Spring 2013

ACUTA Journal of Telecommunications in Higher Education

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Wireless Everything

5G’s Promise
Higher-Speed WLANs About to Emerge
DAS on Campus: Solutions for Wireless
The 10 Most Costly Pitfalls of DAS Deployment and How to Avoid Them
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# Events Calendar

<table>
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<tr>
<th>Event</th>
<th>Date</th>
<th>Location</th>
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<tbody>
<tr>
<td>Annual Conference</td>
<td>April 14–17, 2013</td>
<td>Manchester Grand Hyatt San Diego, California</td>
</tr>
<tr>
<td>Fall Seminar</td>
<td>October 6–9, 2013</td>
<td>Renaissance Grand Hotel St. Louis, Missouri</td>
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ACUTA's Mission is to advance the capabilities of higher education communications and collaboration technology leaders.

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
- Advocating the strategic value of information communications technologies in higher education
- Encouraging volunteerism and individual contribution of members
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CONNECT. COMMUNICATE. LEARN.
Technology for Building Next Generation Education Networks

Just as connections don’t have to be wired, communicating is a lot more than Facebook updates. And learning definitely shouldn’t be confined to lecture halls.

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Visit our booth, #500, at the ACUTA Annual Conference to see a demo of Bluesocket vWLAN
Traffic expectations are huge. By 2016, Cisco says one-quarter of mobile users will have more than one mobile-connected device, and 9 percent will have three or more mobile-connected devices. All will be competing for bandwidth.

Curt Harler, page 10
MAKING THE GRAGE COUNTS ON CONNECTIVITY

THAT’S WHY LEADING COLLEGES AND UNIVERSITIES COUNT ON TE CONNECTIVITY.

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Personal and leadership development are very important activities for me, and I have focused on these areas for many years. I believe not only in growing myself but also in helping to grow others. Leadership competencies play a key role in career development and help to strengthen efforts to develop world-class IT professional and technical staff.

I was fortunate to attend the MOR Associates IT Leaders Program (ITLP, www.morassociates.com) a few years ago. The three core elements of the training included leadership development, strategic thinking, and continuous improvement. This was an excellent experience and one that I felt was valuable to share with others.

In 2009, I was part of a group of fellow ITLP graduates at Indiana University (IU) who got together to create a program called the Emerging IT Leaders Boot Camp. This was a voluntary effort that was self-led and self-taught. The workshop is designed to bring together staff from across the central IT organization, UITS, create an environment conducive to establishing and building peer relationships, and through presentations and workshops provide applied learning opportunities to develop and retain top talent. The two-day, fast-paced workshop uses the leadership skills and competencies learned at the ITLP and delivers those skills to a group of emerging leaders who otherwise would not have the opportunity to learn such important tools.

The program has been very successful and very well received by the Boot Camp graduates. I want to share with you the process that we used to develop and deliver the program.

The Boot Camp meets on two days with roughly six weeks between sessions. The sessions are located off campus to discourage distractions from work to pull participants away. We are fortunate that we have a university-owned outdoor center called Bradford Woods, which provides a location equidistant between the two core IU campuses in Bloomington and Indianapolis with nice scenery and no wireless network.

The Boot Camp serves a cohort of 25 participants. This group is selected by nominations gathered from the UITS associate vice presidents (AVPs) and includes all divisions and campuses. The construction of the cohort is very intentional. While a majority of participants are new or emerging leaders, some more seasoned veterans are included intentionally for balance.

The content of the workshop provides the core of what the participants are there to learn. It was built with the lessons of the MOR Associates ITLP in mind and was a common curriculum for all the facilitators. Careful consideration was given to which ideas and concepts were most important to deliver in a fairly short introductory workshop. The planning team started with the 15 competencies important for IT leaders that were part of the ITLP curriculum. We decided on seven competencies to teach in the Boot Camp. These competencies are:

- Working across the organization
- Developing partnerships
- Communication; presence
- Strategic thinking
- Putting customers first
- Coaching
- Shared leadership

We constructed the Boot Camp curriculum with the idea of balancing group activities with presentations to keep the participants engaged. We also included a group project with the goal of creating
an opportunity to think strategically, practice collaboration, practice communicating ideas, and most important practice providing and accepting constructive feedback. The group presentations were done during the day-two session.

Session topics included strategic thinking and leading from the balcony, the 360-Degree Leader, communication and presentation skills, and peer coaching. The most popular presentations were the Leadership Journeys that were done by UITS AVPs and from Boot Camp alumni. We mixed in some thought-provoking videos and ended each session with a feedback opportunity using the plus/delta tool. Figure 1 lists some of the pluses and deltas from the workshop.

We provided a take-away for the participants that they could post in their offices to remind them of the key leadership lessons learned. Below is the card:

<table>
<thead>
<tr>
<th>Pluses</th>
<th>Deltas</th>
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<tr>
<td>Meeting coworkers from other divisions/campuses</td>
<td>More healthy snacks</td>
</tr>
<tr>
<td>Location (away from work)</td>
<td>Location issues (temperature, loud noises)</td>
</tr>
<tr>
<td>Leadership Journeys</td>
<td>No wireless connection</td>
</tr>
<tr>
<td>Speed relating (communication activity)</td>
<td>No advanced warning about the group project</td>
</tr>
<tr>
<td>Keep group project a surprise</td>
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About four months after the Boot Camp we did a follow-up survey of the participants and their managers to determine how the leadership lessons were being used in their daily work activities. This information was invaluable with helping the planning team work on the next workshop.

We created a Boot Camp project area on the IU learning management system that includes leadership articles and information from the workshop sessions. It also includes a recommended reading list for emerging leaders. That list is below.

There are more elements to creating a Boot Camp that I have not mentioned here, such as how to coordinate such an event and how to obtain funding. My intention is to pique your interest and curiosity in pursuing a leadership Boot Camp at your campus. As you read the articles in this "Everything Wireless" issue of the Journal, you will surely agree with me that the rapid pace of change and the evolution of technology on today's campus provide abundant leadership opportunities. Building leadership competencies in yourself and your staff will strengthen your whole organization. So, pass it on....

**Recommended Reading**

- *What Got You Here Won't Get You There*  
  Marshall Goldsmith and Mark Reiter
- *Made to Stick: Why Some Ideas Survive and Others Die*  
  Chip Heath and Dan Heath
- *The Tipping Point*  
  Malcolm Gladwell
- *Blink*  
  Malcolm Gladwell
- *You Don't Need a Title to Be a Leader*  
  Mark Sanborn
- *Good to Great*  
  Jim Collins
- *Train Your Brain, Change Your Mind*  
  Sharon Begley
- *The 360° Leader*  
  John Maxwell
- *The Invention of Air*  
  Steven Berlin Johnson
- *The Ghost Map*  
  Steven Berlin Johnson
- *Where Good Ideas Come From: The Natural History of Innovation*  
  Steven Berlin Johnson
- *Micro Messaging: Why Great Leadership Is Beyond Words*  
  Stephen Young
- *Effectively Influencing Decision Makers*  
  Marshall Goldsmith
Revelations from the ResNet Survey

In October I spoke at the PCIA Wireless event, representing higher education and the impact of BYOD on the campus. What resonated with me during the preparation of my remarks was the fact that not only are our students driving the “Everything Wireless” trend on campus, but so are our faculty, administrators, and, in many cases, patients, doctors, nurses, and healthcare administrators.

In higher education we embrace the explosion of our mobility needs. To accurately translate the wireless demands of tomorrow’s students, ACUTA conducted research and published the first annual State of ResNet Report in 2012, establishing a baseline from which to monitor resnet trends and practices across higher education for at least five years.

Regarding this study, Joseph Harrington, ACUTA immediate past president and director of networking at Boston College, commented, “An unprecedented perfect storm is forming on the horizon of network technology while IT budgets tighten across the country. With this study, ACUTA will begin to shed light on diverse practices, actively contribute to developing standards, and provide a central knowledgebase that will better equip IT administrators to make decisions for the future.”

This year, for a second time, ACUTA contracted market research firm Forward Analytics to perform the resnet industry research and to report quantitative market intelligence that can benefit higher-education IT departments and enhance residential computer networking available to college and university students.

The 2013 ResNet Trends and Practices Across Higher Education (www.acuta.org/resnet) is based on an online survey targeted at higher-education IT and business leaders. Forward Analytics worked closely with ACUTA and NACUBO representatives to design the 2013 survey. While similar to the 2012 questionnaire, this year’s survey garnered more in-depth data regarding issues that were presented in the earlier study.

A total of 280 surveys were completed, representing 251 universities or colleges (28 institutions had multiple respondents). With a sample population of 1,700 U.S. higher-education institutions, the response rate represents a statistical significance of +/- 5.7 percent at the 95 percent confidence interval. This means that with 251 unique institutional respondents, it can be said that if the survey were repeated 100 times, 95 in 100 times the research findings would vary at most by +/- 5.7 percent. This level of sampling is deemed significant for supporting business decisions and strategic planning.

As the report’s executive summary points out, higher-education institutions may be an unlikely top-of-mind answer to some when it comes to organizations at the cutting edge of communications technology, but they are quite in a league unto themselves. As universities and colleges drive to provide faculty and students with the most powerful and efficient access to information, they are required to architect, deliver, and support the full spectrum of commercially available services including phone, Internet, TV, tablets, desktop and laptop computers, video systems, smartphones, game boxes, smart TVs, iPods, ebook readers, handheld game consoles, and wireless printers—all this at a large scale and consumed by a diverse population of users.

The 2013 ACUTA/NACUBO resnet study reveals that the megatrend, the seismic increase in the number of Internet-connected devices over the past several years, is not showing any signs of slowing. Correspondingly, high-bandwidth applications and streaming services continue to proliferate as well. And, in response, institutions have increased the Internet bandwidth and speed dedicated to their residential networks over the past year. But, we find that the “tipping point” has not yet been reached when wi...
less Internet will render older technologies, such as landline phones and wired Ethernet, obsolete. Therefore, schools are challenged with keeping up with the new and maintaining the old.

At the center of this puzzle are higher education's CIOs and IT departments responsible for managing the technology, infrastructure, lifestyle, and costs. Bandwidth and connectivity/coverage requirements are increasing just as the cost to deliver these services is on the rise.

