kinds of responses, and some students are less reticent to participate.

The research required of students has moved more online, and students need more, not less, instruction on how to discriminate between legitimate sources of information and unfounded opinion. There's more to learn in integrating IT into education, but we know a great deal now.

It goes without saying that modern computing and communication tools enable us to do research—from climatology to the genome—that was unthinkable a generation ago. High-tech tools have also made possible more research collaborations, both on individual campuses and among researchers at other universities. Without smart machines, we would not be seeing advances in emerging fields such as nanotechnology and bioengineering.

Computers themselves have been a fertile field of study at the university. Mosaic™, the first accessible Internet Web browser, NCSA Telnet, and Eudora e-mail were developed at our Urbana campus. The founders of YouTube left our computer science department during their senior year to go to work in California's high-tech industry. They recently sold YouTube, named by *Time* magazine as invention of the year, to Google for $1.65 billion. That's "billion" with a "b."

So IT is integral to the university environment as we know it today. But after a rush to put higher-education "content" online in the heady dot.com years through the 1990s, there were some high-profile failures at Columbia and the University of Chicago, among others, that put a chill on the online higher-education marketplace from the university point of view. A few universities, Maryland and Massachusetts, have crept back into online degree offerings, and universities like mine have some limited efforts. But in large measure, we at the university have ceded the online higher education market to the private sector. We should change that.

**ACUTA:** Perhaps that is how it should be: Established universities teach students on campus, and Phoenix and other specialized private companies take care of the online market. What's wrong with that idea?

**White:** The content and intellectual resources of the American university are incomparable, the envy of the world. As other nations develop their institutions of higher education to compete globally, the model is always the American university. So my view is that we in the public university sector have a great deal to offer to an education market whose needs have changed.

The recently released "A Test of Leadership: Charting the Future of Higher Education," report commissioned by U.S. Secretary of Education Margaret Spellings points out how different college students today look than their prototypical 18-22 year-old campus image: "Of the nation's nearly 14 million undergraduates, more than four in 10 attend community colleges. Nearly one third are older than 24 years old. Forty percent attend part time."

At public research universities, we are very good at discovering and communicating knowledge, and we have well-developed IT infrastructure to deliver higher education to these "nontraditional" students. Our research shows that this nontraditional group is largely made up of single mothers, minorities, first-generation college students, and adult learners.

So in my view, making public education more accessible is not only possible, but it is also our responsibility. It is part of the University of Illinois' charge and mission as a land-grant university to educate citizens and spread prosperity.

**ACUTA**: Are your campuses using IT tools to bring university resources to other audiences?

**White**: Our alumni association recently did a mailing to promote membership and took that opportunity to inform alumni of "a significant new benefit of membership." For their $40 annual membership fee, members receive access to all of our libraries' electronic publications, more than 4,000 magazines, newspapers, periodicals, scientific and professional journals and trade publications. Subscriptions to these publications would have cost an alumnus or alumna hundreds of dollars per year.

The folks at the alumni association asked me to endorse the promotion, and my thought was, "This is a no-brainer." And because we're talking about University of Illinois graduates, I know that sufficient intelligence and education were not in question. What a great deal!

*ACUTA thanks Dr. White for taking the time to respond to our questions and share his insights into some important issues.*

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# Wireless LANs for Voice

Michael F. Finneran
dBrn Associates, Inc.

Since their commercial inception in 1999, the worldwide installed base of WiFi-compatible wireless LAN stations has grown to 60 or 70 million devices. WiFi is now starting to move in an exciting new direction with the capability to support voice communications over those same wireless networks. WiFi phones are being marketed to consumers to provide wireless access in conjunction with voice over IP telephone services like those from Vonage and Skype (now part of eBay). A residential WiFi network would only need to support one or two phones, so they should not tax the capacity of that home network.

For enterprise users, voice over WiFi (VoWiFi) holds a much greater promise in terms of functionality and cost savings. However, supporting a large-scale voice service over an enterprise wireless LAN will present far greater challenges as user expectations regarding security, reliability, and voice quality increase. Wireless LANs can certainly be used to provide mobile voice services, but this is still a developing field. The payoff can be great, however, if we can eliminate cellular charges for calls made within the WLAN coverage area and improve indoor radio coverage at the same time.

### What Is VoWLAN?

As the name indicates, the basic idea of voice over WLAN is to support mobile voice handsets over the same WLAN infrastructure that was implemented to support mobile data access. The original WLAN protocols were designed for the requirements of data rather than those of voice devices, and therein lies the major challenge for a WLAN voice network.

There are four major elements to a WLAN voice network:

1. VoWiFi handsets. These handsets or other voice-capable devices (e.g., softphone-equipped laptops or PDAs) support a WiFi-compatible radio interface.

2. Telephony server. To provide telephone-type connections and features, IP networks require servers that coordinate connections between and provide features for those handsets—that is, the function of telephone signaling. WLAN telephone systems initially used proprietary signaling mechanisms, but the trend in IP telephony today is toward standards-based signaling using the session initiation protocol (SIP).

3. WLAN infrastructure. An enterprise WLAN is like an indoor cellular network: A number of WLAN access points will have to be distributed throughout the coverage area and interconnected through the wired LAN. The original WLAN access points were stand-alone devices, and network engineers would conduct a site survey to determine where they should be placed, to assign channels, and to manually adjust the transmission power for each. Given the challenges involved in ensuring adequate coverage and capacity

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throughout an expansive area, centrally controlled WLAN switches are highly recommended for any large-scale WLAN deployment. Besides assisting in the network layout and radio coverage, most WLAN switches will provide the ability to hand off calls between access points as users move through the coverage area.

4. Management and operating systems. While the handsets, telephony server, and WLAN infrastructure are the essential elements needed to provide WLAN voice service, you will also need systems that monitor performance, record traffic patterns, assist in trouble shooting, and plan for growth. Some of these capabilities may be included in a centrally controlled WLAN switching system, but it is imperative that all of the necessary monitoring and support systems be included to ensure reliable service on an ongoing basis.

