CASE STUDY

COVERAGE SYSTEMS

West Virginia University

Powerwave Technologies Supplies Wireless Communications System for West Virginia University

Powerwave Deploys Campus-Wide In-Building Wireless Infrastructure Solution at West Virginia University

Distributed Antenna System (DAS) installed in partnership with American Cellular delivers improved wireless voice and data coverage in six buildings, stadium and an indoor practice facility

Challenge: To design and implement a commercial wireless coverage system across multiple facilities/open areas throughout the campus, including basements and locations where existing coverage was insufficient.

Solution: A mixed-technology design using a fiber-optic distributed antenna system (DAS) comprised of fiber repeaters, a donor antenna design utilizing radio frequency (RF) repeaters, RF modules and remote hubs.

Result: A campus-wide, seamless cellular coverage system that enhances wireless voice services for American Cellular. The coverage system provides a forward compatible solution to support increased levels of wireless traffic across multiple buildings on the university campus.

Founded in 1867 as a 30,000-acre land-grant institution, West Virginia University (originally called the Agricultural College of West Virginia), is located along the Monongahela River in the picturesque city of Morgantown. Starting with just six faculty members and six college students when its doors opened in September 1867, today West Virginia University has an enrollment of more than 28,000 students and nearly 7,800 employees.

“Wireless communications” is a popular field of study for many college students. In 2004, Student Monitor, a national syndicated and custom market research firm focused exclusively on the college student market, reported that 9 out of 10 college students owned a cell phone, up from 33% in 2000. Student Monitor’s most recent statistics indicate that cellular phone usage by college students continues to rise with 5.2 million college students across the country owning cellular phones. The study also cited that 86% of students acquire their first cell phone prior to entering college.

Realizing that there was a great demand for cellular voice and data services on campus due to this growing trend, West Virginia University officials began to explore technology options designed to improve the existing wireless voice and data services shared by students and staff, and allow for more comprehensive coverage inside campus buildings to meet increased cellular demand.

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"The University's main objective was to bring wireless coverage to multiple campus locations including the Milan Puskar Athletic Center (multiple levels), Mountain Lair Student Center (multiple floors), Bennett Tower Student Housing (ground floor), Engineering Sciences Building (basement and ground floor), and the SkyBox levels in the school's athletic stadium, as well as internal practice field, and the north-end Club House.

Key requirements for the system were as follows: it needed to meet both current and future demands for high signal quality and reliability; it also needed to support a large coverage area and multiple frequencies and carriers; high capacity was also a key requirement as well as a compact, discrete design that could be easily hidden from view.

University officials contracted with American Cellular (a subsidiary of Dobson Communications which is now part of the AT&T family) in 2005 and asked them for assistance in identifying an equipment provider. After reviewing several vendor proposals, American Cellular selected Powerwave, and deployment of the wireless coverage system began in March 2005, and was completed within seven months.

Powerwave Wideband Coverage System (WCS) product line is a flexible platform for wireless enhancement of a base station signal remotely. This line of products can be connected via coax or fiber cable to provide capacity to underserved areas of the network. Applications for this versatile product are indoor distributed antenna systems (DAS) and outdoor coverage challenges. Future expansion and upgrading is made easy using a modular design. Same reliable, field proven technology as Powerwave's Repeater products, as well as the same O&M software for complete NetWay Manager (NWM) and OM-Online compatibility.

Key Benefits

- Ultimate flexibility
- Proven technology
- Fiber or Coaxial feed
- Ease of installation
- Output Power options
- Standard O&M platform

A Wireless Solution that Makes the Grade

Following a site visit to the campus that helped the design team to better understand the layout and inner-workings of the buildings involved, Powerwave designed a solution based upon its LinDAS architecture to meet the project's requirements. Based on proven fiber optic, RF and software technology, LinDAS is designed to deliver cost-efficient coverage while maintaining quality and flexibility.

Capable of operating in medium-to-large coverage areas where high reliability, high performance and low total cost of ownership are key considerations, the system distinguishes itself from competitive offerings in the following areas:

- **Quality** - LinDAS meets future demands for high signal quality. In high speed data systems such as 3G, the signal-to-noise ratio is crucial for system performance. LinDAS is an operator selective system that uses IF (Intermediate Frequency) filtering techniques to minimize noise and interference to the radio base station.

- **Reliability** – LinDAS has a proven Mean Time Between Failure (MTBF) of more than 200,000 hours.

- **Larger Coverage** – LinDAS's fiber optic repeaters have a linear power amplifier with an output power higher than most competitors. Advantages include the ability to handle several frequency carriers while still fulfilling high quality signal requirements (regulatory controlled in most countries). Due to this higher output power, LinDAS can suport a coverage area up to 4 times larger than competitors' systems using only one active remote element.

- **Capacity** – LinDAS' fiber optic system has a dynamic range of more than 70dB giving operators headroom for distributing the signal over long fiber runs.

- **Signal Quality** - The low noise design used in LinDAS improves uplink performance considerably. The system will not be uplink limited, as many DAS tend to be when they are expanded at later dates.