The 2013 study shows that 61 percent of surveyed universities and colleges expect the cost of providing residential networks to increase. But only 38.8 percent of the institutions saw an increase in the operating budget devoted to resnet. Nearly 10 percent of institutions experienced a decrease in the operating budget devoted to resnet. What's more, the expectation is to provide premium, high-performance, uninterruptible network service, despite the fact that the budgets, vendors, and buyers rarely correspond in a direct or neat business fashion. The resnet study reveals that the majority of universities and colleges (61.3 percent) are concerned or very concerned about the ability of their campus to support future demands on the residential network.

Key highlights of the 2012 study include the following:

- A large majority (68 percent) of institutions allow students unlimited access to the residential network.
- More than 62 percent do not monitor bandwidth consumption.
- Nearly 50 percent of IT departments do not recover the cost of supplying bandwidth to residential networks.
- Nearly 60 percent of institutions cite a total capacity below the 500 Mbps threshold.

Less than 10 percent of schools offer around-the-clock support, and more than 65 percent of residents can only access support by phone.
- Only 9 percent of higher-education institutions presently outsource any significant portions of their residential network. However, increasing numbers of CIOs are now considering this as a viable alternative to in-house operations.

The 2013 ACUTA/NACUBO ResNet Trends and Practices study provides a re-measure of the above issues but also explores how the universities and colleges are reacting to the many challenges of resnet.

Please reference the infographic on pages 20–21 and the following elucidating articles for a powerful translation of the "Everything Wireless" demands and requisite support we must provide today for all involved in higher education.

Many thanks to ACUTA members who took the time to respond to our surveys, allowing us to present an up-to-the-minute picture of residential networks.

Reach Corinne at choch@acuta.org.
5G’s Promise: 1,000 x Capacity, 1,000 x Challenges

Most campuses have 3G cellular service. Quite a few have 4G. At the Polytechnic Institute of New York University (NYU-Poly), researchers are working on 5G. NYU-Poly is a private technology university in Brooklyn. Its researchers already have a glimpse of the future in their 5G design, so it is only fair that those who will administer those 5G networks get a sneak peek at what is in the offing.

For starters, 5G will offer at least 1,000 times the capacity of today’s expanding 4G network. That means colleges with hospitals and medical schools attached must prepare for telemedicine applications via cell phone or tablet computer. Architecture or engineering students and faculty will expect to share design drawings via mobile 5G. Theater majors will zip entire movies—not just clips—over the network. All faculty, students, and administration will want the same capabilities.

Everyday downloads to mobile devices will become faster and easier. Buffering for videos or music downloads could well become a thing of the past. One thing is for sure: If the change-over is anything like the move from 3G to 4G, then 5G will add to the traffic on the network.

Currently, a 4G connection generates 28 times more traffic than a non-4G connection, according to a 2012 report from Cisco. There are two reasons: First, many 4G connections are for broadband routers and laptops, which have a higher average usage. Second, higher speeds encourage the use of high-bandwidth applications, so a smartphone on a 4G network is likely to generate 50 percent more traffic than the same model smartphone on a 3G or 3.5G network.

As mobile network connection speeds increase, the average bit rate of content accessed through the mobile network will go up. High-definition video will rule. Mobile video is expected to grow at 90 percent compounded annual growth rate (CAGR) from now to 2016. Cisco figures mobile video will have the highest growth rate of any mobile application. Of the 10.8 exabytes per month crossing the mobile network by 2016, 7.6 exabytes will be video.

If there is any lingering doubt about the demand for bandwidth, cell phone giant Ericsson, in a June 2012 report, notes that total smartphone subscriptions, which reached 700 million last year, should reach three billion in 2017. Total subscriptions of data-heavy devices will grow to 3.8 billion by 2017. This includes smartphones, mobile PCs, and tablets with cellular connectivity.

Keep in mind that a single smartphone can generate as much traffic as 35 basic-feature phones; a tablet as much traffic as 121 basic-feature phones; and a laptop as much traffic as 498 basic-feature phones.

Mobile data traffic doubled between 2011 and 2012 and was up 19 percent between Q4 of last year and Q1 of this year. It shows no sign of slowing. Where will we find the bandwidth? One answer might be 5G technology.

Demand Is a Given

Power users probably are muttering, “About time!” That is because cell phones in the United States typically operate at about half the speed of phones in Japan. Users are hungry for speed and enhanced capability. ACUTA members should rest assured that the college crowd will be among the early 5G adapters . . . when it hits the market.

“Bandwidth-hungry devices are doubling wireless spectrum demand every 12 to 18 months,” says professor Shivendra Panwar, principal investigator on the NYU-Poly 5G project. “4G wireless networks increased the efficiency of spectrum usage, but this project pursues disruptive technologies that will significantly relieve the pressure.”
College campuses are hotbeds of bandwidth power users. Network administrators and planners need to keep in mind that the top one percent of mobile data subscribers generate 24 percent of mobile data traffic. That number is actually down from 35 percent in 2010. According to a mobile data usage study conducted by Cisco in 2011, mobile data traffic evened out over the last year and now approaches the 1:20 ratio that has been true of fixed networks for several years.

It is so bad that Cisco, in its report, stated that mobile network connection speeds grew 66 percent that year. Globally, the average mobile network downstream speed in 2011 was 315 kilobits per second (kbps), up from 189 kbps in 2010. The average mobile network connection speed for smartphones in 2011 was 1,344 kbps, up from 968 kbps in 2010.

As smartphones come to represent a larger share of 4G connections, the gap between the average traffic of 4G devices and non-4G devices will narrow, but by 2016 a 4G connection will still generate nine times more traffic than a non-4G connection.

AT&T Wireless claimed it would be out of capacity within another year if it did not get more bandwidth. Granted, that statement was motivated by AT&T’s desire to acquire T-Mobile and that company’s spectrum. Even though that did not go through, Verizon, AT&T, and every other wireless provider on the planet are looking for more spectrum.

Cisco numbers put mobile video usage at a 25-fold increase between 2011 and 2016, accounting for over 70 percent of total mobile data traffic by the end of the forecast period. Where will we find the bandwidth?

Today’s Wireless Options

Since personal cell phone users compete with security, aviation, military, video-streaming operations, and even taxi companies for bandwidth—bandwidth that users want available on-the-go—there is little doubt that competition for spectrum will be extreme.

There is a rush on to find ways to use existing spectrum more efficiently rather than create new technologies. “That’s the easy way to do it,” Panwar says. Any engineer knows that “easy” is usually efficient, too. However, in a couple of years the crunch will be real.

One tactic competing with 5G is the cognitive wireless approach to bandwidth. Under the cognitive...
Rappaport and Panwar are looking at a five-year time horizon in their work.

First, however, they caution that there is no such thing as "5G" today. "It's just a cute name we came up with," Panwar says. "The standards bodies will determine what it eventually becomes."

That said, the technology they are developing will likely end up on campus as 5G. Unlike current cellular spaces, there is a lot of high-frequency, millimeter-wave space available (millimeter technology is the 30-300 GHz area where the frequencies are measurable in millimeters).

5G, as envisioned today, would be in the 60 GHz area. "The area has promise," Panwar says. "There is more spectrum in that range than there is in all the spectrum areas you are familiar with for TV, cellular, and Wi-Fi."

There are challenges with 5G. For one thing, 60 GHz's reach is quite short today... more appropriate for connecting desktop devices or linking computers to printers across a room. Rappaport is betting on, and working on, a solution to allow 5G signals to reach 200 meters. That is still woefully short of the current cell site signal radius of a mile or so. However, sites in busy urban centers may serve a cell as small as a few hundred yards today. If and when Rappaport's group develops the enabling technology to reach 200 meters, the convergence of cell towers' shorter reach and longer 60 GHz technology may make it all work.

Perhaps more serious is the problem current 60 GHz technology has penetrating brick and stone. While 60 GHz does fine going through drywall, it is a rare college campus that does not have brick and stone structures. At the University of Maryland, for example, the ubiquitous brick buildings would create a 5G nightmare.

Panwar has an answer to that challenge—one already available: repeaters or femtocells. Femtocells are small, low-power cellular base stations that extend a signal into hard-to-reach areas. Panwar envisions colleges putting a femtocell in every large block or quad to cover people walking or moving about.

For users served by operator-owned femtocells and picocells, a sizable proportion of traffic generated by mobile and portable devices would be offloaded from the mobile network onto the fixed network. It already is happening. As a percentage of total mobile data traffic from all mobile-connected devices, mobile offload should increase from 11 percent (72 petabytes/month) in 2011 to 22 percent (3.1 exabytes/month) in 2016, according to Cisco's projections. Without offload, global mobile data traffic would grow at a CAGR of 84 percent instead of 78 percent.

Tall buildings have a way of blocking radio signals. The answer there is easier—more 5G signal hand-offs or directional hand-offs. Cell towers can spread their energy in all directions. But pencil beams allow one-directional signals to navigate narrow building canyons. Of course, the network would have to be able to track an individual's device as the person moved from one confined area to another.

"We are working on that to extend the range and get a better signal," Panwar says.

Traffic expectations are huge. By 2016, Cisco says one-quarter of mobile users will have more than one mobile-connected device, and 9 percent will have three or more mobile-connected devices. All will be competing for bandwidth.

Note that 5G is expected to utilize current or slightly improved versions of existing technology. All of those 4G and 3G devices will not disappear. "This [5G] will not wipe out the old technologies. It will work with current technology," Panwar promises. He notes that even old, 2G cell phones still work just fine on 4G networks and still are supported.
While he hopes to see the eventual incarnation of 5G overlaid on today’s 3G and 4G networks, “This is not the only way things can evolve,” Panwar acknowledges.

**Behind the Research**

However, it is a workable vision for wireless. This is not pure research. There are both public and private groups supporting the work being done by Rappaport and Panwar. NYU-Poly is working with a consortium of government agencies and businesses as they lay the foundation for 5G cellular networks. The money to support the 5G project is there. The National Science Foundation awarded them an Accelerating Innovation Research grant of $800,000. This was matched by $1.2 million from the Empire State Development Division of Science, Technology, and Innovation, which supports the project based on its longstanding partnership with NYU-Poly’s Center for Advanced Technology in Telecommunications.

