You Don't Know Jack?

Unobtrusive distributed antenna systems fed by fiber are not just for TV heroes

By Allen Dixon ■ *Corning Cable Systems*

If the wireless industry were to select a television show that best illustrates the potential of wireless communication, the runaway winner would be Fox's "24." In this gripping series hero Jack Bauer, played by Kiefer Sutherland, hurtles from location to location, risking life and limb to save the country from certain disaster. Jack has state-of-the-art resources at his disposal back in the Los Angeles headquarters but, more often than not, he has to tap into those resources from remote, often hostile, locations. The solution: using his wireless phone, no matter where he happens to be.

Distributed antenna systems (DAS), hooked to optical fiber, will help the wireless industry make sure we can all be like Jack Bauer soon. This article explains why the DAS approach is necessary, and how it works. I'll also talk about a new approach to creating the optical fiber network.

Jack sends and receives sensitive documents, building diagrams and other useful information. He transmits data from captured computers; and coordinates the movements of his team – all through his handset. Jack is connected, efficient and effective– anytime, anywhere.

While our tasks may be, at least hopefully, more mundane, we are on the verge of being able to be connected to a seamless flow of information, wirelessly – in our cars, homes, businesses – everywhere, all the time.

Broadband wireless access (BWA) will deliver high-speed connectivity to wireless phones, laptop computers and other wireless-enabled devices. With promised data rates of up to 100 Mbps, data and voice communication, even video streaming, can be accomplished as easily as if the user were sitting in an office.

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Numerous companies are lining up to provide BWA. Traditional wireless providers are in the process of implementing system-wide build outs, upgrading their voice networks to be high-speed data capable. Municipalities and private enterprises are installing Wi-Fi networks to provide connectivity to both rural and heavily traveled retail/recreational areas. Wireless Internet service providers are using newly accessible spectrum to enable connectivity for business and residential customers.

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The Antenna Site Problem

The one thing all these companies have in common is the need to provide antenna sites, locations where the data will be placed onto and taken off the wireline network. Ranges for the technologies used differ but, because the actual data rate will be a function of the distance from the antenna site, each provider will need to provide multiple sites to provide seamless coverage.

The latest release of the CTIA (Cellular Telecommunications Industry Association, now known mainly by its acronym, see www.ctia.org) semiannual survey indicates that at the end of 2004, there were more than 175,000 tower sites in the United States. While the growth

