Unloading the Tower:

How to Reduce Tower Loading While Increasing Broadband Capacity

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The increase in broadband demand has placed some additional and sometimes dangerous loads on our nation's cellular towers. The newer methods of delivery such as LTE provide subscribers with better service; however, they require larger antenna planes, and additional cables. In the case of the cables, some sort of crane or other lifting apparatus is required to install them, and this can be very costly. Also, it is usually not possible to remove the current equipment before the new is installed. This causes additional problems with weight and wind loading. Fiber optics and microduct technologies are providing the much needed relief to those tower engineers, carriers, tower contractors and others that deal with this on a daily basis.

The trend today is to deploy the new technologies while not disrupting the current one, as taking an entire cell tower out of service for a month or so is really not a practical solution.

Let's use a 3 carrier structure as an example:

You will notice that for each antenna panel, a cable is required for both signal and power. So depending on antenna design, terrain and coverage patterns, each carrier could have upwards of 12 panels and thus 12 cables running up the structure. Most of these coaxial cables run from 7/8 inch in diameter to over 2 inches in diameter and can weigh as much as 2 pounds per foot. Which means a crane is needed to install each cable, which can be $1000 to $3000 per day, and taking a crew of 3-4 people about 20 hours to install.

So if we use the example of a 3 carrier tower with each carrier having 12 antenna planes, you have 36 coaxial cables running up the structure to feed them. If the tower is 300 feet tall you will have about 21,600 pounds of cable that if placed side by side (which is common), is 72 inches wide. The cable placement produces 2 problems:

1. Physical weight on the structure measuring 21,600 pounds of dead weight.
2. Lateral loading on the structure due to wind loading.

Wind loading is a critical factor involved in tower design simply because you have a 3 to 6 foot wide stack of cables that is 300 foot long. That provides a tremendous amount of surface area for the wind to affect (900 sq.ft-1,800 sq. ft .

The movement in the market today is to introduce fiber optics as close to the antennas as possible. Today if a cell tower is fed by fiber at all, it normally is just to the equipment at the base of the tower, and then converted to RF and passed through the coaxial cables to the antenna at the top. By pushing the fiber closer to the antenna, the coaxial cables can be virtually eliminated, thus removing the weight and wind load from the tower. Before this can be done, however, we have to address the issue of power. Since the antenna is normally powered over the coax, we have to provide power from the base of the tower to the antenna location over traditional wires and the signal over the fiber.

There are two manners by which this is done, both with advantages and some challenges.

The early trend was to create a composite cable with multiple strands of power cables and multiple fibers inside one sheath. This sheath looks very similar to the coax, and installs much in the same manner. The advantage is that for a single pass up the tower you have both your signal and your power needs met. The challenges with this type of cable are that because of the power component, they are still very heavy, and require a lifting mechanism to install them. Additionally, because the power cables are copper, they are susceptible to lightning. If the cable takes a lightning strike it will burn both the copper and the fiber that is right beside it in two, taking the tower out of service. It's kind of like putting all of your eggs in one basket.

To answer this problem, carriers are looking to microduct and ruggedized fiber as an answer. FieldShield microduct and fiber can be installed separate from the power cables and service the entire tower structure in a 10 mm footprint. Also, this combination is extremely light. Using the example above, a 300 foot length of FieldShield at .0314 lbs per foot adds only 9.42 pounds of weight and at .0328 ft in diameter, only 9.84 sq ft of surface area total. So comparing the two scenarios using the example above:

1. Coaxial: 21,600 lbs, and 900-1800 sq ft of wind loading.
2. FieldShield: 9.42 lbs, and 9.84 sq ft of wind loading.

Since the FieldShield is so light, no lifting mechanism is needed and can be installed by a crew of 3-4 in less than 2 hours.

Now that the pathway is in place, we run the same type of microduct to each of the antenna locations from a common terminal like the SmarTerminal. The feed tail of the SmarTerminal is dropped town the vertical feed microduct to be spliced at ground level to the feeder fiber. Everything on the tower deck is now plug and play. If we use a 3 carrier tower and are considering a 4^{th} carrier, simply run an empty microduct to each vacant antenna location and cap the ends with water tight caps until the new equipment is installed. Once the equipment is installed, push a pre-connectorized fiber through the microduct and plug the unit in. This type of setup limits the amount of time that a technician spends on the top of the tower and eliminates the need to splice in that environment. All splicing can be done at ground level.

You can see what the advantages are in using fiber not only to the tower, but up the tower, and that is not yet considering the advantage of fiber in regard to its capacity. Fiber can handle some 1000 times the data that a typical coaxial cable can. So in that category, there really is no comparing the two.

By utilizing the characteristics of fiber and by giving it the protection it needs in a harsh environment with FieldShield, we are able to not only increase the capacity of the tower from the perspective of signal, but we can also significantly reduce both physical weight and wind loading. From a labor perspective, we can eliminate the need for a crane and the costs associated with that, as well as hours needed for the installation. Additional savings are also seen when a new carrier is added because of the ability to just plug them in as opposed to having a technician climb the tower with a fusion splicer and splicing on the top of the tower (assuming we have pre-installed microduct to the antenna locations).

So cost savings in labor, weight and wind loading reduction, all while increasing the broadband capacity of the tower, can be achieved with FieldShield microduct and fiber terminated on the SmarTerminal.