#### Major Issues in WLAN Voice

There are six primary issues that will be critically important in support of WLAN voice: security, capacity/quality of service, handoffs, call-access control / load balancing, battery life, and network management. While the first two are pretty much under control, the last three are still very much up in the air.

1. Security*:* Radio networks propagate signals through free space, so it is absolutely essential that all transmissions be encrypted to protect against eavesdropping. The WLAN standards define three levels of encryption:

• Wired equivalent privacy (WEP): Uses an RC4-based encryption with a static 40- or 104-bit key. WEP is universally acknowledged to be totally inadequate for enterprise installations.

• WiFi protected access (WPA). This is an interim security measure developed by the WiFi Alliance that uses the same RC4 encryption as WEP (with a 128-bit key), but the key is changed on every packet to thwart brute force attacks. Although WPA was not well received by enterprise users, to date there have been no successful hacks reported against it.

• WPA2/802.11i: WPA2 is the state-of-the-art encryption for WLANs that is described in IEEE 802.11i. WPA2/802.11i encrypts traffic using the Rijndael-based Advanced Encryption Standard (AES) and is the best solution available today.

While WPA2/802.11i is widely supported in WLAN switches, at the beginning of 2006, there were almost no compatible handsets. That changed during the first half of 2006, as Cisco and SpectraLink both introduced WPA2 compatibility. The WiFi Alliance now requires WPA2 compatibility on any new WiFi-certified devices, and all new WiFi handsets will have it.

2. Capacity/Quality-of-Service*.* Capacity and quality-of-service (QoS) go hand-in-hand to ensure adequate WLAN voice service. Radio loss increases with distance, and WLAN stations with poorer signal quality (measured by the signal:noise ratio) will automatically reduce their transmission rate. Further, poor radio conditions generally result in more frames being retransmitted. The first step in supporting good-quality voice will be to implement a WLAN infrastructure that provides good signal quality and adequate call capacity throughout the desired coverage area.

The requirement for QoS stems from the fact that WLANs operate on the principle of a shared channel. In such an environment, it is important that voice and video transmissions get preferred access to the channel to reduce transit delay and jitter. QoS capability is described in 802.11e, but that standard defines two options:

• Enhanced Distributed Control Access (EDCA): EDCA defines four access categories that will give voice and video users preferred access to the shared radio channel. The WiFi Alliance identifies this option as WiFi Multimedia (WMM) Certified.

• Hybrid Controlled Channel Access (HCCA): HCCA defines a mechanism whereby the access point can take control of the channel for periods of time and poll stations with time-sensitive traffic, essentially providing consistent-delay service. The WiFi Alliance identifies HCCA compatibility as WMM-Scheduled Access (WMM-SA) Certified, but they have suspended development of a certification plan for it due to a lack of interest from manufacturers.

In EDCA/WMM, user priorities are implemented by enhancing two mechanisms from the original WLAN access protocol: the interframe spacing (IFS) and the back-off counter. In a traditional WLAN, a station wishing to send a frame must wait for an interval called the DCF Interframe Spacing (DIFS). All users have the same access priority because they all use the same DIFS interval. They also use the same range of back-off values to address collisions and busy channel conditions (i.e., CWmin and CWmax).

EDCA defines different waiting intervals and back-off ranges for each of four access categories, and shorter intervals are assigned to higher-priority traffic. The four EDCA/WMM-defined priority levels or access categories are designated as follows:

- Access Category 1: Voice
- Access Category 2: Video
- Access Category 3: Best-effort data (identical to current DCF devices)
- Access Category 4: Background data

The new interframe spacing interval is called an arbitrated IFS (AIFS). Two of those intervals (voice and video) are shorter than the current DIFS value, one is the same (best effort), and one is longer (background data). As a result, legacy DCF and EDCA stations can be mixed in a wireless LAN, and transmission from the legacy stations (i.e., pre-802.11e) will all be categorized as "best effort." All pre-802.11e VoWLAN handsets use the legacy DIFS waiting interval, so if they were used in an 802.11e network, they would not be able to access the channel with the same priority as 802.11e-compliant devices.

3. Handoffs. Voice users are far more mobile than data users and will require a handoff capability that transfers a call from one AP to another quickly and securely. The desired handoff interval is 150 msec or less. The IEEE is working on a standard designated 802.11r, with the goal of providing hand offs in less than 50 msec. That standard will not be completed until some time in 2007, but virtually all WLAN switches support fast, secure handoffs today. Handoff times vary depending on the encryption technique being used and whether the caller is moving between IP subnets. Because the handoff function is controlled by the WLAN switch, it will work with any WiFi-compatible handset.

4. Call access control and load balancing. While security, QoS, and handoffs are fairly well in hand, we are now finding that there are other functions that will also be needed to ensure consistent, high-quality voice services. The first of ▶

these is the combined issues of call access control and load balancing.

• Call access control. Even with QoS, WLAN resources will be distributed evenly among all calls in progress. So if too many voice clients associate with a single access point, all of those users will receive degraded voice services (i.e., increased transit delay and packet dropping). Therefore, it is critically important that the network have a call-access control capability that limits the number of voice users that can associate with one access point at any given time. The 802.11e specifications define a mechanism for call-access control called Traffic Specification (TSpec), though a robust implementation typically requires some vendor-defined extensions. Some WLAN switches can now implement call-access control by monitoring a SIP signaling exchange and can deny additional calls by returning a 503-Network Unavailable response code if the AP is overloaded.

• Load balancing. Used in conjunction with call-access control, load balancing provides the ability for excess callers to be steered to an alternate access point rather than be given a busy signal. Load balancing will be defined in IEEE 802.11u; however, that standard is at least two years away. In the interim, many WLAN products are implementing mechanisms to steer excess voice users to APs with available capacity.