Industrial partners include InterDigital, National Instruments, and faculty startup company Ascension Laboratories. They contribute not just money and brainpower but also critical equipment, according to Panwar.

In a prepared statement, NYU-Poly president Jerry M. Hultin said, “This new collaboration will significantly accelerate the progress toward 5G, and it exemplifies the power of NYU-Poly’s philosophy of i2e: invention, innovation, and entrepreneurship. The team is built of experienced faculty entrepreneurs and highly innovative researchers. Students will learn how to create products and companies, working beside these professors and researchers from blue ribbon companies.”

Rappaport started work at NYU-Poly in April 2012 after being appointed in March to lead the new initiative in wireless communications engineering and research. He had previously been at the University of Texas Austin and founded research programs at Virginia Polytechnic Institute.

Rappaport teaches at NYU-Poly’s Electrical and Computer Engineering Department and NYU’s Courant Institute. He also is the director of the National Science Foundation Wireless Internet Center for Advanced Technology research center. He is the founding director of NYU Wireless, the first academic research center to combine engineering, computer science, and medicine.

Rappaport is no stranger to wireless innovation. He is a pioneer in radio wave propagation for cellular and personal communications, wireless communication system design, and broadband wireless communications circuits and systems at millimeter-wave frequencies. His research influenced many international wireless-standards bodies, and he and his students invented the technology of site-specific radio frequency (RF) channel modeling and design for wireless network deployment—a technology now used routinely throughout wireless communications.


**Work for ACUTA Members**

ACUTA members should be prepared to do a lot of down-and-dirty negotiation with all of the wireless providers who serve their area. If you think that negotiating contracts for tower space on tall buildings was a hoot…you ain’t seen nothing yet!

With 5G, there will be many more, smaller cells required to provide the coverage users will demand. Expect to be approached by multiple wireless carriers who...
will want to put cell sites, femtocells, and all manner of other technology at key spots around campus.

Whether the college limits itself to working with one preferred wireless provider or services all is a policy (and, perhaps, regulatory) consideration for administration. Even more challenging might be resolving issues around fiber use. All of those bandwidth-hogging cell signals will require backhaul on fiber or point-to-point microwave.

In 2011, according to Cisco, 72 petabytes of smartphone and tablet traffic were offloaded onto the fixed network each month. Without offload, traffic originating from phones and tablets would have been 217 petabytes per month rather than 147 petabytes per month in 2011.

A college that owns dark fiber will find itself in the driver’s seat when it comes to negotiating with wireless providers.

Any college telecom or IT person familiar with Wi-Fi should not have too much problem keeping up with the network management side of the issue. Remember, there already is cross-competition with Wi-Fi and cellular. 5G is simply the same story told faster.

Security is one area where ACUTA members can rest easier. Today, most of network management and security requirements are handled by the telco. There is no reason this should change for 5G.

However, all of these points need to be delineated on a college’s quality-of-service and service level agreements to ensure that the bandwidth, security, and availability are up to snuff.

What Is Coming

Coverage and data speed drive user satisfaction. Coverage where people need it and a fast and reliable connection to the Internet are “must-haves” for smartphone users. This reflects the need to be constantly connected and to have a positive smartphone experience. In real-world terms, what we need are shorter average page-load times, a more consistent user experience, and elimination or minimization of page-load failures.

On average, Ericsson figures a mobile PC generates four times more traffic than HT (high traffic) smartphones with upper-end operating systems. At the end of 2011, the average mobile PC generated 2 GB per month versus 500 MB per month produced by HT smartphones. An average smartphone generates around half of the volume of an HT smartphone. By the end of 2017, a mobile PC will generate 8 GB per month and a smartphone just over 1 GB.

However massive the final outcome, there are economic, business, and policy issues that need to be addressed to facilitate any iteration of 5G.

Rappaport, Panwar, and their team are well aware of the probable impact of 5G on the American economy. While U.S. firms do quite well on the device side of the wireless business—witness Apple and Android systems—they are almost totally out of the world market in base stations and the like.

Panwar is clear that they hope the core 5G technology is kept here in the United States even if, as in Qualcomm’s case, much of it eventually gets licensed to overseas firms.

“Our intent is that, like CDMA, it will be done in the United States,” Panwar says. However, he concludes, any time one deals with technology, there are uncertainties. That given, ACUTA members still should have a strategy for 5G simmering on the back burner. Those five to seven years have a way of coming around awfully fast.

Ericsson says that, with an increased number of subscriptions, evolved devices, and 24/7 connectivity, global mobile data traffic will grow by 1,500 percent by the end of 2017. Access to the Internet is a prerequisite and will drive further build-out of mobile networks. By 2017, an astonishing 85 percent of the world’s population will be covered by WCDMA/HSPA networks, Ericsson projects.

That’s the good news. Cisco’s study projects that monthly global mobile data traffic will surpass 10 exabytes in 2016. Not all of it will be on your campus. Sometime in 2014, the average mobile connection speed will surpass 1 Mbps. Usage on handsets will exceed 50 percent of mobile data traffic in 2014.

Where will it end? Sometime in 2012 there were over 100 million smartphone users who became members of the “gigabyte club,” using over 1 GB per month. At about the same time, the number of mobile-connected devices exceeded the world’s population. Tablets will exceed 10 percent of global mobile data traffic, and monthly mobile tablet traffic is expected to surpass 1 exabyte per month. The truth is, when the human mind sets to work on technological solutions, there is no end.

Curt Harler is a contributing editor for the ACUTA Journal and a freelance writer who specializes in technology topics. Reach Curt at curt@curharler.com.
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Higher-Speed WLANs About to Emerge

Paul Korzeniowski

Faster, faster, faster . . . that is the mantra for all networking technologies. As a result, wireless LANs, which have been operating at a few hundred Mbps, are about to jump to the Gbps range, an increase that could help academic institutions. “The rapidly-increasing number of mobile users, devices, and applications on campuses are correspondingly driving demand for bandwidth expansion on wireless LAN networks,” says Craig Mathias, a principal with the wireless and mobile advisory firm Farpoint Group.

However, the anticipated upgrade comes with a few caveats. Compliant products are in an early stage of development, so it could be difficult for academic institutions to find all of the pieces they need. Vendors have devised new signaling techniques, but they may not deliver as much throughput as advertised. Finally, the first wave of devices is expected to be expensive, so schools may find it difficult to cost-justify their purchase.

Despite these challenges, expectations are that the new solutions will quickly find a home in academic networks. “We expect that in early 2013, the availability of 5 GHz radio smartphones will stimulate a new phase in demand for 802.11ac products,” predicted Chris DePuy, vice president, Carrier IP Telephony, Wireless LAN, and Wireless Packet Core Market Research at the Dell’Oro Group. Because of that boost, the firm expects worldwide revenue for wireless LAN equipment to reach $9.9 billion in 2016, a 52 percent increase over its 2011 mark.

Wireless Networks Mesh with Universities’ Needs

Wireless LAN usage on college campuses has been growing because these networks have been a good fit for academic institutions. In the classroom, many students already work with laptops, and increasingly they are toting smartphones and tablets to class. Also, students are a nomadic user group and therefore less likely to work from the same location year after year. Finally, many schools are expanding their campus footprints and need a quick and simple way to set up new network connections.

As a result, wireless is becoming the networking option of choice on many campuses. “I fully expect our wireless network to carry the majority of traffic across our campuses within the next five years,” says Eric Hawley, vice president of information technology for Utah State University. The university has deployed more than 1,000 Meru Networks access points to support more than 27,000 students and faculty working on six campuses across the state.

But these networks need more bandwidth. The BYOD (bring your own device) movement is unstoppable. Increasingly, end users are dictating what technology they will use on campus. Many students, faculty, and employees purchase new smartphones or tablets at lunch and immediately connect them to campus networks. These devices are powerful and eat up a lot of bandwidth.

Video’s Ripple Effect

Another factor driving bandwidth demand is that video has become a popular application for both academic and recreational use. Increasingly, teachers are integrating video into their presentations in order to make them more effective. Students also spend a great deal of time on sites like YouTube as well as downloading movies and TV shows and watching them on either a desktop PC or a portable device. Finally,
many video presentations are moving away from standard displays to HD-quality presentations, which are bandwidth intensive.

The latest bandwidth boost falls under the bailiwick of the Institute of Electrical and Electronics Engineers (IEEE), which has been responsible for wireless LAN standards since 802.11 emerged in 1997. As the work on bandwidth upgrades has become more complicated, the development cycles have taken longer, as shown in Figure 1. The initial enhancements were completed in a few years, but now, a handful of years are passing between performance boosts.

Figure 1. The 802.11 Family Tree

Standard | Top Speed | Final Ratification
--- | --- | ---
802.11 | 2 Mbps | June 1997
802.11a | 54 Mbps | September 1999
802.11b | 11 Mbps | September 1999
802.11g | 54 Mbps | June 2003
802.11n | 450 Mbps | October 2009
802.11ac | 1.5 Gbps | Sometime in 2013

With the latest upgrade, the group increased the speed of each link. The fastest current WLAN, IEEE 802.11n, maxes out at around 150 Mbps on one antenna, 300 Mbps with two, and 450 Mbps with three antennas. In comparison, the emerging 802.11ac specification promises to deliver roughly three times more bandwidth: 450 Mbps, 900 M bps and 1.35 Gbps respectively.

The increase comes from a series of changes made to the underlying network protocols. The new specification operates solely in the 5 GHz frequency range; previous versions operated in the 2.4 GHz band as well as the 5 GHz band. The 5 GHz offers a number of potential benefits. The 2.4 GHz range is prone to interference because it is used for a variety of wireless devices, such as Bluetooth peripherals, microwave ovens, and baby monitors. The new band is used solely for wireless LANs.

