THE CONNECTED CAMPUS:

Emerging Wireless Technology Trends on Campus

One of the most pressing issues institutions of higher learning face is not what's going on inside the classroom or even the overall decline in federal and private funding. A critical issue is how colleges and universities are prepared to manage the ever-increasing demands on their communications technology infrastructure. Is higher education keeping up with the pace of change? Are colleges and universities not only equipped today, but also prepared to handle anything that might come tomorrow from move-in day, to game day, to total campus shutdown in the event of a crisis? What are educational institutions doing to keep up with the rapid rate of change? And what will they need to do in the future?

Current Practices and Ongoing Challenges

Communications environments are getting pushed to their limits in higher education today. The demands on the infrastructure are many and varied. Students, who tend to be on the bleeding edge of technology, carry a full arsenal of wireless devices on campus – smartphones, tablets, mobiles gaming systems, and notebooks. They use increasing amounts of bandwidth with their texting, social networking, video chats, and streaming video. Students also look to the campus Wi-Fi as a means of lowering monthly data charges on smartphones and tablets.

Teachers leverage communications technology within the classroom as current teaching standards change to embrace new technology-based teaching methods. University and academic requirements call for increased use of cloud-based networks for storage and parallel processing applications. Departments requiring access to these applications are often in different buildings across campuses.

Stadiums and arenas, as well as hospitals and research departments, present unique challenges to the communications and IT infrastructure. Ensuring public safety, and the ability to communicate effectively with university personnel, students, visitors, and public safety officials in the case of an emergency, has never been greater.

The net effect is that the wired and wireless networks that facilitate all of these services and applications are reaching – and exceeding – capacity. We are maxing out our networks. This reality forces campus IT departments to scramble to find appropriate and cost-effective solutions today.

Spikes In Demand As Traditional Funding Decreases

As schools experience this rapid increase in demand, funding for necessary improvements and updates decreases. Historically, technology infrastructure on campuses has been partially funded through student landline use and/or dorm room cable service. Students have all but migrated toward mobile smart phones and tablets, and away from landline and cable services. As a result, funding from those sources, used in the past to pay for much-needed technological improvements, is drying up. Therefore, the challenges schools face today are not just based in technology; they are financial, tied to the search for funding sources to cover upgrades and transformations.

To address these challenges, colleges and universities must install multipurpose networks that are easy to deploy and manage. These multipurpose networks must be flexible and scalable to accommodate growth and change. And, they must lower costs, through CAPEX or OPEX efficiencies, or through the creation of new revenue stream opportunities.

In the past, one way to solve cellular communications problems has been to employ a "spray and pray" approach — put up an antenna at the highest point, and hope for the best. However, today customers upload more content than they download, and the bulk of cellular traffic occurs indoors, so macro networks cannot efficiently service users in high-density areas. Given the tremendous increase in usage, it is necessary to build networks from the "inside-out" to compliment the macro network approach of "outside-in."

Solution: Distributed Antenna System Networks (DAS)

Distributed Antenna System (DAS) networks solve the problems of over-burdened cellular networks. Distributed Antenna Systems address two critical issues: DAS brings coverage indoors where the outdoor macro, traditionally cell sites, cannot reach or penetrate. More importantly, DAS addresses capacity. It brings capacity relief to the macro network to allow more users in the macro environment to enjoy all the social networking, video streaming, and access to cloud-based storage that anyone could want. Indoor users benefit from having dedicated capacity and quality service throughout the indoor space.

Although DAS is not a new technology, some of the trends affecting it, like enabling both public safety and cellular services with the same infrastructure, are new.

Funding Presents A Key Challenge

Funding DAS implementations, often multi-million dollar projects, is a key challenge for colleges and universities. Campus IT departments hope to be able to shift the burden of cost to wireless operators, which allows them to fund other critical improvements to infrastructure. Operators tend to be more focused on servicing the high traffic places on campus where capacity is a problem, like the stadiums and arenas, rather than with dorm or library access. Additionally, hospitals are more likely to receive funding for DAS deployments – even though the carriers or university – as physicians and clinicians now rely upon smartphones and tablets to deliver patient care, in addition to pagers and security and ground staff communicate using private 2-way radios. Finding funding for dorms, classrooms, and offices remains problematic.

COMMUNICATION DURING PUBLIC EMERGENCIES IS ESSENTIAL

The need for effective cellular and public-safety communications during emergencies on campus is absolutely critical – as evidenced by current events:

In 2012, there were ten school shootings that left a total of forty one people dead and thirteen wounded.

2013 has been even more deadly. In the month of January alone, eight school shootings took place.

In March, 2013, a suicide on an Orlando, Florida campus uncovered a massive plot to massacre students.

Campus shootings were reported in Christianburg, Virginia and Houston, Texas in April of 2013.

Explosions have been reported on five college campuses in 2013.

THE CONNECTED CAMPUS

More cloud services, social media and mobile devices mean colleges and universities must constantly keep up with the demand for more capacity.

THE STADIUM
Staying connected with friends, family and social media is part of the fan experience. Staff, media and security personnel also rely upon wireless networks to do their jobs and maintain a safe environment.

THE CAMPUS GROUNDS
Students and faculty increasingly use cloud services, video conferencing, online data storage and BYOD. They expect full-bar coverage and capacity from campus DAS and Wi-Fi networks anywhere, anytime.

THE SECURITY BEAT
Security personnel and first responders depend on private two-way radios and public safety networks for public safety communications.

THE HOSPITAL
Electronic health records, digital X-ray imaging, HIPAA-compliance, pagers, wireless medical devices, smartphones and tablets: all part of today's connected healthcare environment and all requiring high-bandwidth data networks and complete 3G/4G cellular coverage throughout the medical campus.