5. Battery Life. Short battery life is an ongoing concern with WLAN voice handsets. Even with the original WiFi power save mode, voice handsets typically get a maximum of three to four hours of talk time. That means the battery may not last an entire shift. In WMM, the WiFi Alliance incorporated a power save option, called WMM-Power Save, that provides a 20 to 40 percent improvement in battery life. The 802.11e identifies that battery-save feature as Automatic Power Save Delivery (APSD).

A number of WLAN switching systems take additional steps to conserve battery power, such as filtering ARP requests and other broadcast traffic at the access point. Some also use transmission power control in the access point to reduce the transmit power of the client device to the minimum required to connect.

6. Network management. Network management is typically the most overlooked area in WLAN voice. Providing good, ongoing service will require tools to collect statistics to assess overall network performance, assist in problem resolution, and plan for upgrades. There are a number of performance statistics you will want to collect to monitor the performance of the WLAN voice service:

• Calls per access point (average and maximum)

• Calls denied/load balanced per access point

• Percentage of calls dropped per access point

• Percentage of packet retransmissions per access point

• Average data rate used per access point

• Average and maximum handoff time

• Call detail recording: With the move toward standard SIP-based signaling, many WLAN switching systems can now intercept the SIP signaling exchange and use that information to produce call-detail records that link to the called and calling numbers. Some can even produce a mean opinion score (MOS) to estimate the quality the user experienced for the connection. That information can be critical in responding to trouble reports made after the call is completed. Among the information elements to collect are

- Date, time, and duration of the call
- Called and calling parties
- Percentage of dropped calls
- APs used, handoff times, handoff reason
- Percentage of packet retransmissions
- Average data rate

### Conclusion

While WLAN voice is in its infancy today, there will be great pressure to deploy it based on the potential to make key personnel accessible throughout the facility while reducing the cost and improving the coverage of cellular service. The key to delivering on that promise will be a WLAN infrastructure that is well planned and well managed.

**Michael F. Finneran is a wireless network analyst, consultant, and educator. He has published over 100 articles on various network technologies and writes a regular column that appears in *Business Communications Review*. Contact him at: mfinneran@att.net**

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# Delivering Broadband over Power Lines

**Walt Adams**
**COMTek**

As we try to meet the ever-increasing demand for broadband access, one of the significant technologies is so obvious it might be overlooked. Broadband over power lines (BPL) turns existing power lines (both outside buildings and inside buildings) into a giant Ethernet network. BPL technology uses the existing power transmission pathways to guide network signals throughout a building, campus, or city.

Currently, there are two methods of delivering BPL signal over the "last mile" to the end user's location. The first option bundles the signal onto the actual power line running into the end user's facility. The second employs an RF (wireless) signal from a nearby utility pole.

### Option One: Power Line Delivery

To use the network when the signal is delivered over an incoming power line, a subscriber plugs a BPL modem into virtually any existing electrical outlet and connects his or her computer or router to the modem via an Ethernet cable. To use BPL outside a building, the owner of the electric distribution lines (i.e., the power company) grants permission to attach the BPL devices to their power lines, typically for a fee. Once the BPL network is running (either in-building or outside), it operates exactly like any other Ethernet network, with subscribers' desktop speeds running anywhere from 500 Kbps to 20 Mbps.

One of the benefits of this technology is expediency. Every building is prewired, and a subscriber/user can move his or her computer merely by unplugging the modem from one electrical outlet and plugging it back into a different electrical outlet. For a campus BPL network, this means that any electrical outlet, streetlight, or junction box is a network connection, so there is network virtually anywhere on campus. A security camera, WiFi hotspot, laptop, desktop, or any other network device that is available at Best Buy, Circuit City, or other retail outlet can be installed anywhere in about 20 minutes or less. BPL is a good solution for new buildings, but it is an outstanding solution for retrofitting existing buildings for network communications.

### Option Two: Wireless Delivery

In this scenario, BPL signal is delivered to the end user's location via a wireless link installed on a nearby utility pole.

Lehigh University in Bethlehem, Pennsylvania, partners with a local power company who used this approach to establish a BPL network intended for off-campus students who may have issues getting broadband access into their homes or apartments. (On-campus students use the wired Ethernet jacks Lehigh provides.)

Lehigh's website provides information about BPL, including a list of attractive benefits to potential users:

- No telephone line required
- Two-way transmission
- Supports home networking
- Access to virtual private networks (VPNs)
- Easy to install and use
- Higher Internet speeds that allow streaming audio and broadband media
- Utilizes existing power infrastructure for communication needs

Students are told they will need a wireless network adapter for their computer and the device needs to support the IEEE 802.11b and/or 802.11g standard.

They may opt to purchase a combination network adapter/wireless extender. This device makes the connection to the access point and, in effect, strengthens the signal between it and the computer. Signal strength will vary within the coverage area and will depend on such variables as distance from the access point, "clutter" such as trees and buildings, characteristics of the computer (wireless card, age of computer, etc.), and signal interference from cordless phones, microwaves, and other wireless network devices.

With home networking, Lehigh users can share their BPL Internet connection among multiple computers; share peripherals, such as printers and scanners; trade documents, MP3s, and other files within the home; protect personal information from Internet attacks with a built-in firewall; and interact with other computers in the home network for multiuser games.

Lehigh's experts are not the only ones who strongly recommend the use of a personal firewall with BPL as well as other technologies. A firewall is considered a first line of defense in protecting private information.

#### Considerations and Limitations

Backbone speeds are currently anywhere from 84 Mbps to 200 Mbps, but they are getting faster every year or two.