**Wireless Pipes Get Fatter**

In addition, the 5 GHz band offers more bandwidth than its predecessor. In North America, the 2.4 GHz band has 83.5 MHz of total bandwidth while the 5 GHz band has a total of 495 MHz, which means that the 5 GHz range can carry almost six times as much traffic as the 2.4 GHz range can. As a result, 802.11ac offers wider connections and more flexibility than its predecessors: The new devices support 20 MHz, 40 MHz and 80 MHz channels compared to 20 MHz and 40 MHz with the older networking techniques. The wider the channel, the fatter the transmission pipe, and the more data users can push through it.

Starting with the 802.11n specification, engineers have been adding speed by bonding channels, basically connecting two adjacent channels into one transmission line and effectively doubling the available throughput. With 2.4 GHz, only three of the 11 available channels could be linked. With 5 GHz, that feature is capable on all 11 channels.

Also, the previous specifications supported MIMO (multiple input, multiple output) spatial streams. Here, multiple antennas are used at both the transmitter and receiver to increase data throughput without adding bandwidth or increasing transmission power. Basically it spreads the same total transmission power over multiple antennas to achieve more bits per second per hertz of bandwidth. 802.11n specified up to four MIMO spatial streams; 802.11ac doubles that number to eight MIMO spatial streams.

Another plus is greater reliability, which comes from more antenna diversity, another new feature. With 802.11n, MIMO could only be used for a single client at any given time, while 802.11ac improves on this by supporting multiple clients simultaneously.

**Improved Network Throughput**

Beamforming (see page 12) also enhances system performance. Here, the network device detects incoming signals and sends feedback to the transmitter, which can adjust the phase and amplitude of the signals at its antennas. This feature was optional with 802.11n but will be incorporated into the silicon for all 802.11ac systems.
The new specification features a different modulation technique. The emerging standard supports 256 QAM (quadrature amplitude modulation), which is a way to modulate radio waves when transmitting data. 802.11n maxed out at 64 QAM, so the advent of 256 QAM should deliver significant throughput improvements.

Yet, the new standard faces some hurdles before it will be widely adopted. First, time passes from when a new standard is drafted to when customers can purchase compliant devices, and 802.11ac is still evolving in that area. The IEEE completed a first draft of the standard in July 2011. Final approval (an often time-consuming process) is anticipated for sometime in 2013.

The First Wave of Products Begins to Arrive

However, once a standard hits draft status, vendors start developing products, and that has been the course that 802.11ac has followed. The vendors' work began with network chipsets and components and has been gradually extending to network devices. In November 2011, Quantenna Communications released an 802.11ac chipset designed for consumer Wi-Fi routers. Broadcom Corp., which has been a leader in the Wi-Fi space, outlined its plans at the CES show in January 2012. Qualcomm, with its Wi-Fi expertise and technology coming from its Atheros acquisition, also started shipping 802.11ac products in 2012. Redpine Signals developed a low-power 802.11ac technology for smartphone application processors.

With those elements falling into place, compliant network solutions have begun to emerge—although the bulk initially has been geared to the consumer market rather than to the enterprise. In April 2012, Netgear announced new high-speed 802.11ac routers, and in May, Buffalo Technology unveiled a wireless router and client bridge adapter.

As the devices begin to arrive, schools will have to determine how well they will function. Theoretically, 802.11ac Wi-Fi radios could take advantage of all of the new promised features. However, it is expected that first-generation devices will support some but not all of the new features. For instance, the eight MIMO spatial streams and use of 256 QAM may not be included in first-generation products, so maximum throughput will be available only in future releases.

Reading the Fine Print

Even when those features arrive, it is unclear how much of a performance boost schools will receive. As with previous Wi-Fi standards, the speeds touted in the promotional materials are theoretical maximums and more than what users typically experience. In some cases, the actual throughput may be 20 to 30 percent less than the promised high-water marks.

Another issue is that the new devices use a great deal of electricity, which could cause battery problems. Part of the reason for the increase is the use of proprietary power-management functions, and another factor is simply the higher throughput that 802.11ac offers. Battery drain could be a significant problem for mobile devices such as laptops, smartphones, and tablets.

As noted, the IEEE standard likely will not be finally ratified until sometime in 2013. Schools may be a bit leery of deploying such systems because the Wi-Fi Alliance has not yet issued interoperability criteria for 802.11ac devices. Consequently, academic institutions could run into compatibility problems if they mix and match different vendors' products. When first-generation 802.11n products arrived, there were snafus connecting different systems. Because 802.11ac relies on a number of new features, similar problems may arise.

Managing Complexity

The vendors will have to put more advanced management functions in place for several reasons. Networks are becoming denser: Institutions are serving several thousand access points and tens of thousands of users. Also, networking technology is starting to take advantage of virtualization technology, which improves system performance but makes management of different devices more difficult. Older management tools cannot support these new functions.

Pricing is another open issue. The expectation is that early users will pay a premium for the faster speed. Estimates are that first-generation products will be 20 to 50 percent higher than comparable 802.11n devices. Pricing is expected to decline as sales ramp up and suppliers have a larger base to spread their development costs over.

None of the possible implementation issues appears to be a showstopper. In fact, when previous versions of 802.11 have gone through similar transitions, a few bumps with the early implementations have been followed by a rapid uptick in product sales. The new specification is expected to be completed in 2013, the first wave of installations is moving into the pipeline, and significant deployments are expected in the next few years.

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In November and December of 2012, the Association for Information Communication Technology Professionals in Higher Education (ACUTA) and the National Association of College and Business Officers (NACUBO) conducted the second annual long-term study of Residential Networking (ResNet) practices across the United States. ResNets provide connectivity to students living in the residence halls of higher education institutions. A total of 280 surveys were completed by IT and business officers who represent 251 universities or colleges in 44 states. Key findings of the survey are reflected in this “State of the ResNet 2013” infographic.

The 2013 report reveals schools rising to meet bandwidth demands but struggling to manage escalating costs amid tightening budgets. It is the second installment of a comprehensive five-year tracking study to measure the broad variation in residential networking trends and challenges facing universities and colleges across the country.

ACUTA and the National Association of College and University Business Officers (NACUBO) have published the 2013 ACUTA/NACUBO State of ResNet Report, casting a spotlight on important residential networking issues and challenges facing universities. It is also the first time that respondents extend beyond State of the Residential Network 2013.
The ACUTA/NACUBO Study paints a vivid picture of the intensifying tug-of-war between rising ResNet costs and tightening budgets at many of our nation's universities and colleges, said Dee Childs, ACUTA Environmental Scanning Committee chair, who is the associate provost and CIO of the University of Alabama in Huntsville. "It is our hope that the study will provide a comprehensive and coherent inventory of practices, perceptions and priorities to help administrators rise to the challenges of the coming years."

"Reaping the rewards of technological leaps while maintaining both administrative and budgetary efficacy is a delicate balance for administrators," John Walda, NACUBO President and CEO, adds. "The ACUTA/NACUBO Study provides a positive step toward fostering greater cooperation and dialogue among stakeholders and an important contribution to helping higher-education institutions develop successful ResNet strategies."

Key highlights of the report are incorporated into this infographic. The full report is available on the ACUTA website at www.acuta.org.
LTE: The Next Wave of Wireless Evolution

James S. Cross, PhD
Ray Horak

What would the ideal wireless technology provide? Improved HD audio? Better video conferencing? Data rates of 1 Gbps? Maybe even carrier aggregation? Get ready, LTE is coming.

The next wave of the wireless evolution continues to build momentum in the business and public sectors. College and university mobile phone users will continue to find compelling reasons to trade up as new smartphones are launched with dual-core processors and near-field communication chips in support of an incredible array of apps that seems to grow exponentially day by day. Although the academic community continues to be challenged by budgets that are not only tight but also shrinking, Long Term Evolution (LTE) is poised to provide relief.

What Is LTE?

According to self-proclaimed techno-geek Neal Gompa, “To most it is a faster network technology. To network operators around the world, it is a way to simplify their infrastructures to reduce costs while improving the quality of their offerings to subscribers. ...In the end, it is Long Term Evolution of the Universal Mobile Telecommunications System (UMTS).” (www.extremetech.com/mobile/110711-what-is-lte) Gompa calls it an “easily deployable network technology, offering high speeds and low latencies over long distances...[It’s] what the 3GPP (3rd Generation Partnership Project, the group responsible for standardizing and improving UMTS) designates as their next step.”

Also known as E-UTRAN (Evolved Universal Terrestrial Access Network), LTE is the access part of the Evolved Packet System (EPS). Initiated in 2004, the LTE project focuses on enhancing the Universal Terrestrial Radio Access (UTRA) and optimizing radio access architecture. It is an evolution of the GSM/EDGE and UMTS/HSPA network technologies standards and provides increased capacity and speed using new modulation techniques.

According to 3GPP, the goal of LTE is to increase spectral efficiency, increase peak data rates and increase frequency flexibility. Thereby LTE improves the capacity and speed of wireless data networks. A further goal was to redesign and simplify the network architecture to an IP-based system with significantly reduced transfer latency compared to the 3G architecture.

How Does LTE Work?

LTE is a standard for greatly simplified access to a high-speed packet-switched network. According to Gompa, it “doesn’t have the capability to handle voice calls and text messages natively (which are typically handled by circuit-switched networks like GSM and CDMA). The LTE SAE (System Architecture Evolution) is essentially a simplified version of the one used for UMTS networks today.

“LTE uses two different types of air interfaces (radio links), one for downlink (from tower to device), and one for uplink (from device to tower),” says Gompa. “By using different types of interfaces for the downlink and uplink, LTE utilizes the optimal way to do wireless connections both ways, which makes a better optimized network and better battery life on LTE devices.”

According to the 3GPP, LTE capabilities include the following:

- High-order modulation: Up to 64QAM
- Scalable bandwidth up to 20 MHz
• Downlink peak data rates up to 300 Mbps with MIMO transmission (up to 4x4)
• Uplink peak data rates up to 170 Mbps
• Operation in both TDD and FDD modes
• Increased spectral efficiency over Release 6 HSPA by two to four times
• Reduced latency: Up to 10 milliseconds (ms) round-trip times between user equipment and the base station, and to less than 100 ms transition times from inactive to active.

