Backhauling in Access Spectrum: Is it Worth the Hidden Costs?

Greg Friesen

Article

October 7, 2013

As networks are approaching capacity limitations and moving to small cells, backhaul is becoming an increasingly daunting challenge. More specifically, in many countries, spectrum choices are limited and finding availability can be a challenge. While the 24-80GHz bands have sufficient spectrum, they are primarily line of sight bands. When seeking a NLOS solution, sub-6Ghz bands are attractive, but 5.8GHz is very crowded and prone to interference. As a result, many mobile operators are considering the use of access spectrum in the 2.1-3.7 GHz bands for NLOS small cell backhaul.

Image via Shutterstock

The benefits of using licensed sub-6GHz bands for small cell backhaul are very clear. The costs for these bands are usually sunk, so there is not an immediate link license cost. What's more, because the spectrum is licensed, an operator can guarantee service availability without concern of third party interference. And, since these bands are typically area licenses, an operator can use a single solution across an entire market.

There are, however, significant challenges in implementing LTE backhaul using these bands. To start, the amount of spectrum is very limited, with an operator typically having access to only a single 20 or 40 MHz unpaired channel. This spectrum also requires TDD operation, which has high delay, meaning it will typically only be suitable for a last mile, or perhaps "daisy chain" of two links. In addition, providing market-wide coverage and mitigating self-interference will typically require the spectrum to be divided into two to four channels. This results in channels of only 5-20MHz, limiting backhaul capacity to 25-100Mbps.

Even more significant than the delay and capacity challenges of these bands are the hidden costs. The 2.1-3.7GHz bands have traditionally been access bands and have been auctioned off at market value. In the United States, the 2.5 GHz spectrum was recently valuated at a cost of $.21/MHz POP. Using this spectrum for backhaul, and assuming 300Mill POPs, and a 20MHz license to cover 50,000 sites, one can anticipate a cost of $25,000 per 20 MHz link. In comparison, the cost target for a total small cell site is in the $5000-$10,000 range.

What's clear is that the spectrum cost would quickly ruin the business case for small cells. Some operators may have invested in this spectrum, and therefore consider it a sunk cost. Yet, in these cases, a broad small cell strategy is likely not in play, since it is typically employed to help with spectrum scarcity by improving spectrum reuse. In this case, an operator would be better served to use the 2.1-3.7 GHz spectrum as access spectrum, rather than backhaul spectrum.

Given that this licensed sub-6GHz spectrum is not economical for broad small-scale backhaul, is there any application for this spectrum in the small cell backhaul network? Yes, this spectrum can still be useful in suburban and rural areas where there is not spectrum exhaustion, but where small cells are instead being used for increased coverage. The sub-6 Hz licensed bands can also be used for temporary backhaul to initially turn up a small cell site. This will be beneficial to expand coverage before user penetration increases.

However, as capacity grows, the spectrum will need to be recovered for access, and backhaul will need to be transitioned to a higher-capacity, wireless link, such as a 38GHz, or 60 GHz link, or perhaps fiber, if the site can be accessed. Also, in some cases, the 2.1-3.7 GHz spectrum may not be licensed for access, and therefore can be very suitable for backhaul. A good example of this is in the

United States, where 50MHz of 3.65 GHz spectrum is available on a per link basis for backhaul applications. This spectrum is shared, so there are still interference concerns, and the very narrow amount of spectrum means capacity will be quite limited.

In summary, it's clear that 2.1-3.7 GHz licensed spectrum can be a very useful tool as part of a small cell backhaul network. However, it will not be the only solution, and the total cost and alternative uses of the spectrum must be very carefully considered before widely deploying what may be an extremely valuable asset. Addressing these concerns also doesn't necessarily lead to a universal solution, as the spectrum allocation, usage, ownership and costs vary broadly between countries and sometimes even between markets within a country.

View this Article Online

http://www.mobilitytechzone.com/topics/4g-wirelessevolution/articles/2013/10/07/355843-backhauling-access-spectrum-it-worth-hidden-costs.htm