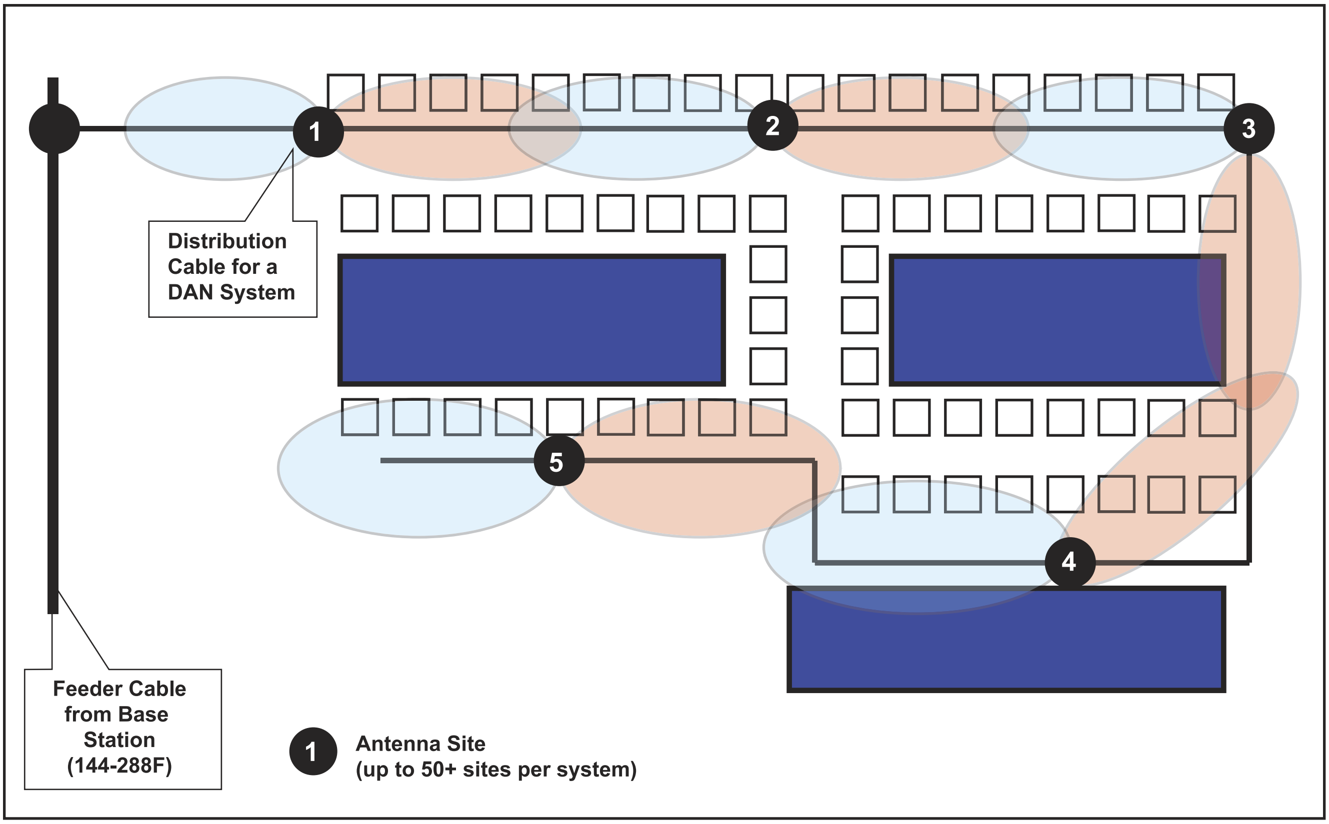

Figure 2. Distributed Antenna System Schematic

of these sites is welcome news from a coverage perspective, the sites have become marshy ground for wireless service providers as they attempt to provide the seamless coverage our new Jack Bauer-types demand.

Antenna sites must be big enough to support the antenna and any ancillary equipment, should have power available, easy access, and be free of obstructions that would block coverage. The number of sites meeting these criteria gets smaller every day. Often, even when desirable sites are available, the terms of use from the site owner are unfavorable and force providers to consider alternate, less desirable sites. Of course, the less desirable sites create new coverage issues, which force the provider to either accept spotty coverage or find and populate an additional site.

In addition to the decreasing number of suitable sites, the service providers face opposition from the same customers who are demanding better coverage. Many communities are placing strict requirements on construction of wireless antenna sites. Federal law prohibits communities from enacting an outright ban, but the law does provide broad latitude to the community. As a result, stringent and ultimately costly requirements for location and appearance restrict the available locations.

With conventional antenna sites limited, it is clear that some new approach is required to fulfill the promise of anytime, anywhere connectivity. Service providers must consider new technologies to provide seamless, consistent, reliable coverage. Optical fiber is one such technology.

Network designers and equipment manufacturers in the public and private network spaces have taken advantage of the attributes of optical fiber for more than 20 years. Optical fiber cables literally provide the backbone for today's telco and cable television networks. The use of optical fiber has extended now from the backbone, through the distribution, and into the homes of capacity-hungry users. In private networks, Ethernet travels over backbones at 10 Gigabits per second. Small, rugged distribution cables can deliver Gigabit Ethernet right to the desktop.

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Historically, wireless telephone networks have had comparatively light traffic and, because the traffic was mainly voice, low bandwidth requirements. With the introduction of camera phones, advanced data services, and an ever-expanding customer base, wireless networks are now in a position to enjoy the benefits of optical fiber.

Figure 3.1 and 3.2 – Multiple small antennas on existing poles don't raise the ire of neighbors. Photos courtesy of ADC.