LTE Origin

The world’s first publicly available LTE service was launched in Oslo and Stockholm in December 2009. Although LTE is the natural upgrade path for carriers with GSM/UMTS networks, CDMA holdouts such as Verizon Wireless, who launched the first largescale LTE network in North America in 2010, and KDDI in Japan have announced they will migrate to LTE, as well. As a result, LTE is poised to become the first truly global mobile smartphone standard. Note: The frequency bands used vary from country to country. North America uses 700/800 and 1700/1900 MHz; Europe, 800, 1800, 2600 MHz; Asia, 1800 and 2600 MHz; Australia, 1800 MHz; and Brazil, 450 MHz. The variation in frequency bands from country to country translates into a requirement for multi-band mobile devices, much as is the case with contemporary cell phones.

Smartphone Demand Driven by Apps

Contemporary computing and communications technologies are developing at a rate nothing short of astounding. Untold thousands of people are developing clever apps, many of which seem to have an insatiable appetite for bandwidth.

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With the exponential rise of demand for smartphones, LTE deployment has become critical in the marketplace. The power of mobile computing devices that also happen to make phone calls has advanced by leaps and bounds. Dual-core powerhouses that come with sophisticated technologies built in. Examples include:

- Point-and-shoot camera
- Display resolutions that exceed the limits of the human eye’s ability to distinguish separate pixels
- Near-field communications technology that enables payment by phone by waving a phone in front of a payment kiosk in place of a credit card
- Siri-type voice-activated intelligent assistant agents. For example, Siri tells a series of jokes to warm up the crowd at the 2012 World Developer Conference.

- Augmented reality allows us to point our smartphone at our surroundings, and it will show an overlay indicating historic landmarks, key sites, and businesses in the area as opposed to being limited to one-off apps such as Goggle or the Layar browser.

IDC projects that total smartphone shipments will reach 659.8 million units in 2012, up 33.5 percent from the 494.2 million units shipped in 2011. Smartphone shipments are projected to grow at a CAGR of 18.6 percent until 2016. “The worldwide smartphone market is poised for continued double-digit growth in the years ahead,” says Ramon Llamas, senior research analyst with IDC’s Mobile Phone Technology and Trends team. “Strong end-user demand, broader and deeper selection of smartphones at mobile operators and smartphone vendors, and lower price points will drive shipments higher in the years to come.”

Take special note of the fact that the increased use of smartphones and bandwidth-intensive apps will translate into increased load on campus communications infrastructure, perhaps requiring capital-intensive reconfigurations and upgrades. Users of multi-mode smartphones may opt to use free Wi-Fi rather than expensive cellular voice and data airtime. Distributed antenna systems (DASs) installed before 2010 variously will require splitter, antenna, and head-end equipment reconfiguration and, in some cases, replacement.

Conclusion

According to the European Telecommunications Standards Institute’s IPR-database for intellectual property rights, about 50 companies have filed patents covering the LTE standard. Whether you are a private business, a college or university, or a local, state, or federal government agency, communication is essential to success. LTE next-generation technologies are transforming mission-critical operations and strengthening critical core services with broadband connections, rich-media applications, and collaborative devices.

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The 10 Most Costly Pitfalls of DAS Deployment and How to Avoid Them

Approximately 99.8 percent of all college students use some kind of mobile device or cell phone on campus, according to a recent study by Ball State Institute for Mobile Media Research. It's no surprise then that campus environments—which are among the most wired communities in the country—are expected to provide ubiquitous wireless coverage.

From increased staff and employee productivity to improved public safety, distributed antenna systems (DASs) remain a leading option to improve wireless communications in a campus setting—one of the most challenging and sophisticated user environments in which a DAS can be deployed. For those without a solid understanding of the technology, the road to a successful DAS installation can be fraught with peril.

Some of these hazards are of the financial variety, and others are revealed during the decision-making process. The key to a successful and beneficial DAS deployment is to recognize the most costly of these pitfalls and know how to avoid them. Here is a look at the top 10 pitfalls as they relate to a campus DAS installation.

10. Not having the right representation

The importance of representation can't be overstated. Ensuring that you have a knowledgeable advocate in your corner will enable you to make sure your needs are met.

When selecting an advocate, look for a company that has experience working with wireless service providers (WSPs), that understands the different technology options available, and that has experience managing a DAS deployment from start to finish. Get recommendations from your peers in the education industry, subject-matter experts, or consultants. Selecting a systems integrator that is product- or equipment-neutral will help ensure that you get the best possible solution for your unique requirements.

9. Not conducting a wireless needs assessment

Knowing what you have and what you need is paramount. Asking the right questions up front will go a long way toward ensuring the best possible solution. What is the justification for a DAS? Who needs coverage? What considerations are driving the decision-making process? Are coverage and capacity being sufficiently considered? Are future expansions and improvements being taken into account? Is the ultimate goal to achieve higher call-completion rates? Faster data throughput? Increased public safety?

Although these are all questions that need to be answered in advance, this is by no means an exhaustive list. It is essential that you thoroughly navigate the landscape to determine what’s best for your campus.

8. Failing to engage the wireless carriers early in the process

If a DAS installation involved only a couple of parties (the end user and the DAS provider, for example), there would undoubtedly be more DASs in the world. However, it is almost never that simple. There are multiple participants in the process, and each has different interests and concerns. One of the most important players is the wireless carrier,
who can make suggestions to or approve designs, recommend integrators and/or vendors, and in some cases, provide funding. Remember, any enhanced DAS signal that will affect a carrier's network requires an approval or retransmission agreement, so it's best to engage the wireless carrier on the front end of the project.

6. Underestimating space and infrastructure funding.

A successful DAS deployment (as any other project) requires that you understand the potential costs. From the design and installation of the system to maintaining it, a DAS deployment can quickly become a costly proposition. Understanding those costs up front will enable you to determine if it makes fiscal sense to move forward and, if so, help you identify the best way to fund the project.

Many colleges and universities have the misconception that wireless carrier funding is ideal since it will not hit the college's bottom line. The truth is, carrier funding is not a guarantee, nor is it necessarily the best option. Carriers have their own criteria for determining whether it makes financial sense for them to provide capital for a system. Colleges and universities must consider all the financial solutions available to them.

There are several methods by which a DAS can be financed, including self-funding, carrier funding, hybrid funding (both carrier and end user), and third-party funding. Each method has its own benefits, and adequate consideration should be given to each.

6. Underestimating space and infrastructure requirements

The carrier equipment that provides the RF signal necessary for wireless coverage needs a fair amount of space and requires basic infrastructure—such as an ample power supply, an HVAC system for cooling, T-1 for 2G and 3G cellular networks, and SONET or Ethernet for 4G cellular network connectivity—in order to work properly. Intermediate hubs and related gear also consume considerable space. In addition, fiber is needed between buildings and back to the RF source. In such cases, it is important to know if there are pathways between the affected buildings and if there is a means to pull fiber in those pathways if needed.

Architectural and aesthetic concerns should also be given consideration, particularly if your institution has a planning or design policy in place. While most equipment will be located indoors, some antennas and RF gear may be installed on external structures.

5. Underestimating maintenance costs or failing to develop a maintenance protocol

As noted, DAS deployments require a substantial financial investment. With that outlay often comes the expectation that the system will provide worry-free service for years to come. Unfortunately, due to ever-changing technology, virtually every DAS will need to be maintained.

Ideally, a DAS installation should be 100 percent reliable, all of the time. Realistically, however, any system with active components will likely experience some downtime. When a system does go down, it can be costly in time, money, and convenience for faculty, students, and staff and could pose a serious safety issue.

Before you begin, you should know who will respond to service calls, how quickly they will arrive, and how much you should expect to spend. Determine who will own the maintenance commitment and what will and will not be included.

4. Failing to understand public-safety radio requirements

DAS systems are typically thought to be enhancers of cellular and Wi-Fi systems. But in many cases, a DAS is used to improve public safety and first-response radio systems. It is very important to understand if your new DAS supports public-safety radio systems and whether the system will coexist without interfering with other radio systems on campus.

In addition, virtually all college students use some kind of mobile device or cell phone on campus. While outdoor caller location accuracy is generally not a problem for first responders, a DAS distorts indoor caller location accuracy and outdoor accuracy when GPS is not available. This is particularly troublesome given that the vast majority of E911 calls are made indoors.

There are cost-effective solutions that have been shown to dramatically improve caller location accuracy on campuses and other venues that tend to utilize DASs. When considering a DAS, be sure to discuss with the carrier representatives the impact of the DAS on the ability to locate E911 callers. When putting together an RFP, make sure it has a clause that requires the WSPs to maintain the integrity of E911 caller accuracy.

3. Failing to verify the technologies and frequencies supported by the DAS

Before beginning the installation process, work with the wireless carriers to determine which frequencies, if any, will need to be enhanced now and in the future.

Some additional questions to consider are: Is Wi-Fi required? Will coverage be available on campus radios? On what frequencies do local public-safety officials operate?

2. Underestimating the time and resources needed to deploy a DAS

A DAS deployment is not an overnight project. In fact, the entire process could take upwards of 18 months, depending on the scope. Planning for that and determining who the ringleader will be is critical to success. This person will help determine
which stakeholders will have a seat at the planning table. This group could include representation from facilities management, information technology, security, legal, procurement, building and operations management, public safety, finance, and communications. It could also include an outside entity that acts on behalf of the university throughout the process, ultimately taking the burden off internal resources.

Externally, there are just as many relationships to manage. These can include the systems integrator, subcontractors, wireless carriers, public-safety stakeholders, and post-deployment managed services.

Keeping open lines of communication with every party involved will be the difference between a painless installation and a long, costly project.

1. Having a vague post-installation validation plan

The absence of a clearly defined plan to verify that the new system meets all of your requirements is the final hazard on the road to a successful DAS deployment. A poorly performing or incomplete system obviously will not meet the wireless coverage needs of the college staff, students, and visitors, resulting in a great deal of frustration for everyone and wasting resources—including time and money.

Conclusion

As with most other big-ticket ventures, doing a lot of advance planning to bring a DAS to your campus, consulting with peers who have been through successful implementations, and knowing where the pitfalls are will help ensure your success.

