BEST PRACTICES

FOR WIRELESS BACKHAUL NETWORK UPGRADES

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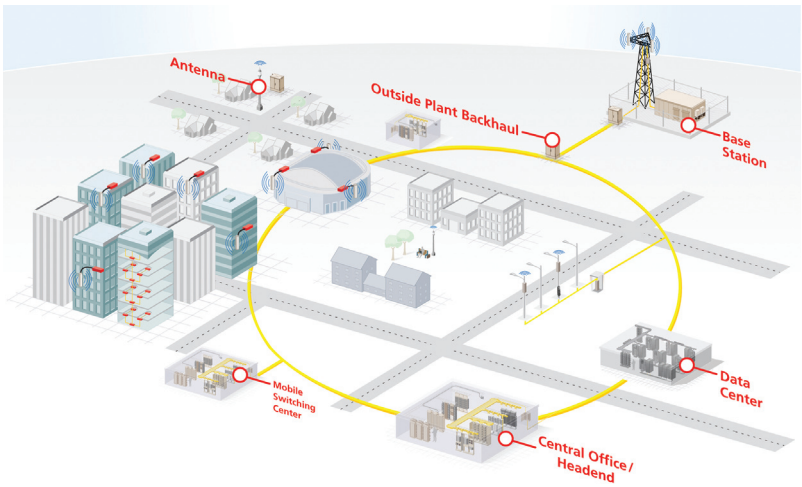
Traffic on wireless networks is growing dramatically, driven in large part by the growing popularity of wireless data and video. Carriers are upgrading from traditional T1 copper cable to fiber to support higher-speed connections between cell towers and high-speed backbone networks. Although the mobile operator is the ultimate user of these connections, the mobile operator rarely has landline infrastructure or owns its own cell towers, instead relying on other operators for those elements of its network.



"Installing fiber in backhaul networks is a key investment area for a wide range of companies—including mobile operators and tower operators, as well as telecom carriers and cable companies that provide backhaul network connectivity," says Tom Huegerich, vice president of global fiber engineering at ADC.

In this article, we look at connectivity issues involved with upgrading to a fiber-based backhaul network infrastructure for all these companies. In particular, we note the critical role that connectorized fiber can play in supporting these new backhaul fiber deployments.

FIVE KEY CONNECTION POINTS

Five key connection points form the foundation of a wireless backhaul network. These include the antenna, base station, outside plant, central office or headend and data center.

1) The antenna. Some large wireless carriers may own their own cell tower. But, more commonly, the cell tower is owned and operated by a company that specializes in that business. Three cell tower companies—American Tower, Crown Castle and SBA Communications— have a large share of the U.S. cell tower market. Together, these three companies own about three-quarters of all cell towers in the United States.

A typical cell tower may have antennas owned by several different mobile operators attached to it. Each mobile operator's antenna connects to a radio owned by that operator.

2) The base station. The base station houses the radio, which is connected to the tower-mounted antenna. Often the base station is housed in a base transceiver station (BTS) cabinet owned by the mobile operator. Some cell tower operators allow mobile operators to put their cabinets inside a hut or shelter owned by the tower operator. Alternatively, the BTS cabinet may be located outside the tower operator's hut.

Connectivity between the base station and the antenna is sometimes called "fronthaul." Traditionally, this fronthaul connection was made via a copper coaxial cable. But increasingly, these coaxial links are being replaced by fiber. Unlike copper, fiber is not vulnerable to losses, which (in a typical coaxial link) can lose half the power just in cable losses. Due to all the dielectric characteristics of fiber, it also requires no grounding.

Fiber connections are essential to supporting two emerging and important alternatives to the traditional tower-mounted antenna—the distributed antenna system (DAS) and the remote radio head. Both these options provide smaller coverage areas than a traditional tower-mounted antenna. The remote radio head is designed to fill in coverage holes, particularly those created when a 3G or 4G network is overlaid onto an existing 2G infrastructure. Distributed antenna systems provide even greater flexibility because they can be configured for multiple protocols and frequencies, which can be changed as needed. In addition they enable mobile operators to shift network capacity from one area to another throughout the day, week or year— as needed to support customer traffic patterns.

Both distributed antenna systems and remote radio heads rely on remote devices that can be mounted on a pole or located in a telco cabinet. Radio heads can be located as much as two kilometers away from the base station. Distributed antenna systems often are supported by a base station hotel located in another part of a metro area, which houses radios supporting distributed antennas throughout the metro area. Fiber is required between the base station radio and antenna for distributed antenna systems and remote radio heads because of the combination of distances between network elements and the bandwidth required.

3) *Outside plant.* The term "outside plant" refers to the landline backhaul provider's wiring and transmission equipment installed outdoors between the base station and the backhaul provider's central office or headend. In some cases, the backhaul provider brings connectivity to the tower operator's hut, from which connections are made to BTS cabinets owned and operated by multiple mobile operators. In other cases, the backhaul provider may bring connectivity directly to an individual mobile operator's BTS cabinet. This part of the network is quickly transitioning to fiber-based solutions.

Backhaul providers are constantly upgrading their network infrastructure to support the increased data rates that mobile operators are demanding.

4) Central office or headend. Often, the backhaul provider is the incumbent local telephone company, in which case the outside plant backhaul connection is to a central office (CO). Some competitive carriers also provide backhaul connectivity and their connections, too, would be to a CO. Alternatively, some cable systems operators provide backhaul connectivity, where the outside plant connects to the cable operator's headend.