Lehigh explains that BPL provides users with a certain amount of bandwidth. With a home network, all computers share this bandwidth. So, for example, if one computer is doing something that requires a large amount of dedicated continuous bandwidth, like streaming video or a large graphics file transfer, other computers may experience some impact on throughput speed. In general, more simultaneous users and higher-bandwidth consuming activities will mean that the available bandwidth may be shared and throughput speeds can decrease.

With last-mile wireless delivery, certain devices such as microwave ovens and ham radios might interfere with signal. Wireless channel congestion and too many devices on the same or contiguous channels may also impact BPL service. A cordless 2.4 GHz phone may interfere with 802.11b, particularly if it supports full spectrum.

Since BPL is not as widespread as cable and wireless modems, modem costs have not yet achieved mass market pricing, so they're still a bit pricey (ranging from $49 to $89 and up).

From a campus or wide-area perspective, one of the biggest limitations with BPL is having to work with the owner of the power lines. For campuses that own the power company, this is obviously not an issue.

There are two competing de facto BPL standards (DSL and Home Plug), but IEEE standards are being developed and should be finalized in the next 12 to 18 months. Meanwhile, the de facto standards continue to coexist (think VHS versus Beta Max), and the lack of standards means you can only rarely mix and match equipment from different vendors.

#### Requirements, Suitability, and Costs

Many campuses facing access issues are considering BPL. For in-building, only electrical wiring is required. It is literally plug and play. For an entire campus, it requires authorization from the power line owners, plus installation costs for installing devices on the electric wires.

Campus administrations that need network devices in many locations are well served by BPL technology. To determine suitability, the question to ask is "If I had a network signal wherever there is an electrical outlet or a lightbulb, what would I do that I won't/

can't do now due to the expense of putting in a traditional solution?"

For security cameras, WiFi hotspots, building management (sensors, etc.), retrofitting older buildings, and more, BPL may have application. BPL is best used in conjunction with traditional network solutions, including copper, fiber, and wireless. For example, one can install a wireless point-to-multipoint system to connect buildings on campus, then distribute the bandwidth throughout the building from the rooftop wireless installation via BPL.

With BPL, in-building costs are very competitive compared to running new wiring or moving LAN jacks; and since the building owner also owns the building electric wiring, there are no fees. Campus and wide-area costs vary tremendously on a case-by-case basis due to distances, equipment costs, and power company fees, although equipment costs will come down significantly over the next two years as IEEE standards are finalized.

In-building solutions are widely available from multiple vendors, including name brand vendors such as DLink. Campus and wide-area vendors are fewer, and their technologies vary significantly due to the lack of international standards, thus these costs are still a bit high.

### What Does the Future Hold?

Penn State University research indicates that speeds as high as 1 Gbps are possible (http://cictr.ee.psu.edu/CICTRnews/White%20LED/Physic-Org.htm) ; however, it is reasonable to expect subscriber speeds of 100 Mbps (similar to existing Category 5 twisted-pair Ethernet LANs) in the near future.

In-building use is currently very compelling and will only get better, and the technology supports VoIP and video (subject to bandwidth speed limitations). For campus and wide-area use, it is best to engage a company with actual hands-on BPL experience, as this technology still has many nuances for campus and wide-area deployment.

**Walt Adams is vice president of Broadband at COMTek. Contact him at wadams@comtechnologies.com.**

Editor's note: Additional information may be found at http://www.ansi.org/news_publications/news_story.aspx?menuid=7&articleid=1312.

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# Gordon College Expands Access to Multimedia Educational Resources

**Russ Leathe**
**Gordon College**

Forty-nine percent of today's university students are "nontraditional," according to the Association of Non-Traditional Students in Higher Education (http://www.antshe.org). They are older, they work full-time, and they don't live on campus. Many of them rely on evening or remote education programs to continue their education.

Educational institutions must find new ways to reach students who can't get to the brick-and-mortar classroom and new ways to bring the wider world of knowledge into schools. Technology can be the number one tool for expanding access to education for both traditional and nontraditional students.

As student retention and graduation rates become more of a focus for measuring an institution's success, campus administrators can look to technology to address the varied needs of students and how to improve student performance. Mobility, interschool collaboration, distance learning, multimedia classrooms, and video courses—the blended learning environment can be a differentiator. Colleges and universities can be better prepared not only to attract faculty and students but also to retain them and help them be more productive and successful.

### Gordon College: Incorporating the Power of Technology

With a multinational student body of more than 1,600 students, Gordon College in Wenham, Massachusetts, has an established commitment to excellence in education, global outreach, and cultural exchange. Gordon has repeatedly been selected as one of the nation's best liberal arts and sciences colleges, as recognized in the annual "America's Best Colleges" edition of *U.S. News & World Report*.

In 2000, a broad-based committee of students, alumni, faculty, and administrators developed a vision for enhanced education services, leveraging a new generation of communications applications and infrastructure. They believed that IT could work to deliver extraordinary education experiences on an ordinary IT budget. The blueprint yielded a phased, multi-year plan:

- Phase 1. Upgrade the physical infrastructure.
- Phase 2. Deploy Ethernet IP communications foundation.
- Phase 3. Deploy IP telephony.
- Phase 4. Deploy wireless LAN technology.
- Phase 5 . Deploy video-on-demand and live TV distribution over Ethernet .

Phase 1 consisted of upgrading the campus optical and copper infrastructure. Single-mode fiber was chosen between buildings; multimode fiber between wiring closets; and Category 5, 5e, and 6 copper cabling for all data and voice locations. It was at this time that the decision to run data cable for video instead of coaxial was made, resulting in a savings of almost $200,000.

To complete its plan, we sought a vendor who would work with us as if our goals were their own. We chose Alcatel for the remaining phases of this strategic plan.

Phase 2 has really been phases 2a and 2b, because we have totally upgraded our network infrastructure. For this phase, the key requirements were standards compliance, high availability, server load balancing, and manageability. We now have a 10-gigabit ring between four main campus buildings, with multiple gigabit links to wiring closets in dorms, lecture halls, offices, and the library through one vendor, which is more manageable.