Mike Altman is director of business development for Cellular Specialties, Inc. He has been working within the in-building segment of the wireless industry for 12 years, leading teams involved in the turnkey deployment of approximately 1,000 in-building systems.
Every student, faculty, and staff member at a university carries a mobile phone or tablet, and every user expects that device to work in all places. This is a challenge for university IT departments, particularly as tablet computers and smartphones are also being used by a majority of students and faculty in and out of the classroom. Users may have trouble getting a wireless signal inside dorms or other campus buildings, and hundreds or thousands of simultaneous users wanting to use data-intensive applications at the same time may strain the network's capacity. While a distributed antenna system, or DAS, is not the only solution to the challenges of providing adequate mobile service on campus, it is an important option to consider.

**DAS 101**

A DAS is a system of antennas that propagate a wireless signal throughout a campus. The signal comes initially from a service provider's base station (typically multiple service providers provide base stations for a DAS), and the signal is routed through a system of electronic hubs and cables to reach the signal amplifiers and antennas.

A DAS addresses two distinct challenges: providing adequate signal coverage in all areas of campus, including indoor spaces; and providing adequate network capacity to support hundreds or thousands of users wanting to access the network simultaneously for voice and data applications.

Coverage—the ability to get your service provider's signal on a mobile device—is compromised on many campuses because dense building layouts can block signals from nearby cellular towers. In addition, the stone, brick, and concrete construction of most college buildings can attenuate cellular signals coming in from the outside, and belowground areas of campus often have no coverage at all. Even newer campus buildings can block cellular service because they use low-e glass and other energy-efficient construction materials that block and reflect the signals.

The capacity challenge has to do with the number of users on the network and the applications they are using. With students using smartphones and tablets to download or upload videos, share files, access streaming-music sites, and perform other data-intensive applications, the network can run out of capacity. In this case, calls may be dropped, the network will run slow, or users who show "four bars" of signal strength on their phones will be unable to get on the network at all.

The solution to these issues may be to deploy a DAS. A DAS is one part of the movement to smaller cells by service providers who need to boost network capacity. Newer services such as LTE are promising much more network capacity, and building more cell towers may not always be the best way to deliver that capacity. By deploying local DAS solutions, service providers can bring the mobile signal closer to users. Service providers have already deployed DAS products in many airports and municipal stadiums. Now colleges and universities are looking at the same types of system as a solution to their mobile services challenges.

A DAS is an extension of the mobile network, taking a signal from a mobile base station (owned by a wireless service provider) and distributing it through a series of small antennas located in building ceilings, on light poles, or on the walls or roofs of buildings. Bringing the mobile signal closer to end users delivers better coverage, making it possible to use voice and data services everywhere on campus. A DAS also addresses the capacity issue because each antenna simulcasts all the network aggregate capacity, so as not to tie small amounts of capacity at each antenna like a hotspot.
Practically speaking, a DAS requires space in equipment and wiring rooms for host units, as well as fiber and coaxial cabling to link the host units with the antennas. Universities familiar with Wi-Fi network deployment will find deploying a DAS to be a similar undertaking, except that the licensed signal for the DAS must come from an outside service provider such as AT&T or Verizon.

In the era of “bring your own device” (BYOD), universities must be prepared to support mobile services from all major providers in their area. While some campuses try to dictate which devices can be used, end users find ways to skirt these policies.

Depending on its size, a DAS can cost from tens of thousands up to millions of dollars. There are three basic ownership models, but all require carrier approval: the university, one or more service providers, or a “neutral host” who agrees to build and operate the DAS in exchange for a share in the service revenues from service providers or who will recover the investment by leasing the network back to the service provider. Using a neutral host is often a popular option, because the neutral-host provider manages the relationships with service providers and takes responsibility for getting the system deployed. If the university funds the DAS, the funding usually comes out of the IT or security budgets, and it may be recovered through technology fees assessed to students as part of their residence fees.

With this general overview in mind, let’s look at the key steps to be taken in specifying and acquiring a DAS.

1. Understand the application
The first step is to accurately characterize the DAS application. What is your specific problem? Why do you need the DAS? Some possible answers include the following:
- To improve safety and security infrastructure
- To improve interactive classrooms
- To offer greater online-learning opportunities
- To offer wireless access as a student amenity
- To use as a recruitment tool for students and events on campus

When you begin to consider wireless communications access, it may be overwhelming to know where to begin. Equipment and solution integrators offer experience and insight into the technology and its implementation and can provide technical performance surveys of the campus. The wireless service provider is clearly a major stakeholder in bringing the RF to your campus, but knowing where to begin starts with the people using wireless in and around your property—the faculty, staff, and students. In order to understand what’s important to them and to prioritize service areas, consider sending a cellular usage survey to students, faculty, and staff. It might include the following questions:
- Which service provider do you use?
- What type of device(s) do you have (smartphone/tablet/phone)?
- Where do you use the device most?
- Which service do you use the most (voice/text/data)
- What data applications do you use the most?

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DAS Deployment Issues

Deploying a DAS can be a complex business, and several issues can affect its cost-effectiveness and time to install. This section lists issues and solutions actually experienced on college campuses.

- Wireless propagation can be complex, and building plans don’t always reflect the nature of the RF environment. For example, the upper floors of a multistory building may “see” macro network signals from a variety of sources, so it will be important to establish a dominant signal indoors to keep users’ mobile devices from hunting from one source to another. A room that looks uncomplicated may bounce wireless signals around due to filing cabinets and other furniture. In addition, unique building features may affect signal coverage and propagation, such as long hallways with offices on both sides, or banks of metal lockers. Even large wooden benches, which may absorb signals, can be a factor.

The solution to these variables is to do a thorough site survey with wireless analyzers before finalizing the deployment plan. A good site survey will help establish precise locations for distributed antennas so that they have the greatest impact in complex RF environments.

- Building construction materials and existing cable infrastructure can pose problems when deploying DAS cabling and antennas. Thick concrete, steel beams, and other architectural features can make a DAS harder to deploy. A thorough review of existing building plans and consultation with the facilities maintenance department will help reveal potential trouble areas so that additional time can be budgeted for working around or through them.

- Special requirements can throw off work schedules by demanding additional work. For example, older buildings may have asbestos abatement needs or historic property considerations, which may extend deployment time or limit available placement locations of equipment and cabling. High ceilings will require scissor-lift equipment, for example, and historic buildings may have lath and plaster walls instead of sheetrock, so they may require additional labor or expertise during deployment, or they may require special measures to be taken to blend a wireless solution in with historic decor.

Again, the facilities maintenance department can be a good source of information about ceiling and wall types because they’ve encountered them while installing or maintaining HVAC ductwork. This department also should be able to provide information about what’s above ceilings.

- There will be multiple mobile service providers involved in a campus deployment. Some may have cell sites on campus, and others may have sites near the campus. During DAS installation, it will be necessary to determine how to aggregate service-provider base-station capacity to deliver it to a DAS headend (the point of interface between the DAS and carrier and public-safety signals). Campus representatives should involve service providers as early as possible in the planning process so this complex situation can be worked out in advance.

- It can take several hundred square feet to house the necessary base stations and DAS headends, and this space may not be readily available on campus. The space must also provide access to the on-campus fiber network so that the DAS signals can be distributed. By using a DAS that allows long-reach fiber runs, campuses can get more flexibility in where the DAS headend is located. In some campuses, the DAS headend is even located off campus at a service provider’s location.

- Mobile operators often want to secure their base stations so only they can access them. This involves building cages around individual providers’ equipment.

- Tight deployment schedules during summer months can be disrupted if all of the service provider and DAS equipment hasn’t been shipped to the campus by the time it’s needed. The campus should identify priority areas for first deployments so that if the entire deployment can’t be completed within the allotted time, at least the most important locations will be deployed.

- Fiber assets must be available to every building where the DAS will be deployed. Otherwise, the campus will have to pay to trench new fiber to make the needed links.
• Where on campus have you had service problems?
• How would you rate service in various areas of campus (list areas such as dorms, student union, stadium, classrooms, outdoor areas, library, etc.)?

The survey should provide good information about priorities for areas to cover and services to support. You should be able to tell potential solution providers where you need service, which providers’ services are needed, the size of population to be served in a given area, and special deployment considerations (i.e., historic buildings and special needs, such as clean tents, high-lift equipment, and more).

2. Engage service providers and investigate solutions

Once you understand your basic needs, you should reach out to all of the major mobile operators serving your campus area and solicit their help in identifying potential solutions. Service providers can recommend solutions and vendors who supply them.

There are several DAS products on the market, but there are key differences between them and not all may be suitable for your environment. Depending on your needs, the following attributes may be useful:
• Multiprovider capability. The DAS should be able to carry signals from multiple service providers simultaneously. This simplifies installation because only one set of antennas and electronics is needed.
• Unified 2G, 3G, and 4G services support. The DAS should be able to handle any of the mobile services used on campus.
• High-power/low-power antennas. High-power antennas are used in stadiums and in outdoor areas, while low-power antennas are used inside buildings. If possible, the solution should include both types of antennas with a common hub-management system so the system designers have the greatest flexibility in deploying a solution.
• Use of existing fiber. The DAS should make use of the campus’ existing fiber plant to minimize costs.
• Use of optical multiplexing. Some DAS products can incorporate optical multiplexing to reduce the amount of fiber needed. If fiber is scarce on your campus, you should investigate this feature.
• Digital transport between the base station and the DAS host unit. Using digital transport between the DAS host unit and the base station allows for the service provider’s base station to be located off campus, so the university doesn’t have to provide space, power, and cooling for it. Service providers may prefer to locate their base stations in nearby central offices.
• Cascading expansion hubs and remote antenna units. By allowing hubs to control other hubs, this architecture allows for far greater scalability in campuses with large DAS installations.

As for the vendor providing the solution, you should choose one that has a lot of experience deploying DAS products on college campuses and working with the service providers in your area.

3. Issue an RFP

Once you have a basic understanding of DASs and the problems you are trying to solve, bridging the gap between problem and resolution can be a challenge. How do you select the right technology for your property? How do you select the right partner?

At this stage, it is common to distribute a request for proposal (RFP) to find the right partner to deliver a solution consistent with your organization’s communication goals. RFPs provide a comprehensive and objective manner to audit the market and select the partner best for you.