Figure 4 – OptiFit Drop Cable Assembly

Figure 5 – MultiPort Terminal

Single-mode optical fiber provides tremendous advantages in the broadband wireless network. Wireless network managers already prefer optical fiber because of its enormous bandwidth and because it provides a clear and graceful path for capacity expansion. A single optical fiber strand can easily carry 10 Gigabits per second of information over the distances involved. Other benefits of optical fiber include long-distance error-free transmission without need for repeaters, and invulnerability to crosstalk, lightning strikes and power surges.

Most significantly, though, optical fiber also enables an alternative to the issue of antenna location and increased coverage. Service providers can use a distributed antenna system to expand their current coverage or fill holes in existing coverage, especially in urban and suburban areas.

The basic concept of a distributed antenna system is to use multiple smaller, lower power antenna sites, or nodes, to provide more efficient coverage in a chosen area (see Figure 2). Equipment at the remote antenna node converts the RF signal into an optical signal. The optical signal travels across an optical fiber stub, which is tied into a high-fiber-count optical feeder cable terminating in a base station hotel.

The DAS design approach offers many benefits. The nodes are less expensive than large tower-based installations and can be placed to provide optimal coverage. For broadband wireless access, though, the biggest benefits come in two other areas. The first area is zoning and permitting. Using smaller equipment and pre-existing structures, (such as power poles, lamp posts, and so forth) has significant benefit. A significant barrier to providing coverage in residential and recreational areas is NIMBY (Not In My Back Yard!) syndrome. All customers want increased coverage but it is difficult to find communities willing to support tower construction within their neighborhoods. The nearly invisible profile of distributed antenna nodes (see Figure 3) can overcome this resistance and expedite municipal approvals.

The second area of improvement is equipment utilization. Currently, each antenna site is connected to a dedicated piece of transmission equipment located nearby. This equipment must be installed whether it is fully used or not. A DAS network, however, uses fiber to connect all nodes into the base station hotel, which contains the equipment required for each node. Consolidating transmission equipment at a central location allows better use of equipment ports. It also allows the service provider to adjust coverage patterns, in real time and remotely, eliminating truck rolls to multiple locations and creating optimal service for users.

Easier Connections

Recent innovations in optical cable assembly manufacturing have changed the way fiber can be deployed in a DAS. Conventional installations involve placement of a high-fiber-count feeder cable. Smaller distribution cables are then fusion spliced onto the main cable to provide service to individual neighborhoods or streets. Each "branch" off the feeder or distribution cables requires fusion splicing to provide a continuous fiber path. Though fusion splicing is automated and simpler than ever, deployment of the system is still slowed by the need to prepare the site and the cables before splicing can begin.

New factory preconnectorized feeder systems provide a much simpler installation approach. Using route information provided by the service provider, specific fibers in the high-fiber-count feeder cable can be connectorized in multiple locations along the feeder in the factory. The feeder cables are then deployed using conventional installation techniques, simultaneously aligning the connection points with the remote antenna nodes. Once the feeder is installed, preconnectorized distribution cables connect to the feeder and the remote node using hardened connectors (see Figures 4 and 5). In this way, service is provided nearly instantly to the antenna node.

Moving the labor normally associated with field installations to the factory has several benefits. The controlled factory environment ensures a consistent, reliable product for each connection point. The time normally spent preparing for splicing is now spent providing service. This enables crews to deploy and turn up nodes faster, reducing the time required to provide service to bandwidth-hungry customers.

The combination of distributed antenna system using optical fiber and new optical cable assembly technologies can deliver on the promise of anywhere, anytime connectivity for wireless devices. The DAS can use unobtrusive, plentiful sites to ensure coverage; the preconnectorized feeder and distribution assemblies can provide rapid, cost-effective deployment of the DAS. The two technologies are a natural fit.

Jack Bauer saves the United States from an array of threats. But being a hero doesn't always require tracking down and destroying a cruise missile. Sometimes, it's enough to just be available when you can't actually be there. In that way, we can all be a Jack Bauer to someone. ◆

About the Author

Allen Dixon is the Market Development Manager, Wireless for Corning Cable Systems. He can be reached by email at allen.dixon@corning.com.