DAS Alone May Not Be Sufficient

However, the DAS may not be enough to satisfy the capacity requirements. For example, on game day, the University of Tennessee attracts more than 100,000 fans to Neyland Stadium. Demand for capacity for that number of people can strain carriers' RAN (radio access network), which manifests itself on the user's handset as showing full-bar signal strength but being unable to upload a photo to, say, Facebook. That's when carriers seek to leverage an important campus asset: unlicensed spectrum on the university's Wi-Fi network. Like DAS, Wi-Fi helps augment the macro network. Wi-Fi is attractive because these bands are free and wide - offering big channels to stream data.

Enter Wi-Fi

Like DAS, Wi-Fi technology is not new. But unlike DAS, Wi-Fi uses unlicensed spectrum. Recent protocols enable wireless data networks to be more robust. Still, Wi-Fi does not possess the bandwidth and throughput of wired networks. Campus IT departments must move Access Point (AP) locations, or add additional APs, to deliver services as capacity requirements continually change and increase. Physically shifting infrastructure adds to costs.

There Are No Silver Bullet Solutions

The reality is that there are no silver bullet solutions to wireless communications challenges. Today's "toolkit" includes DAS and Wi-Fi and will soon be joined by small cell technology. Small cells, akin to Wi-Fi AP, are a local base station but differ by using cellular standards. User requirements vis-à-vis capacity throughput are driving changes that will occur to technology infrastructure, and this will have a profound impact on funding, tracking and monetizing such investments.

Emerging Trends: Convergence and Fiber Networks

Networks are evolving to handle more data; faster, and more perfectly. They will continue to change rapidly—demand on the infrastructure depends on it. Two key trends in campus technology include convergence and fiber networks.

Increasingly DAS networks will be called upon to support both cellular and public-safety services. The

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fledgling in-building public-safety market of today is similar to the early days of neutral-host cellular DAS, when building owners insisted on a single platform, as opposed to having three systems installed by three different shareholders.

Similarly, offloading traffic to Wi-Fi networks will resemble the neutral-host DAS model whereby multiple wireless carriers can share the costs of participation in a carrier-grade network able to deliver a consistent user experience for their customers. This technology, ideally-suited for large stadium deployments that face a capacity crunch on game day, diverts data traffic to the Wi-Fi network. Using a security gateway, traffic for each carrier is authenticated and routed to the carriers' own backhaul pipe. Quality of experience for the user is ensured because the network is no longer constrained by the ISP's bandwidth, which is sufficient for everyday use but not for the volume of game day. The system tracks and charges each carrier for only the amount of traffic that accessed the public network.

Solutions for Fiber Exhaustion

Gigabit Ethernet fiber multiplexing solutions will increasingly be deployed to solve fiber exhaustion. Demand for throughput is being driven by the explosion in Wi-Fi-enabled mobile devices, and the emergence of bandwidth-intensive cloud-based services, social networking, advanced collaboration and medical applications. Data throughput and speed are typically constrained by the point-to-point fiber optic links that connect campus buildings. Fiber multiplexing solutions use wavelength divisional technologies to channelize fiber strands – increasing the capacity of existing fiber deployments without the need to install or lease costly new fiber strands. As an example, a single strand of fiber can deliver multiple wavelength channels each running symmetrically at 1Gbps up and down stream. This represents significant CAPEX and OPEX savings.

Shift to Fiber and Digital DAS

Although copper cabling (CAT 5 & 6) has long been the standard, over time, the industry will shift to a fiber infrastructure to meet throughput requirements. Put simply, today's copper may not be high enough quality to support 1GE speeds. Further, the physical medium of copper is unable to support higher data rates of 10 GE. Fiber infrastructure is physically smaller and lighter than copper, and is easily installed by technicians. Most importantly, fiber delivers almost unlimited room for future bandwidth expansion.

Lastly, DAS will go digital. Following the trends of convergence of services and the continued emergence of fiber, Radio Frequency (RF) and Internet Protocol (IP) will converge onto a single, digital architecture. The platform will enable plug-in and support for cellular and public-safety communications, Wi-Fi services and other applications such as RFID, building automation, security and more. We predict this infrastructure to similarly enable fiber-to-the-desktop.

Ultimately, these next-generation networks will be smarter and more flexible. They'll handle increased data, enable better use of network resources, and scale capacity – up or down based upon use and need during peak and off-peak times. At the core will be intelligent backhaul to centralize network management and lower operational expenditures. This will be essential for higher education campuses.

How Long Will This Take?

Some of these trends may reach fruition by year's end; others, currently under development, will be several years in the making. No one fully knows what a good balanced network looks like. We expect to see new technology trends develop at a rate of at least one new trend every two years, as demand-- and solutions to meet demand--continue to grow and evolve.

The problems facing higher education campuses will only grow as they continue to struggle with disparate networks they don't control, and unlicensed frequencies they cannot maximize or that do not have a clear ROI. The urgent need to provide clear communication for public safety and the exponential growth of the demand for capacity means that technology solutions will need to be consolidated offerings bringing multiple networks together. They can be monetized and must provide unfettered access for students, employees, safety personnel, and the general public.

To be sure, the years ahead are certainly going to be interesting.

About the author: Ken Sandfeld is Vice President at SOLiD where he is focused on bringing leapfrog technologies out of incubation and into the market to solve some of the industry's biggest problems. Mr. Sandfeld possesses over 16 years of experience in the wireless infrastructure industry and is passionate about bringing cutting-edge, new technology to the wireless space. He frequently presents and blogs about emerging technology trends. Prior to his current leadership role, Mr. Sandfeld held management positions at MobileAccess, Remec, Spectrian and Zyfer.