The RFP should request detailed information about the type of DAS to be used, its performance, its warranty, the overall design of the DAS, the deployment process, cellular services provided over the DAS, company history, and references. Service providers or DAS vendors should be able to give you a sample RFP you can use as a template.

4. Manage the deployment

After choosing a DAS vendor, it’s time to negotiate the actual deployment. Some college staffs can handle the cabling aspect of the deployment and need only to have the system electronics installed by an outside party. Campus technical teams will be familiar with the ceilings and raceways where cabling must be installed, and may want to handle the DAS cabling installation themselves. Other campuses want a turnkey deployment that includes everything.

It’s wise to plan the deployment for a time when it will be the least disruptive to the campus, say during summer break. If the DAS is being deployed for a major event such as a football game, make sure it can be deployed, tested, and commissioned in time for the big day.

After deployment, either the university, the service providers, or the neutral host manages and maintains the system.

With colleges and universities seeing a proliferation of mobile devices, the challenges of wireless coverage and capacity loom large. Properly assessed, specified, and deployed, a DAS is an increasingly popular way to address these challenges and provide clear and consistent mobile service throughout the campus community.

John Spindler is director, product management, at TE Connectivity’s Wireless Group. Reach him at john.spindler@te.com.
Decision Criteria for Selecting a Wireless Intrusion Prevention System

Wireless LAN intrusion prevention systems detect, monitor, diagnose, and defend against unauthorized access attempts, interference, and attacks. This research offers advice about the critical questions to ask when selecting products.

Key Findings
- Wireless intrusion prevention systems (WIPSs) enable important security features that should be evaluated and prioritized by WLAN buyers. If WIPS is acquired as part of the WLAN infrastructure, security features should be a highly weighted evaluation criterion.
- Radio frequency monitoring of wireless LANs (WLANs) is necessary to manage their performance and capacity, determining the root cause of problems reported by users, and sensing/defending against intrusions and interference.

Recommendations
- The pervasiveness of WLANs means that companies must invest in IPS, especially if there is a "no wireless" policy, meaning that all wireless communications should be detected and blocked.
- RFPs for WIPS should require evidence that the vendor has engaged external security evaluations or obtained product security certification appropriate to the buyer's business process.
- WIPS buyers should plan to monitor growth and IPS requirements of other forms of wireless communications beyond Wi-Fi, particularly cellular data services, such as 3G and 4G/LTE deployed via femtocells.

Analysis
Wi-Fi is a standard extension of corporate networks. Enterprises need WLAN IPS tools to ensure that vulnerability management and intrusion prevention processes are extended to cover wireless extensions to wired networks. WLAN IPS also plays an important role to ensure that:
- Supported WLAN performance is not impeded by interference or denial of service (DoS) attacks
- WLAN traffic is kept private and secure
- Users are prevented from installing unauthorized WLANs
- Unsupported/unauthorized WLAN technologies are barred from operation
WIPSs can operate at Open Systems Interconnection (OSI) Layer 2 (data link layer) or Layer 3 (network layer), with the latter most common. They can:
- Detect the presence of rogue or misconfigured devices, and deny access to protected segments of enterprise networks.
- Route noncompliant wireless device connections to guest networks, Internet portals or quarantines.
- Scan radio frequencies within and near the wireless networking bands for inter-
wireless validate wireless performance optimization.

cells

difference and unauthorized traffic. Ideally, the IPS will have a road map for emerging wireless networks such as 4G/LTE femto-cells or small cells, which will have a future impact.

- Help organizations enforce WLAN security configuration and access policies.
- Perform real-time traffic analysis for performance optimization.
- Verify the health of devices, as well as validate wireless authorization certificates used in some Extensible Authentication Protocol (EAP) types.
- Coordinate with wired network access control (NAC) or intrusion detection and management systems.
- Mediate attacks such as DoS—executed as radio frequency (RF) interference—and the appearance of rogue devices using automated approaches, as well as by notifying administrative personnel to take action.
- Generate network health and compliance reports, and provide historical data for event analysis and predictive modeling.

There is a lot in common between wired and WLAN intrusion detection and prevention solutions. Both evaluate devices requesting network connections, taking actions to deny, reroute and remediate out-of-compliance requests. However, WIPSs do not eliminate the need for wired IPSs, and vice versa. Wired and wireless IPSs work from different event and activity baselines. However, coordination is important because users can have multiple wired and wireless devices and access paths, all of which need to be accounted for in a user profile. No vendor yet provides a solution that integrates wired and wireless IPSs. With the emergence of a converged access layer, however, the market is slowly moving in this direction. Vendors increasingly offer both solutions, and buyers need to understand where they can take advantage of inherent coordination of IPS functions with enterprise wireless networks. There are several different combinations possible for clients and AP communication, as shown in Figure 1, and the job of the WIPS is to ensure authorized clients associate with authorized APs. The WIPS must also take appropriate action on unauthorized devices, by blocking the port of the Ethernet switch where rogue APs may be connected, for example:

- Authorized APs and Clients: These are the legitimate/authorized devices operating on the enterprise WLAN. Authorized clients are configured with the credentials to connect only to authorized APs.
- Unauthorized APs and Clients: Known as rogue devices, they are deployed without the knowledge of the IT department, disrupting the performance of the RF environment, and possibly exposing networks without proper authentication. An AP deployed by an employee or guest without the knowledge of the IT department is not the only rogue device on the WLAN. A rogue device can also be a WLAN client device.

Figure 1. IPS Access Control Matrix

![IPS Access Control Matrix](image)

Role of WIPSs

The essence of a WIPS is to ensure that only authorized devices (access point [AP] and wireless clients) participate in an enterprise wireless network. In this case, the role of the IPS is to ensure that only properly configured and authenticated APs and clients are allowed to connect to enterprise networks. In the Wi-Fi market, the use of strong EAP types, particularly EAP-TLS in WPA2 Enterprise mode, makes forced entry to properly configured APs impractical. However, misconfigured enterprise APs or client devices, as well as user-installed unmanaged APs, can cause havoc. The WIPS will monitor for evidence of enterprise data packets passing through unauthorized devices in the airspace, and attempt to block transmissions. Combined with wired NAC, the IPS can shut down wired network services that are associated with offending APs and clients, as well as rule out false alarms caused by neighbor systems.

WIPS functions can be summarized in terms of three types of devices that interact...
(laptop, tablet, smartphone, printer, and so on) working in wireless AP/bridge mode, and any wireless devices or tools (other than AP) that are not deployed for regular work, but wind up causing interference in the RF environment. Rogue devices can grant network access to unauthorized users and also degrade the performance of a WLAN by launching attacks or stealing the shared media. However, it is very important to distinguish between rogue and neighboring wireless infrastructure devices.

- Neighborhood APs and Clients: These devices belong to other companies or individuals in nearby proximity. Some signals from neighboring APs and clients may propagate to your environment, or neighboring clients may try to access your enterprise's authorized APs, often by accident. WIPS requires registration of valid neighboring APs, which prevents them from being considered as rogue devices.

Questions to Ask When Evaluating WIPS

These questions should be used as the framework for an RFP.

1. Which WIPS Architecture Is Best for My Company?

WIPS systems use APs as sensors to listen to and analyze traffic. Vendors offer three configurations: infrastructure, hybrid, and overlay:

- Most buyers with compliance-driven security requirements will be satisfied with an infrastructure solution.
- Enterprises with high levels of security requirements — including government, PCI companies and those with "no wireless" policies — will likely require an overlay solution.
- Environments between those extremes will find a hybrid solution is likely to provide the best balance between cost and security.

On the other hand, even organizations with the lowest security needs may not want to invest more in an infrastructure vendor's incumbent solution, or they may have specialized needs, and should consider the overlay solution. Specify your preference, but ask vendors to explain the pros and cons of their architectures in your context:

- **Infrastructure solutions**, available from all mainstream vendors, combine production and sensing activities in common APs. The aggressiveness of the WIPS function is reduced because APs are placed for production use, rather than optimal listening. APs must spread resources between client traffic and WIPS operations by using "time slicing." Higher-end APs may have multiple radios that reduce time-slicing effects. Infrastructure solutions are offered by all mainstream wireless vendors, and are the least expensive in terms of installation, training and complexity.

- **Hybrid solutions** dedicate some of the vendor's APs to the sensor role, rather than relying solely on sharing the load with production APs. The vendor can thus improve detection and monitoring efficiencies. The mainstream wireless infrastructure vendors increasingly prefer this approach to move their product road maps forward.

- **Overlay solutions** provide the most aggressive approach to security by means of dedicated monitoring sensors (specialized APs) that operate separately from production APs. Sensors may be placed in locations and in sufficient numbers for optimum surveillance. Overlay solutions are often supplied by a second vendor operating independently from the default wireless infrastructure, and may offer the most competitive features for detection and analysis.

Questions for Reference Accounts

It is important to ask reference companies not only why they like the IPS they bought, but also what they didn't like about other products. Ask questions dealing with:

- Difficulty or ease of installation
- Quality of support
- Administrator and help desk feedback
- Missing features
- False positives and false negatives
- Ongoing management experiences

Detailed RFP Questions

- What is the size and viability of the existing customer base? How many deployments of your size or larger has the vendor completed, (that is, the number of monitoring sensors, locations, and so on)?
- What security certifications have been awarded for the product?
- What are the security mechanisms used to validate access points and sensors to the console, and to encrypt data streams?
- What tests are made against a client's access request to determine system identity and health? Can a noncompliant client system be remediated?
- Do you provide noncompany device connection management, including guest network support, for devices such as visitor, contractor and employee bring your own device (BYOD)?
- How is the system scaled across multiple buildings and separate locations? How much traffic do sensors add to the wired network? Will remote sensors report back to a central site via the Internet, through network-address translation (NAT) and firewalls?
- What is the recommended size of installation, ratio and placement of sensor APs, and fully expanded cost calculations, standardized to cost per square foot or meter.
- How are product updates distributed and installed? How often is the system updated?
- Beyond basic Wi-Fi, how many channels and frequencies can be monitored? What is the cycle time needed for sensors to work through all of them?
Do you have a plan to monitor use of femtocells in the enterprise and other emerging signals? Will the WIPS be field-upgradable for new signal types and spectra?

