Ingredient for Wireless Success: DAS

When Wi-Fi isn't quite enough, add DAS to the mixture

by Scott Gregory

College students are the most demanding mobile-technology consumers on the planet. Whether downloading videos from Netflix, uploading photos to social media, or sending the latest assignment to a professor, most students have little idea what technology supports their mobile lifestyles—and they don't care. They just want it to work.

College students, staff, faculty, and visitors bring their own devices to campuses and expect ubiquitous access, anywhere and all the time. To meet expectations, colleges and universities are being forced to spend millions of dollars to provide campuswide coverage and deliver unlimited bandwidth at little or no additional cost to the student. According to Earl Lum, president of EJL Wireless Research, "Many IT staff are looking for a unicorn solution: a free network with unlimited capacity and bandwidth for consumers who don't want to pay anything."

Campuses have invested in Wi-Fi and fiber rings to address many of the communications needs of their staff and students. Using a Wi-Fi access point, students can Skype, Viber, WhatsApp, and make calls using voice over Wi-Fi. On some campuses, the combination of Wi-Fi and the macro cellular network meets the need for communication on campuses, but relying on this approach alone can lead to significant gaps.

According to Lum, for one campus, the wake-up call for change came from a mother who tried to call her freshman daughter for days, and finally contacted the chancellor's office to ask, "Is my child safe and how can I reach her?" She learned that the service provider's network didn't penetrate into her daughter's dormitory, so calls didn't get through.

The 9-1-1 emergency system falls into another communications gap. The wireless carriers are mandated to deliver location data along with every outgoing 9-1-1 call so that emergency first responders and services can locate callers within minutes. No similar service or technology exists for Wi-Fi or voice over Wi-Fi, and carrier Wi-Fi calling is still in early stages of deployment. With heightened concerns about public safety on campus, the lack of outgoing 9-1-1 location services from dorms or classrooms poses unacceptable risks of liability.

A third gap will be more obvious in the near future. Tens of millions of square feet of new buildings are being constructed on campuses nationwide, many of them LEED certified. The new building materials allow virtually no mobile signal to penetrate inside the building from the service provider's antennas outdoors. So mobile devices won't connect to the service provider networks in those buildings either, turning them into cellular dead zones, and amplifying risk in an emergency.

According to Donny Jackson, editor of *Urgent Communications:* "In these energy-efficient buildings, the idea that radio signals from an outdoor tower consistently will be able to penetrate inside a building to provide indoor coverage—particularly coverage that does not drain battery life from a device—no longer is realistic. Instead, a more reliable approach is to design coverage inside a structure" with in-building networks.

Balancing Wi-Fi Traffic

Another complicating factor is the increasing load on Wi-Fi networks. Suppose that a large university has 5,000 to 10,000 users relying on Wi-Fi that addresses gaps in the macro cellular service. As more mobile users adopt voice over Wi-Fi, demand on the campus Wi-Fi network rises, prompting network upgrades. Already many campuses are experiencing heightened demand from data traffic alone.

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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 and deploying new infrastructure adds to costs.

Rather than doubling down on Wi-Fi, some campuses are balancing their investments by using private spectrum from cellular carriers, delivered via DAS (distributed antenna systems), to address growth in voice and data traffic, while preserving their public spectrum. By combining