5) *Data center.* To support their service offerings, mobile operators operate data centers, where subscriber and billing information is maintained. These data centers support several mobile switching centers that help manage traffic throughout the network. Adjunct capabilities such as voice mail, content and application downloads and location-based services also may rely on equipment and software residing in the mobile operator's data center. Often, mobile operators have just a few redundant data centers serving the entire country, so traffic may need to travel great distances between the backhaul provider's central office or headend and the data center.

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THE COSTS OF CONNECTORIZATION VS. SPLICING

As tower operators, mobile operators and backhaul providers upgrade portions of the backhaul network with high-bandwidth fiber connectivity, they must decide whether to splice fiber or to use a connectorized approach. Spliced connections are fused together using splicers that create a high-temperature arc to "melt" the fibers together. A connectorized approach uses multi-terminal connections in place of splices, enabling installers to quickly complete connections with plug-and-play, factory-installed fiber connectors.

More and more companies supporting the wireless backhaul network—including the mobile operator, tower operator and landline backhaul provider—are finding that they can more quickly install fiber solutions while reducing total installation costs. At the same time, the plug-and-play approach provides more network flexibility. The connectorized approach also simplifies the troubleshooting process—an important consideration when multiple parties are involved in providing the underlying network connectivity.

Installers can easily make connections using connectorized fiber. The process does not require the specialized training needed for splicing, eliminating the need to use highly specialized—and more costly—labor and equipment to handle fiber installations.

Installers also can install the network more quickly when they use connectorized fiber rather than splicing. ADC estimates that connections that would require an hour to splice would require only about three minutes using connectorized fiber. Faster installation can be a particularly critical requirement when upgrading mobile backhaul networks because those upgrades often are driven by network capacity concerns on the part of the mobile operator, whose data traffic has increased more quickly than anticipated.

"Often, there is an urgent need to get more bandwidth right now," notes Huegerich.

Nowhere is it more important to minimize the time required to make connections than at the antenna. Upgrading those connections typically requires installers to climb the tower—and making splices from a position high up on the tower is challenging, especially in inclement weather or when high winds are blowing.

The time savings that result from choosing a connectorized solution, coupled with lower labor costs, can generate significant cost savings for the company installing fiber. And

that's true for all parties involved, whether it's the backhaul provider upgrading its outside plant, the tower operator bringing fiber to the hut or the mobile operator upgrading connectivity to its data center, BTS cabinet or antenna.

OTHER BENEFITS OF CONNECTORIZATION

Cell towers, and the backhaul network that underlies them, are a dynamic element of today's mobile networks. "The vision we have is that these towers will be every bit as complex as data centers," Huegerich points out.

In the past, it might have been acceptable for cell towers to be out of operation for a few hours, but as mobile communications are becoming more and more critical, that is no longer true. "Towers can't go down anymore," says Huegerich. "People expect a higher quality of service now. Being down for two hours is unacceptable. People want more up time and higher service quality." To help meet customers' high expectations, some mobile operators may have a service level agreement with their tower operator that penalizes the tower operator for any downtime, Huegerich adds.

By using connectorized fiber, the companies involved in mobile backhaul networks can maximize their ability to meet mobile customers' high expectations by minimizing the time required to make changes to the network configuration or to troubleshoot problems.

For example, a new mobile operator might want connectivity to the cell tower, or an operator that is already connected may want to increase the speed of its cell tower connection. Those changes will be much quicker and easier if the parties involved have used connectorized fiber. And the tower operator may be able to simplify the process even further by installing a cross-connect system in the hut and leaving room to grow.

Another important benefit of the connectorized approach is simplified troubleshooting. Troubleshooting fiber connections at a cell site typically involves disconnecting the fiber and using an inexpensive light source on one end and a power meter on the other end. If the light can be detected at the one end, the technician knows to look elsewhere for the source of the outage. When connectorized fiber is used, it's much easier to disconnect the fiber for testing than when the fiber has been fusion spliced—and reconnection also is simplified.

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This is particularly important for connections to the cell tower, where the process of taking apart and replacing a fusion splice is so burdensome that if some technicians encounter a problem with the fiber, they will simply install a new fiber rather than troubleshoot the first one, Huegerich says. That process not only wastes materials; over time, it complicates ongoing maintenance and troubleshooting of the cell site.

SMART OPERATORS ASK FOR HELP

Mobile operators are in the business of providing bandwidth. They rarely have the time, money and expertise to do the installations themselves. Pressed by the need to boost backhaul capacity as fast as possible, many operators enlist the help of outside experts. These service professionals work closely with operators to design, engineer, furnish and install fiber-based backhaul networks that deliver maximum reliability, scalability and efficiency. By taking advantage of fiber solutions and expertise now available, operators can fortify their backhaul networks to handle the explosion of mobile-broadband traffic.

SUMMARY

Upgrading mobile backhaul networks to fiber in order to support higher data rates is a key priority as data traffic on these networks continues its dramatic rise. Many parties are involved in this process, including mobile operators and tower operators, as well as the telecom carriers and cable companies that provide landline connectivity.

Overall, there are five distinct connection points within the mobile backhaul network, including the antenna, base station, outside plant, central office or headend and data center. By using connectorized fiber, rather than fusion splicing at these connection points, the parties involved can save time, minimize costs, simplify troubleshooting and make the network more future-proof by providing a higher level of flexibility to support future network upgrades and changes.

Click here for more information about Wireless Backhaul Network Upgrades.