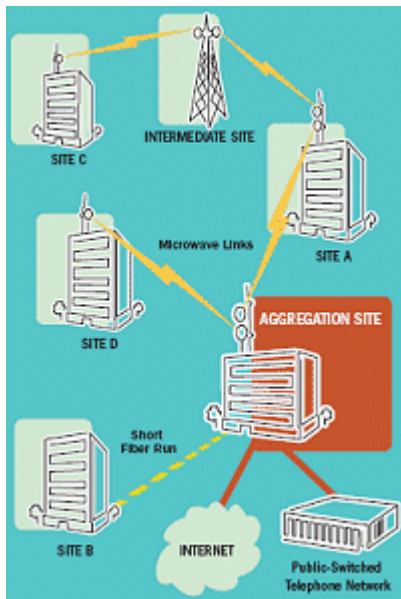


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Breaking Up the Bottleneck

by Stephen R. Leeolou

The new affordability of ultra-high-speed networks is relieving K-12 schools of insufficient bandwidth and opening them up to a world of digital education.



MAKE THE CONNECTION: *Hybrid networks—combining high-speed wireless and optical fiber technology—link sites to each other and to an aggregation site.*

THOUSANDS OF AMERICA’S K-12 schools are struggling to meet the demands of the digital era. Standards for student curricula, teacher credentials, and in-school security are rising rapidly. To keep pace, school districts are doing an admirable job of installing the internal high-speed computer networks and basic internet service needed to take advantage of new electronic learning opportunities.

However, partly as a result of this progress, virtually all US schools are or will be running into severe bottlenecks with their external network connections due to insufficient bandwidth. These restrictions to online access and speedy connectivity are caused by great numbers of students and teachers simultaneously attempting to utilize media-rich internet, data, and interactive video applications through conventional, external last-mile connections. These “pipes” cannot support schools’ ever-increasing network throughput requirements.

The vast majority of US schools' current "high-speed" broadband connections are leased dedicated phone-company pipes known as T1s, which operate at a maximum transmission speed of 1.5 million bits of information per second (Mbps). Along with advanced coaxial cable lines that offer speeds of 3 to 5 Mbps, T1s are a significant improvement over original dial-up modems, but they will quickly collapse under the weight of most schools' peak network loads as the use of online, interactive, multimedia applications grows.

These high-quality multimedia services are extremely bandwidth-intensive. Compounding the swelling bandwidth requirements is the likelihood that distance-learning connectivity will need to be available not just in computer labs, but ultimately at each desktop, so that various educational offerings can be simultaneously accessed by individual students. Consequently, the number of students concurrently requiring extremely high-speed online access can be expected to grow exponentially—as will schools' aggregate bandwidth needs

The plain truth is, based on their location, population density, and demographics, tens of thousands of schools are unlikely to gain access to affordable, last-mile fiber connections in the next three to five years, if ever. Without rapid deployment of fiber optics or other robust broadband technologies, school systems—mostly in outer suburban and rural America—aren't merely going to fall behind schools in our major cities, but also those in academically progressive nations such as Japan and South Korea.

Bridging the Digital Divide

Based on the current laws of physics and economics, a ubiquitous broadband solution for K-12 schools will require the deployment of hybrid networks. These would consist primarily of optical fiber backbones and high-speed wireless pipes in locations where distance, demographics, and fragmented landline competitors dictate a more economical solution.

Facing such a challenge was the **Iredell-Statesville Schools** district in North Carolina. To live up to its mission to "rigorously challenge all students to achieve their academic potential and to lead productive and rewarding lives," the district determined that its most pressing need was improved infrastructure—an ultra-high-speed and reliable network. Its solution was to install a digital microwave network to manage centralized, web-based administration functions, launch media-rich learning across all classrooms, and prepare for the future of interactive, video-based distance learning. Iredell-Statesville's new network connects 33 of its 35 schools and four central office facilities. Their Ethernet network services deliver 100 Mbps dedicated access between the district's endpoints. With access speeds approximately 67 times faster than its former T1 technology, the district is loosening up its bandwidth bottleneck and gaining traction in the new world of digital learning.

During the 2005-2006 school year, Iredell-Statesville employed interactive learning across select schools and classrooms and incorporated multimedia features such as live

internet websites into its curriculum. With 2006-2007 under way, the district plans to make use of its expanded technological capabilities to extend its interactive-based programs to students, teachers, and administrators across all of its schools and central office facilities.

Behind the Scenes

Digital microwave broadband networks such as Iredell- Statesville's can support ultra-high-speed—10 Mbps to 1 gigabit (1 billion bits)—internet access and integrated data, video, and VoIP services at capacity and reliability levels that rival fiber connections. This can be most reliably accomplished by utilizing radio frequencies licensed by the Federal Communications Commission, which guarantees protection against interference from other publicly available radio frequencies such as those used to operate baby monitors, garage-door openers, and weather-related radar systems.

Wireless networks, using what's known as WiFi connections, operate in the unlicensed radio spectrum, which typically cannot deliver comparable carrier quality or symmetrical throughput levels. To take advantage of those frequencies with an ultra-high-speed network, the first step of deployment is a line-of-sight path analysis. LOS matters because many types of radio transmission depend on the line of sight between the transmitter and receiver. Signals generally travel in a straight line, and barriers in the visible field can block signals.

Microwave, a subdivision of the radio spectrum, operates solely on a "visual" basis. Unlike low-frequency AM/FM radio, microwave does not penetrate physical obstructions and therefore requires the microwave community to operate above obstacles. This entails one external antenna and radio to transmit and, at minimum, one external antenna and radio to receive.

The purpose of the antennas, which can be placed on rooftops or standalone utility poles, is to provide microwave networks with clear LOS. A licensed microwave radio is attached to an antenna in one location and communicates with an antenna and radio placed at an endpoint, such as a school.

In the case of Iredell-Statesville, the LOS analysis involved calculations from about 20 different attributes to indicate the optimal microwave paths between the schools and central office facilities. These results were further refined through on-site surveys and helped determine the type of external structures the district would need to deliver ultrahigh- speed, FCC-licensed microwave networks at fiber-quality performance levels.

The external structures that support the connectivity among Iredell-Statesville schools and central office facilities are antennas mounted on concrete utility poles. The poles range in height from 100 to 140 feet and resemble lighting poles found in school parking areas or football fields. The antennas form what's called a ring network, and connect each of the school sites to each other and back to the main aggregation site at the district office.

The Iredell-Statesville example demonstrates the impact of recent advances in digital technology, which have reduced the complexity and cost of high-speed microwave networks. Deployment of these systems has been made much easier, quicker, and cost effective. By employing affordable broadband access capacity to schools in underserved markets, administrators are able to relieve districtwide bandwidth barriers and gain ultra-high-speed, high-capacity entry to the world of advanced digital education and security.

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