- Can you leverage other vendors' APs as sensors?
- Do you provide a preconfigured policy engine with example and recommended templates for IPS detections, actions and countermeasures?
- Do you automatically apply countermeasures for known attacks?
- How do you detect suspicious behavior, and at what point do you take action? Explain how you deal with false positives.
- Do you provide an administrator look-up database for tactical-response suggestions to common security events?
- Do you provide traffic analysis to help optimize wireless network operations, reliability and performance?
- What functionality is integrated into the base-level product versus additional licenses?
- How do WIPS signatures get updated with new attack vectors?
- Do you integrate/interoperate with wired NAC systems?
- Do you integrate with client-side directory systems to validate access requests?
- Can you pinpoint the location of attacks and suspected vulnerabilities on a building map diagram?
- Does the system generate audit logs for maintaining records of AP configurations, usage patterns and all user activities/actions with respect to the system? How long is data stored? How is it backed up and purged? Are historical analysis reports provided?
- What audit and compliance features do you provide for dealing with PCI and U.S. Health Insurance Portability and Accountability Act (HIPAA) scenarios (as applicable)?

Thanks to Gartner for allowing us to include this article, which was originally published by Gartner in January 2013. For more information about Gartner, contact Claudia Stengel at claudia.stengel@gartner.com.
Thanks to Our Exhibitors and Sponsors!

Thanks to these companies that exhibited or sponsored at one, two, or all three of our events in 2012. 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!
2011-2012 Institutional Excellence Award

Wagner College
SIP Solution with Fixed Mobile Convergence

In the Spring of 2011, Wagner started looking for ways to upgrade our aging PBX to a system that was flexible, reliable, and feature rich. We were faced with a deteriorating PBX, escalating maintenance costs, and a dwindling amount of support for such an antiquated product. Our dialing and online and voicemail directories were not synchronized, further complicating the process. We knew we needed to move to a VoIP-based solution, but the current data infrastructure would not support VoIP and PoE to the desktop.

In late Summer 2011, Wagner partnered with Postrack Technologies and Phybridge to create an innovative solution that did not require any major upfront expenditure and still provided us with a flexible and reliable phone system. Leveraging Phybridge's unique UniPhyer technology, we were able to deploy a fully featured VoIP phone system—without upgrades to the infrastructure. The UniPhyers solved our issue of delivering power and data to the phones by utilizing the existing phone cabling while keeping voice and data traffic separated. The solution also provided a global address list that unified our dialing and online and voicemail directories by integrating with our LDAP server.

Further, as we look toward the future, we are not bound to any specific hardware, so we always have the opportunity to upgrade to the latest and greatest. All of the funding for this project was internal, as lease agreements replaced maintenance agreements.

Planning
Among the major hurdles we encountered when planning our own VoIP implementation were the limitations of our data network in relation to providing power to the new phones. There were very few PoE-capable switches scattered throughout the campus, and a major refresh was still a couple of years out. The capital expenditure for an early upgrade was more than we could handle. Coupled with the fact that our support staff was overwhelmed with the frequency and magnitude of PBX issues, the time to act was immediate.

Purchasing a new PBX would be a large expenditure as well, and meant that the support staff would need to learn how to install, administer, and deploy an entirely new system in a short amount of time. Our directories being out of sync was a major deciding factor as well. We could not move forward having to maintain 3 separate databases for 3 different products. We needed unification, and we needed a turnkey solution that required little or no downtime for such a critical service.

Planning for this project was done by a senior technology team, consisting of the CIO, project manager, network director, client services director, and the telecommunications staff. The team worked closely with Postrack to define the key objectives and goals both for the project and the institution. Several team members visited the Postrack facilities to see the technology at work. They inquired about redundancy, network design, and MPLS failover capability. We obtained test UniPhyer units to

Wagner's delegation accepted the Institutional Excellence Award at the Awards Luncheon at the 2012 Annual Conference. Pictured, left to right: ACUTA President Joe Harrington, Paul Liu, Frank Cafasso, Anthony Spina, Larry Foster (Windstream, sponsor of the award), Dilawar Grewal, and Matt Arthur, chair of the ACUTA Awards Committee.

Thanks to Windstream for sponsoring this award.
test our existing infrastructure and ensure viability and reliability in our current environment.

Once tested, the CIO presented the solution to Senior Staff, including the President. Key advantages communicated included the following:

1. The flexibility to change technologies as the industry changes since we are not heavily invested into hardware
2. Using SIP to expand the scope of services to the students, as well as advancing business processes, and
3. Most important, the solution provides a path forward into planning for a cohesive communications solution as smartphones and tablets become an integral part of our data world.

The CIO and CFO worked closely on lease agreements. The implementation plan was carefully crafted to maximize efficiency with limited support staff. Student technicians were tasked with delivering and setting up phones, letting senior support staff concentrate on the bigger picture. Communicating the transition to the campus was critical. Advertising the who, what, and when of the project, leaving no room for confusion, was a must.

Promotion of Technology and Maturity of Effort

The project addressed some key concerns:

- Students don't particularly care for differences between data and voice technologies and/or devices; they are focused on the functionality and devices that are relevant to them.

The solution provides phones in dorm hallways for emergency purposes and a migration path to enable Skype-like connectivity with the campus via mobile apps.

- Smartphones, tablets, and mobility had to be addressed ubiquitously.

Support for these devices and fixed-mobile convergence is included in the solution out-of-the box for each user at no additional cost. The campus is piloting this technology with select users to determine how it will fit into our business processes.

- Given the environment of rapid change in communications technology, we did not want to be “married” to a particular vendor or technology because of hardware purchases.

Leasing endpoint hardware and outsourcing the management of a physical PBX allows us to focus on quality while other companies focus on running and maintaining services in times of limited personnel resources. Additionally, the hardware we have leased is open-standards based, allowing us to switch easily between hosted vendors if necessary to improve functionality. This places the pressure on the provider to deliver cost-effective upgrades as new technologies emerge.

- We had a specific focus on voice services and did not want this project scope to expand into a refresh of our data network.

The Phybridge solution lets us integrate voice and data for our end users without investing heavily in our data network. PosTrack's FMC solution also allows us to leverage the wireless environment in making student accessibility to resources more seamless than before.

- While outsourcing certain responsibilities (maintenance of voice system hardware) was desired, we needed to be able to respond directly to the needs of the campus.

In this environment we have complete control over provisioning, MACs, and management of our own cable plant. We are able to utilize our current expertise in telecommunications and networks, rather than having to hire someone else. This solution enabled us to bring in new technologies without overly disrupting how people are accustomed to conducting their daily business.

- We wanted to extend the reach of our communications environment.

Using SIP services we have been able to expand hours and accessibility and are able to drive forth the Wagner identity by in-
creased availability through our four-digit dialing.

Quality Performance and Metrics

In order to measure and manage the solution, we are collaborating with the vendors to create a monitoring environment that will track service uptime and voice quality using both quantitative and qualitative measures. Given that we were the first campus to use a PosTrack/Phybridge solution, monitoring of network performance in this new environment relies on several data sources, from vendor-provided data to direct testing and evaluation by our team to user interviews. We did encounter a significant quality concern early on in the project. Despite testing by PosTrack, Phybridge, and on-site testing by our staff, the range (feet of cable) of the Phybridge solution proved to be lower than expected. While IP connectivity was not a problem, deterioration of power quality caused some strange performance issues beyond 900 cable feet. We are solving this issue by creating secondary locations to house Phybridge equipment that reduces the length of cable runs to the endpoint. Given this, and the fact that the new voice system has been installed for only a few weeks at the time of this application, specific metric data is not yet available.

Cost-benefit and Risk Analysis

- Our evaluation of a traditional VoIP deployment suggested that we would need at least $750,000 to procure a voice system and upgrade our LAN to deliver VoIP to the desktop. The capital outlay for this solution was less than $30,000, including the necessary modifications to our telecom cable plant.

- The cost for PosTrack hosted services, including mobility, FMC, unified messaging for each user, DIDs, and unlimited long distance was roughly equal to our monthly costs for PRLs and long distance.

- Since the lease agreement amounts are very similar to our previous maintenance agreement amounts, and we did not have to spend the upfront major capital costs, return-on-investment benefits really start from day one.

- We have offloaded the risk and cost associated with obsolescence. All upgrades are included in the voice solution, and if new technologies are not delivered, we can procure them ourselves and integrate with or replace the hosted solution.

Customer Satisfaction

At the time of submitting this proposal, we have only had a few weeks to gather this information with students back on campus. For basic telephony users, the change has been fairly seamless as our initial deployment is focused on getting basic features up and running while we evaluate our new technology options. As can be expected, the change from a legacy solution to a sip-environment had some impact on procedures and business processes for staff using more advanced telephony capabilities, and staff are still adjusting and learning those changes. We have seen several individuals move from an initial state of confusion to excitement as they learn about the new capabilities that replace some of the familiar features and processes. We believe that will be the trend as users continue to become familiar with the new technology and we introduce new features.

For users who are piloting mobility solutions and soft-clients on laptops and tablets, initial results look very promising. The staff using the solutions report feeling much more connected when they are out of the office, but also have a sense of privacy since they are using their campus DID.

It is highly recommended that in an installation of this sort, the IT department provide "cheat sheets" on how to work the phone features analogous to the old phones and the way people were accustomed to using those features to conduct daily business. Also, publicizing a one-on-one training schedule for the campus really helps develop customer comfort and satisfaction. It is also highly recommended that the first group to be trained on the new system be the departmental secretaries.

It is worth noting that the unexpected issue with respect to range of the Phybridge devices created a substantial strain on the staff who would have been tasked with meeting with campus end users to provide customization and training on the new solution, which caused some poor first-impressions of the system. In order to correct this issue, PosTrack staff created and delivered an end-user training program that matched our specific deployment, and provided direct support to our technical team and helpdesk as we were managing the cable plant issues. This support was outside the scope of their initial agreement, and was very helpful in managing the expectations of the campus as we migrated to a new system.

The contact person for this project is Frank Cafasso Director, Network and Communications. Reach him at frank.cafasso@wagner.edu

Reach him at frank.cafasso@wagner.edu
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