The requirements for the third phase demanded a solution that supported wireless, digital, analog, and IP telephony in one chassis. Deploying the Alcatel OmniPCX allowed the college choices: analog phones for the dorm rooms; digital phones for the offices; IP phones for classrooms, remote buildings, and select departments; and wireless phones for the IT department.

The phone system proved to have more capabilities than we ever thought possible. We are now looking to integrate the PCX with cellular technology for our students.

With IP telephony in place, we were ready to embark on the fourth phase—ubiquitous access to the college's resources. We chose a cost-effective WLAN solution to provide wireless network access from almost anywhere on campus. The WLAN was designed to extend the reach of the wired LAN, rather than acting as an overlay.

We envisioned a secure mobile environment, where the same mechanisms we use to authenticate the wired user are used for the wireless user. We are now able to apply QoS parameters based on a user's ID or the access point service set identifier. This means the college can confidently employ WLAN IP phones and other mission-critical wireless applications, secure in the knowledge that the traffic will be assigned the highest priority throughout the network. At Gordon as at many other campuses, classrooms are moving in the direction of an all-wireless environment, where the laptop is the primary learning device for students and the instructors' main teaching device.

Deploying video was the final step in the multiphase upgrade of the network, applications, and services. We realized that recruiting and capturing the minds of today's students would require a learning infrastructure that facilitates "learning on demand" and "teaching from any place." Our leadership recognized the key role technology plays in delivering campuswide access to school resources and extending that access to the larger community. Gordon has long delivered course materials, archived audio lectures, and multimedia curriculum content online. The next step was exploring the power of video.

Our students benefit from video applications that are available anywhere and anytime over our IP networking infrastructure. With this system, IT doesn't have to install any software on the end user's computer, eliminating a large amount of support and rollout issues.

With a video solution for streaming TV channels, coverage of campus events, and video-on-demand, Gordon students can view licensed, digitized library assets from their dorm rooms or other locations via campus wireless hot spots. The digitizing of our analog video assets and providing video-on-demand means that no student is disenfranchised. No longer is a student or faculty member at the mercy of a single video source.

### Benefits of Video

Delivery of digital content is not just limited to old videotapes and DVDs. With video-on-demand, students can capture lectures and store them on a video server for review at their convenience. This is a terrific teaching tool. We all know that not every single student learns the same way. Students today are multimedia and multisensory oriented. Being able to view a lecture multiple times aids the learning process by moving the information from short-term memory to long-term memory.

In addition to teaching and learning, the video-over-Ethernet network facilitates remote viewing of ceremonies and athletic events. Students and alumni can stay connected even when they are overseas by viewing campus events online. Like Gordon's founders, several students' parents are missionaries in Africa or India. With video over Ethernet, parents can witness their child's graduation over the Internet.

The video solution also connects Gordon with other institutions around the world, delivering virtual guest lectures to and from its campus. And within a matter of minutes, the college president can now broadcast live to the student body, addressing everyone with the same emergency information or other public updates.

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To enhance student safety and campus security, the college is planning to install IP security cameras in some of its remote parking facilities, monitoring them via the wireless network. If a problem is reported, the dispatched officer could potentially assess the situation by means of a laptop in the vehicle before arriving at the scene.

By using the campus-wide Ethernet network, the college can expand video access to new buildings over the single infrastructure without having to install cable wiring.

**Securely Managing the Virtual, Mobile Campus**

Before deploying video over Ethernet, we faced a network crisis that many colleges and universities have faced. I remember the day I got married, I remember when all of my children were born, and I remember when the Blaster worm hit my network. What this meant was that every single switch on the student side of the campus was saturated, overloaded. We had to physically disconnect the fiber uplinks to restore stability to the IP telephony network.

After two weeks of individually cleaning student computers, we vowed that this would never happen again. An Alcatel solution allowed the school to deploy its mobile, blended learning environment safely, balancing openness with the need to protect the campus. Schools can now leverage existing systems and add role-based, policy-driven network security.

We use the OmniVista network management platform to manage the voice and data network. This platform accommodates additional applications that operate inside the main management software. One such application is the Quarantine Manager.

The Quarantine Manager interfaces with any third-party security device that generates a syslog, including wired and wireless LAN switches. This gives the college an end-point security solution that delivers proactive virus and worm attack prevention, enabling continuous compliance with corporate security policies. If a PC trying to access the network is not 100 percent in compliance with any piece of the policy, the machine is assigned to a quarantine VLAN and remains there until the security problem is fixed. This fine granularity allows the solution to be utilized on shared media—such as wireless access points—since only the misbehaving device is quarantined, not the port into which the device is connected.

The college also installed a Fortinet Fortigate unified threat management appliance to identify these anomalous traffic patterns. Within 10 minutes of installation, Fortigate and Quarantine Manager collaborated to isolate nine different attacks. The dynamic nature of this solution was just what we needed.

We have a staff of four, and we don't work 24/7. Attack containment is just as important as bandwidth, reliability, and redundancy when evaluating network vendors. Without this capability, every network is a disaster just waiting to happen.

We were able to address our security needs both within the classroom and campuswide with the ability to protect student records, secure billing, and financial aid systems.

**The End Goal**

Each phase of our five-phase plan led to the ultimate goal of delivering video in the final phase. The gigabit Ethernet core, security, quality of service, network management, and bandwidth allocation were critical. When an institution adds video applications—including live TV and video-on-demand—network administrators must be able to control bandwidth and manage network traffic.

Gordon College now delivers secure, multimedia networking that helps break down barriers to education. As a result, our teachers and students are fulfilling their goal of community outreach around the world with 21st-century tools for 21st-century teaching and learning.

**Russ Leathe is director of Networking and Computer Services at Gordon College. Contact him at russ.leathe@gordon.edu.**

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# Thanks to Our Exhibitors & Sponsors!

