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The Wide Open Small Cell Backhaul Playing Field

Greg Friesen

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Although it is unclear how quickly outdoor small cells will be adopted, it is widely accepted that small cells will be broadly deployed, and that they are essential to meet mobile capacity growth. For outdoor deployments, backhaul is a key challenge that needs to be addressed. One of the reasons the backhaul challenge is so daunting is due to a lack of a universal set of requirements, and the problems vary widely between operators and even markets within an operator. This diverse range of requirements means there will likely be a very wide solution set, as well as new vendors offering niche solutions for specific operator requirements.

First let's examine the range of outdoor small cell backhaul challenges and operator needs. Outdoor Small Cells are deployed in dense urban areas, which means they are installed on non-traditional telecom locations, such as light poles, traffic lights, billboards, telephone booths and sides of buildings. In these low, street-level locations, obtaining line of sight can be very difficult. Many sites do not have line of sight, and even those that do may be subject to temporary street-level blockage. This leads to spectrum allocation issues, as non-line of sight technologies are only reliable in the limited sub-6 GHz bands. While the 5 GHz band has some spectrum, it is subject to interference from a wide range of consumer devices and WiFi access points. The 2.5 and 3.5 GHz bands are available as licensed bands in some countries, but typically there is a limited amount of spectrum and it is only owned by one or two operators, and may not even be permitted for backhaul usage.

There are three potential bands above 24 GHz suitable for small cell backhaul, although all of them require line of sight. The 24-38 GHz bands are available in some countries, but the minimum antenna size limitation, spectrum availability, and cost of spectrum varies widely by country, making for very operator specific scenarios. The 60 GHz band or V-Band is a band that is available in a high percentage of countries, allows small antennas and is lightly licensed or unlicensed. This band has multiple GHz of spectrum and therefore can deliver high capacities to not only deliver service to a single site, but also to provide aggregation capacity for multiple sites. Although the range is typically limited to about 500 MB, this is quite suitable for most small cell deployments. The 70-80 GHz band or E-Band, also has a wide amount of spectrum, however, spectrum costs in this band can sometimes be higher, and there are minimum 1 foot antenna size limitations in many countries.

The next consideration is capacity requirements for small cells. Operator estimates on capacity range anywhere from 10 MBps to 1 Gbps depending on their density, target network capacity, and whether they are deploying for capacity or coverage. Target network availability is also a wide ranging requirement for small cell networks. Some operators want similar availabilities in their small cell network as their traditional macrocell network of 99.995-99.999 percent. Other operators view small cells as delivering extra capacity, and therefore best effort, as when a small cell is down, users will still be served with the existing network, but at a lower capacity. For these operators, target availability can be as low as 99 percent.

The type of deployment structure and where a system is deployed on the structure also has a major impact on the backhaul. On a billboard or the side of a building, there is very little twist or sway, and therefore a system like 60-80 GHz with static narrow beam antennas can be deployed without problems. In other locations, such as the arms of streetlight, there will be significant twist and sway, and wider beam or self-aligning solutions may be required. If high hub location, like the tops of large buildings are used, and the small cell density is high enough, then some operators may consider muli-point solutions to minimize CAPEX and install costs. These solutions will be limited by line of sight in the >24 GHz bands and by capacity, in the sub-6 GHz bands. The last, but very significant consideration is the mechanics and powering. The size, weight, shape, color and power available

may be dictated by mounting location as well as city councils, which often have very strict regulations for anything mounted at street level.

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