- **Compact** - The RF combining box is designed to combine multiple operators' frequency bands and sectors into a common distribution network. LinDAS uses miniature components to keep the overall system size compact and easy to mount into crowded equipment closets.

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- **Operation & Maintenance** - LinDAS can be controlled and monitored on several levels. This can range from simple LED detection to sophisticated software management of large systems with alarm integration to an overlaying Management system that allows LinDAS to cooperate with other Powerwave repeater products already in operation. Operation and monitoring of the individual Remote Hubs in a network can be done over fiber from the Central Hub.

- **Carrier Neutral** - LinDAS is flexible and can easily be tailored for use in multi-carrier systems of any size.

- **Outdoors** – LinDAS can also be used for outdoor applications by leveraging higher output Remote Hubs.

Based on a single mode fiber optic DAS system, the LinDAS consists of two main blocks, the Central Hub and the Remote Hub. The Central Hub consists of two units, the passive RF Combining Module (RCM) and the active RF/Opto Converter Module (CM), and is located close to the base station. The Remote Hub (RH) consists of a dual direction amplifier cabinet housing the RF/Opto converter, RF and IF filtering and outputs to passive antennas, and is located close to the service area. Other system components include directional service antennas, wide band antenna splitters, and operation and management (O&M) software.

Due to a lack of fiber connectivity within the campus' smaller facilities, Powerwave deployed a Donor Antenna system. As part of the Donor system, a yagi antenna, or directional antenna system, was mounted on the building rooftop of each building, and pointed in the direction of the donor site. When signals are received, they are immediately fed to an RF amplifier, then amplified and re-distributed over a passive DAS system designed and installed throughout the building.

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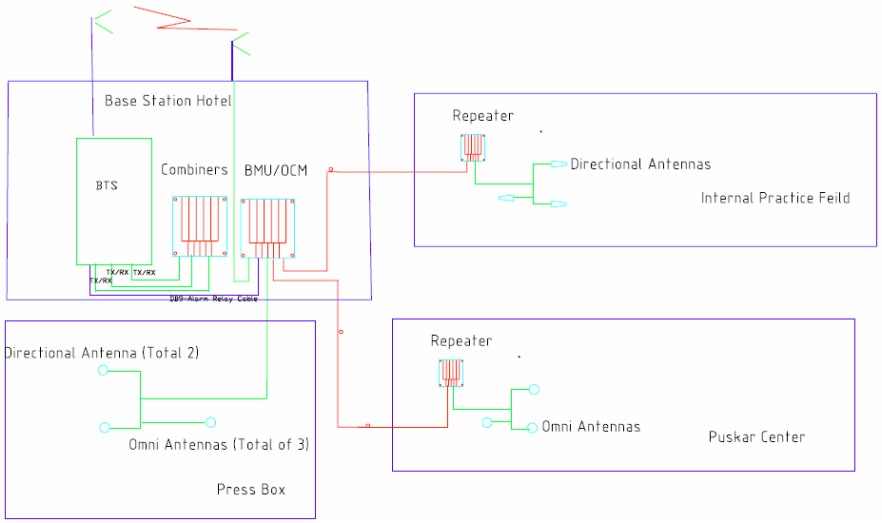

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As with many technology deployments, challenges came about but were faced head-on by Powerwave and American Cellular. The main challenge throughout the implementation was not technical in nature, but rather aesthetic. In introducing a new technology, it was important to blend the wireless coverage system into the existing environment to create a seamless look and feel. To meet this challenge, Powerwave's Omnidirectional Antenna was selected because of its ability to flow into the internal design of the buildings and remain hidden from plain site view.

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Passing with Flying Colors

In October 2005, Powerwave and American Cellular completed installation of the DAS system and Donor Antenna Design in the seven facilities. The system passed all tests and now supports multiple wireless carriers and all current commercial wireless frequency bands. Student residents, staff, faculty and visitors benefit from clear wireless voice and data communications inside the buildings. With the Powerwave DAS system now in place, West Virginia University is well equipped to handle the increasing demand for on campus access to wireless voice and data services.

The system is also forward-compatible, and can be easily expanded to support future data services available through multiple service providers. It is anticipated that the next step will be to add American Cellular's 3G services onto the DAS.

About Powerwave

Powerwave Technologies is a global source of end-to-end wireless solutions for wireless communications networks. Powerwave designs, manufactures and markets antennas, boosters, combiners, filters, repeaters, multi-carrier RF power amplifiers, tower-mounted amplifiers and advanced coverage solutions, all for use in cellular, PCS and 3G networks throughout the world. Corporate headquarters are located at 1801 E. St. Andrew Place, Santa Ana, Calif. 92705. Telephone (714) 466-1000. For more information on advanced wireless coverage and capacity solutions, call (888)-PWR-WAVE (797-9283) or visit www.powerwave.com. Powerwave, Powerwave Technologies and the Powerwave logo are registered trademarks of Powerwave Technologies, Inc.

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