Thanks to these companies that exhibited or sponsored at one, two, three, or all four of our events in 2006. ACUTA members are their potential customers, but representatives from many of these companies have also become our partners in success as well as our friends. As they determine whose events they will attend each year, ACUTA is glad they have chosen ours!

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# The Real Impact of Napster

**Scott Genung**
**Illinois State University**

I recently came across a copy of our student newspaper (*The Daily Vidette*) from March 2, 2000. I had saved it because of an article that represented one of those defining moments in my career. The headline read "ISU blocks Napster.com," referring to a decision to block Napster P2P (peer-to-peer) file transfers at Illinois State University.

Each day for nearly a week following, related articles appeared in the student newspaper expressing outrage over this action. Students believed that the university was violating their rights and that the action was heavy handed. Shortly afterward, I met with the president of the Student Government Association and explained that this action was taken to address the excessive use of Napster. Only then did the controversy begin to subside. It was an important lesson. The bottom line is that students expect broadband access on our campus networks to be unconstrained—both then and now.

Like many other institutions of higher education, Illinois State was not prepared for the emergence of P2P applications in early 2000. Prior to this, the growth in Internet capacity had kept pace with consumption. In reaction to this controversy, before the start of the fall 2000 semester, I was directed to implement a system that allowed service to Napster to be restored, while concurrently protecting Internet bandwidth consumed by other applications.

As we evaluated different products that summer, it became clear that quality of service (QoS) was the technology we were seeking. But QoS by itself was not enough. The solution had to report applications as they emerged, detail bandwidth consumption by application, and provide the means to control it. Working with an IT networking solutions integrator, Information Systems Group, the product we found that met these requirements was the PacketShaper QoS appliance from Packeteer.

Since February 1999, the university has employed two Internet service providers for the campus in order to minimize the impact of an outage by a single carrier. During the summer of 2000, a pair of PacketShapers was installed in our WAN, with an appliance dedicated to each service-provider network. An application class for P2P was established, and all known P2P applications were assigned to it. These applications are often moving targets, which added to the complexity of this project; but when students returned that fall, access to Napster was restored, and Internet volume was managed at a predictable level. Since then, the university has not experienced further over-consumption problems from P2P applications.

As a result of this work, however, it became clear that managing P2P using QoS was only a first step. If a group of applications could be managed to prevent overconsumption, then conversely a different group of applications could be managed to prevent starvation. This led us to create a second application class specifically to guarantee Internet resources for key applications on campus. The key issue with this new class related to what the applications were. As the debate over bandwidth guarantees unfolded, it became clear that a different approach was needed. Instead of focusing on specific applications (such as a Web-based e-commerce system), a new model emerged based on three generic application classes: mission-critical, less than mission-critical, and managed. This approach cooled off the debate and made it easier to assign new applications as they emerged.

### QoS as a Security Strategy

In August 2003, I experienced another defining moment with the return of faculty and students to campus. Over the summer, a major software virus emerged for Windows XP. This situation overwhelmed both equipment and circuits throughout campus. In response, the university turned to the PacketShapers to help find these infected systems. Using reports generated by these products, infected systems were identified and removed. These reports were also useful in developing filters designed to prevent the spread of this and other viruses.

By the summer of 2004, a security plan was developed that incorporated the use of IPS (intrusion prevention system) technology from TippingPoint (a division of 3Com) to block and report on signatured threats, QoS technology to provide near-real-time reports on high-volume sources, and anomaly-detection technology from Lancope to report on anomalous Internet volume over time. Since implementation, network service for the campus has not been disrupted by a worm or a virus.

#### Functionalizing QoS

Although the primary goal of the QoS project was to protect limited Internet resources, the university quickly discovered the value of the application discovery and reporting capabilities of the PacketShapers. Since implementing this technology, the use of application classes at Illinois State University has evolved. No longer is it solely a tool to restrict consumption of Internet bandwidth by P2P applications. Today, it provides the means to ensure the delivery of mission-critical applications, offers a reasonable level of service to applications that are not yet mission critical, promotes the use of legal music and movie services, minimizes the impact of common denial-of-service attacks, and enforces the original policy for managing P2P volume.

To functionalize these goals, the university maintains four classes of service for Internet bandwidth: gold, silver, copper, and bronze.

The gold class of service is designed to protect Internet bandwidth consumed by mission-critical applications. The intent of this class is to prevent these applications from being starved of bandwidth at any time. This practice ensures that the gold class applications behave in a useful and predictable way. The gold class provides up to 40 percent of Internet bandwidth, with volume not to exceed 70 percent of capacity.

Applications in the gold class include (but are not limited to)

- several proprietary applications
- the Web (i.e., HTTP, HTTPS, etc)
- e-mail (i.e., SMTP, POP, IMAP)
- calendaring
- voice and videoconferencing (H.323, SIP, RTP, and others)
- VPN (i.e., IPsec, PPTP)

The silver class of service consists of applications that are less critical to the mission of the institution. These applications may experience bandwidth starvation during peak times. The silver class provides up to 15 percent of Internet bandwidth, with volume not to exceed 30 percent of capacity. As new applications emerge, they are placed into the silver class, which includes (but is not limited to) voice or video streaming, terminal emulation (i.e., telnet, SSH), file transfer (i.e., FTP, not P2P), instant messaging, and gaming.

The copper class of service is designed to promote the use of legal distribution services for copyrighted music and movies. This class was developed to help support an initiative to automate education and enforce copyright laws on campus as part of the Digital Citizen Project (http://www.digitalcitizen.ilstu.edu/). Under this initiative, users are alerted when they are transferring copyrighted content over P2P networks using products from Audible Magic. The user is also made aware of legal sources of content both on and off campus. Volume from these off-campus sites is then managed by this class. Like the silver class, the copper level of service provides up to 15 percent of Internet bandwidth, with volume not to exceed 30 percent of capacity. The copper class currently consists of the following applications: iTunes, FlashVideo, and Napster2.