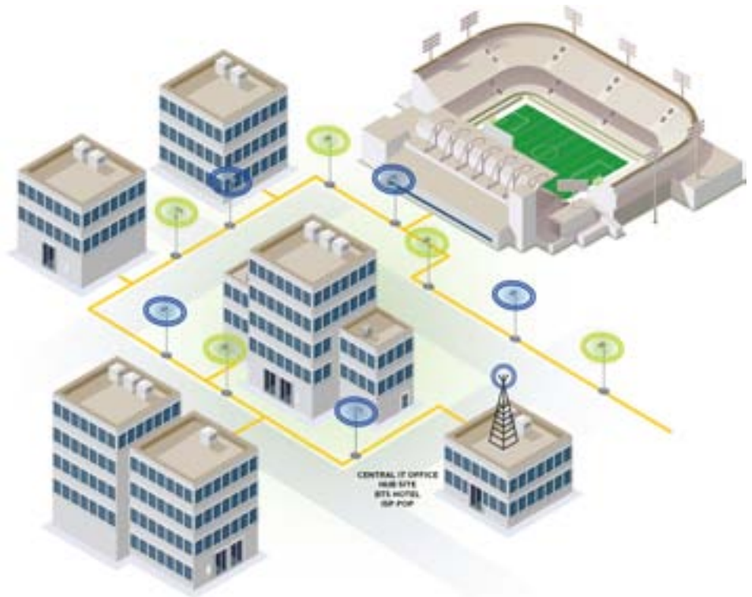

Figure 1. Example of Outdoor Campus DAS Solution. The connected university requires wireless solutions that keep students, faculty, administrators, operations personnel, visitors, and first responders connected.

licensed and unlicensed spectrum, campuses can offload traffic to the most cost-effective network as demands inevitably increase.

So what is DAS?

Imagine that the macro cellular network has been shrunk down so that it can be deployed in buildings or across a college campus. Mobile-service providers connect to a centralized head end that connects, in turn, to the campus network. Remote antennas on the campus network radiate RF signals to smartphones on campus, like sprinklers from a hose. The DAS network extends and strengthens the service provider's signal in places where it is weak, lacks capacity, or suffers from RF interference.

DAS equipment can "densify" the edge of the carrier's network by addressing both coverage and capacity. Coverage issues crop up when the radio signal can't penetrate to a location. For instance, RF signals can have difficulty penetrating through a second or third wall into a building's center. LEED- certified buildings use materials that block RF signals, specifically the glazing used for windows.

As LTE and VoLTE become more prevalent, capacity will have a bigger impact. Lack of capacity is to blame when you see five-bar coverage on your smartphone, but it lacks the bandwidth to load a webpage. Capacity issues can crop up in large, crowded stadiums where thousands of people are uploading photos to the web at the same time, for instance.

DAS equipment can support multiple technologies (3G/4G), frequency bands, and multiple carriers, providing the comprehensive coverage most campuses require. They integrate easily with existing fiber ring networks and can be flexibly deployed where needed.

Gigabit Ethernet fiber multiplexing solutions will increasingly be deployed to address fiber exhaustion. 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.

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.

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Controlling the Last Wireless Mile on Campus

With DAS, campuses can maintain control over the last mile of their wireless networks, just as they already control their PBX, LAN, WAN, and WiFi networks. Think of your campus as a population center with growing demands that need to be met over time. Because DAS relies on a centralized head end, campuses can spread capacity over their fiber network gradually as demand grows, rather than negotiating with carriers for network build-outs or small cell deployments.

On the 8,709-acre Duke University campus, more than 200 buildings are connected to the DAS network. The university owns and controls this vital asset. Carriers paid a pro rata share of the network build-out, with a seven-year, self-renewing commitment to network refreshes as the technology evolves.

Bob Johnson, Duke's senior director of communications infrastructure and global strategies, evaluated various approaches before deciding to maintain control over the DAS network. He persuaded carriers to join the university-owned model by running the numbers. "We've got 45,000 people working on campus or attending Duke. We said to the carriers, 'If you are not in on the DAS network, you'll miss out on four to eight years of a Duke demographic, and you'll lose those subscribers." AT&T, Sprint, and Verizon partnered with Duke, with the initial investment for the in-building wireless network costing approximately $1.00-$1.50 per square foot. The carriers are paying for usage either by sectors or by frequencies.

In Duke's hub-and-spoke model, a fiber ring connects the buildings, with carriers connecting to the network at a single head-end location. SOLiD's DAS equipment brings signal into the buildings, supporting voice and data traffic. The entire system is designed to scale as demand increases over time.

Johnson chose to invest in both Wi-Fi and DAS networks. He says, "You need both technologies today. With DAS, when fans leave Duke's stadium after a home game, they can continue the fan experience all the way home." For more details on Bob's decision-making process, see this video: http://www.solid.com/bold-ideas/the-middleprise.html

Looking Ahead

The problems facing higher-education campuses will grow if 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 in demand for capacity means that technology solutions will need to be consolidated offerings that provide unfettered access for students, employees, safety personnel, and the general public.

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