The bronze class of service consists of applications that are non-mission-critical and detrimental to the performance of the campus network. The bronze class provides no bandwidth guarantees, with volume not to exceed five percent of Internet capacity. The bronze class consists of the following P2P applications: Abacast, Audiogalaxy, BitTorrent, DirectConnect, eDonkey, Gnutella, Hotline, LimeWire, KaZaA, and more.

Finally, there is a default class of service that is designed to identify application volume that has not yet been classed. This can occur if no application signature is available or if the appliance does not have enough information to classify the volume. The default class provides no Internet bandwidth guarantees, with volume not to exceed 10 percent of capacity. This approach prevents unclassified security threats from consuming all Internet resources.

Reports are frequently reviewed to ensure that the resources allocated for each class produce the desired results. Since implementation in 2000, these policies have been modified nearly each semester as new applications emerge and Internet capacity is expanded. As mentioned earlier, these reports are useful in identifying new security threats by volume.

#### Conclusion

Technology permeates nearly all aspects of our lives. As our dependence upon it grows, our tolerance for poor service or disruption diminishes. Because resources will always be constrained, the key to meeting this need requires visibility to which applications are consuming resources and which are important to your users. At Illinois State, this theme is what QoS is all about.

**Scott Genung is the interim director for Telecommunications and Networking at Illinois State University. Contact Scott at sagenung@ilstu.edu.**

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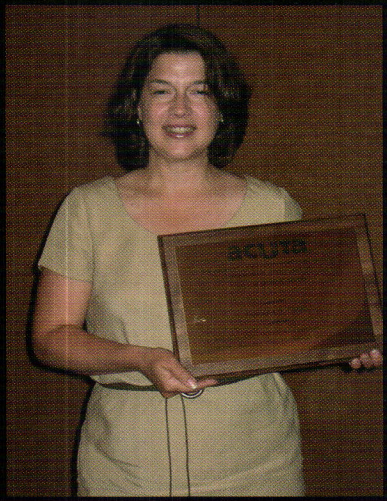
## Bill D. Morris Award
## 2005–2006



Tamara Closs was presented with a plaque to commemorate her selection as the recipient of the Bill D. Morris Award.

# Tamara Closs
## Duke University

This year's winner of the Bill D. Morris Award was former ACUTA President Tamara J. Closs of Duke University. In presenting the award at the Annual Conference in San Diego, President Pat Todus remarked, "The Bill D. Morris Award is one of two prestigious individual awards that are presented annually to an ACUTA member deemed by the president to best exemplify the dedication, vision, professionalism, and leadership brought to ACUTA by the late Bill Morris of the University of Central Florida. Bill was President of ACUTA in 1988-89, and this award was established in his memory in 1991.

Todus identified Closs as someone who exemplifies these qualities, who has given back to ACUTA since becoming a member 16 years ago, and "someone who has made a real difference and continues to do so."

Closs's many contributions to ACUTA include participation in various events as a speaker, moderator, and monitor as well as ongoing participation through the years on a variety of committees: Program Committee, Nominating Committee, Awards Committee, and the Communities of Interest Task Force. Closs has also served on the Higher Education Advisory Panel and as an ACUTA Director-at-Large. She was also appointed to represent the ACUTA organization on the FCC Consumer Advisory Committee, and served as president-elect and immediate past president before and after her year as president in 2004-05.

When asked for her comments after being named this year's award winner, Closs remarked, "I was honored and humbled to be selected from the hundreds of individuals that make ACUTA a premiere organization. The award recognizes dedication, vision, professionalism, and leadership. These attributes are a reflection of the membership's commitment to supporting their institution's teaching, learning, and research missions. I am grateful for the opportunity to serve and appreciate the honor of receiving this award."

Closs is currently assistant vice president, Communications and Systems Infrastructure, at Duke University.

Thanks to PAETEC Communications, sponsor of this award

# Harvey "Buck" Buchanan

## Florida State University

At ACUTA's 35th Annual Conference in San Diego this past July, the Awards Committee recognized Harvey "Buck" Buchanan of Florida State University as the recipient of the ACUTA Ruth A. Michalecki Leadership Award for 2005-2006. This prestigious individual award recognizes ACUTA members, associate members, and corporate affiliates for outstanding leadership.

Buck has served in numerous volunteer leadership roles within ACUTA, including the Marketing Committee, Website Recognition Task Force, and as chair of the Membership Committee. Last spring, he was elected to his first term on ACUTA's Board of Directors, serving as a director-at-large.

A well-known and popular speaker at ACUTA events, Buck's "trademark" is his unique approach to customer service. His engaging educational sessions are very popular among attendees at the Annual Conference. Buck is well liked and well respected by his peers and in the communications technology industry. He is full of energy, always has a positive attitude, and exemplifies the definition of a leader.

Buchanan also provides visionary and innovative leadership at FSU in telecommunications, data networking, video services, access and security services, and caller information center applications. He is known for his entrepreneurial and creative approach to developing services for the campus community, and has repeatedly been recognized with greatly expanded responsibilities on campus. He actively encourages and supports the professional development of his staff. He often acts as a mentor to both institutional and corporate newcomers to ACUTA, selflessly offering guidance, his expertise, and a listening ear.

Congratulations to Buck for being selected by his peers for this very special honor.

Thanks to PAETEC Communications, sponsor of this award

## ACUTA Ruth A. Michalecki Leadership Award 2005–2006

At the Annual Conference, Buck Buchanan was congratulated by Rick Simmons of PAETEC Communications, sponsor of the Award.

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## Here's My Advice

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2. Securing the data stored on the remote device (laptop/phone): What policies do you have in place, and are your end users educated on the security risks associated with them connecting to public networks, and then to your institutional network?

WiFi hot spots provide a great convenience, but they also open your laptop to unsecured access. Every laptop with wireless capabilities must have a software firewall installed and operational. Settings on the wireless card must not permit peer-to-peer communication.

What about the infamous thumb drive? Small but dangerous. What is your policy on using these and other removable media?

3. Securing the data while being transported. Access via the public network requires the use of VPNs if you want to have any chance of protecting your networks and resources. The debate over SSL vs. IPSEC may require you to do some additional research or bring in outside assistance—but to select "neither" is unacceptable.

4. Securing the remote device itself. Portable devices tend to get lost or stolen. Web-enabled telephones may get passed on to another person when your employee upgrades—think of a portable device with passwords still stored in it in the hands of some teenagers! Educate employees with remote access privileges to the dangers involved.

**So, Here's My Advice...**

First, recognize that remote access is a reality that cannot and should not be stopped. It is progress that can provide tremendous opportunities for your institution. Instead of resisting it, look for more ways to use it to lower costs, improve productivity, enhance campus life, and potentially save lives.

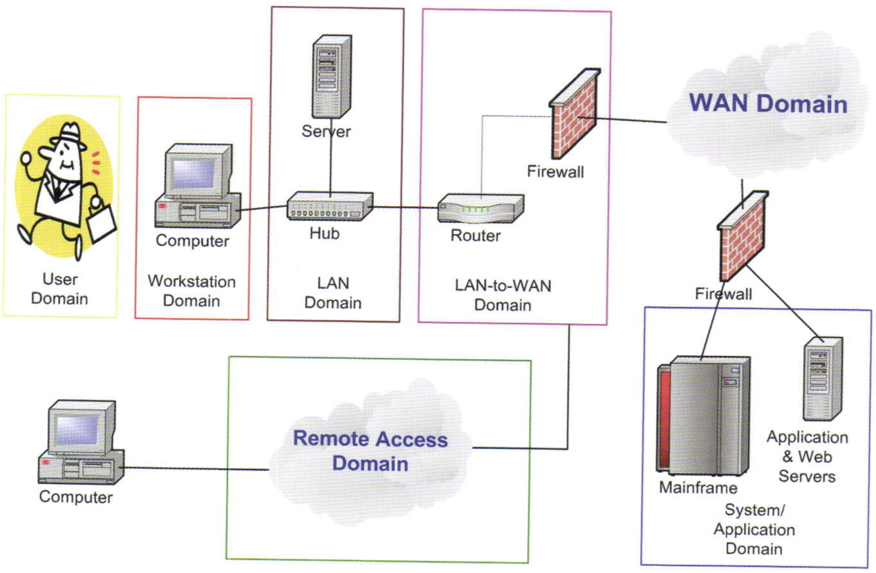
Then, set about the task of ensuring that remote access is as secure as possible. This will require you to communicate security policy to the departments that are installing IP-enabled devices and to enforce those policies. I suggest a preemptive strategy that has *you* taking the lead with campus executives to educate them of the possibilities *and* the true requirements to make it work in a secure manner. The sooner the security requirements are communicated, the more likely they will be budgeted and implemented as part of the remote-access project's budget. Educate campus executives about the need for and the costs associated with all of the following:

- Personal firewalls
- User authentication on the device
- Network authentication and authorization (including a policy-compliance scan of the device)
- Data encryption on the remote device
- Network encryption/VPN

If the projects still show a positive return on investment or are seen as worth the cost, then you have done your job to ensure that the network and institutional resources are not only accessible but also protected.

**Ron Walczak is the principal consultant at Walczak Technology Consultants, Inc., and a frequent contributor to the *ACUTA Journal.* Reach him at ron@walczakconsultants.com.**

Figure 1. Areas of Information Security Responsibility



## Here's My Advice

**Ron Walczak**
**Walczak Technology Consultants, Inc.**

# Broadband Access to Campus Resources

The rollout of broadband access to the residential community has created the ability to access campus resources with speed and reliability that rival on-campus connections. This high-speed method of off-campus access provides opportunities to improve efficiencies and reduce costs but unfortunately exposes your network to even more potential for abuse.

Broadband access is now delivered to our homes, offices, and handheld devices at costs that are low enough to encourage widespread use. My office is in a very small rural town in western Pennsylvania, yet I have a cable modem (4+ Mbps), a carrier wireless card (380–500 Kbps), and DSL (500 Kbps). Even my Treo Smartphone connects at 1.3 Mbps! Once you get over the depression of realizing that all this access from off campus has made your days *longer*—with no additional pay—you have to get serious about increased diligence to protect your institution's networks and assets.

### Great Improvements

The IP network now reaches beyond the server farm and into your institution's HVAC, building automation, fire panels, and other management and maintenance systems. The ability to remotely access these systems for maintenance and emergencies is a tremendous benefit that can save time, money, and even lives.

The facilities department now has the ability to manage and monitor environmental systems within buildings via the network. This leads to efficiencies and rapid response to malfunctions. Alarm reporting for a wide variety of systems and security via the IP network helps those responsible to have a longer "leash" without losing touch.

For example, we are currently designing a network of fire alarm panels that will report via the IP network—to the college's security department as well as directly to the fire department. The local fire chief will be able to monitor all building fire panels from his workstation. Talk about improving life safety!

### Increased Risk

Now the bad news: All this remote access increases certain risks while providing all those benefits. Whenever anyone gains remote access to your network, a variety of security issues arise. In his book *Network Security Assessment—Guarding Your IT Infrastructure*, David Kim, president and chief security officer of Security Solutions, Inc., provides great practical advice on how to address the seven domains of information systems security (see diagram on page 47). Remote access is just one of the areas, but it is critical.

Remote-access security concerns include, but are not limited to, the following:

1. Securing the data stored on campus: You must have firewalls installed to protect the application servers.

(continued on page 47)