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Reader Forum: Why 60 GHz matters for small cell backhaul

Posted on 10 October 2011 by by Joe Schraml, VP of Marketing, BridgeWave Communications. Tags: Opinion, Reader Forum

Editor's Note: *Welcome to our weekly Reader Forum section. In an attempt to broaden our interaction with our readers we have created this forum for those with something meaningful to say to the wireless industry. We want to keep this as open as possible, but maintain some editorial control so as to keep it free of commercials or attacks. Please send along submissions for this section to our editors at: dmeyer@rcrwireless.com.*

Mobile networks up to 3G were designed to deliver excellent coverage to the handset, accommodating small PCM voice channels on the order of eight kilobits to 16 kb, rather than high data speeds. 3G networks are deployed with radii typically around three to eight kilometers in diameter for the macrocell, and backhaul capacity of less than 50 megabits per second for connection to the core network. While most mobile networks today utilize 3G, operators are moving to technologies such as WiMAX 802.16e or even HSPA+ to claim "4G." In 2011, the Global Mobile Suppliers Association counted 17 commercial LTE deployments, with 180 operators in 70 countries committing to LTE, with another 64 in service by 2012.

4G is all about speed

With base stations capable of 170-plus Mbps per sector and data rates to the handsets on the order of 10 to 100 Mbps, 4G networks are being built on the promise of speed. However, as operators look to cost-effectively and rapidly migrate to 4G, the initial thrust of building out these new cell sites simply means co-locating the next-gen base station with the existing 3G equipment to light up an area. While this provides excellent 4G speeds to the handsets and devices for those

users within proximity to the cell tower, data rates rapidly decrease as one travels farther away from the base station, disappointing users looking for that 4G experience.

Small cell trends

There's a definite need for small cell architectures to augment the macrocell for ubiquitous 4G coverage. Some estimates say the ratio of picocells to macrocells will be on the order of five to one, while other predictions say anywhere between 10 to one and 20 to one. On top of that, analysts predict that by 2015, the small cell market could hit $5 billion.

Implementing picocells

4G picocell requirements differ from their 3G predecessors in terms of coverage area and backhaul capacity. To handle the 4G data explosion, large numbers of picocells will be required to economically deliver high speeds, especially in dense urban areas and other highly populated locations. A typical picocell site will likely cover a few hundred meters in diameter, but require backhaul capacity to scale beyond a few hundred megabits per second, reaching gigabit speeds.Operators may not have the luxury of placing picocells where it's convenient – locations such as on light poles are being considered because they already contain means to power the base station while height and location in urban areas make them ideal for illuminating a 4G coverage area.

Backhaul options

But what about the backhaul connection? Fiber is ideal, however the cost and challenge of implementing fiber to each picocell site is beyond the capex limits of most operators, especially in urban areas where streets and sidewalks cannot easily be trenched. As fiber will likely cover less than 30% of the requirement, wireless then becomes the logical backhaul choice.

Microwave radio systems from six to 40 GHz have been used for backhaul of the macrocell, however scaling these solutions to backhaul small cells presents a few challenges in terms of size, speed and regulatory hurdles. Antenna regulations within these bands dictate minimum gain requirements that can only be served by large diameter parabolic reflectors. Bandwidth limitations mean these solutions top out around a few hundred megabits per second for a single RF channel, while the high recurring (in some areas) licensing costs cannot support large scale deployments.

60 GHz wireless for small cell backhaul

When one combines the need for short distance connectivity as well as high capacity gigabit transmission rates, the 60 GHz millimeter wave frequency band is the ideal spectrum for the wireless backhaul of picocells. Characteristics that make 60 GHz the ideal spectrum include:

–Spectrum availability: The 60 GHz frequency band offers up to 7 GHz of spectrum. Full duplex transmissions utilizing low-order modulation methods such as two- or four-level PSK can yield multi-gigabit transmissions. Equipment designs are simplified and low-cost power amplifiers can be operated at near P1dB without distortion. Transmissions at native gigabit speeds simplify the network design by eliminating quality of service mechanisms, while providing ample capacity to support daisy-chain, ring and mesh architectures.

–Distance: Oxygen molecules resonate at 60 GHz, attenuating the RF signal by as much as 14 dB/km. This limits the distance of these 60 GHz transmissions to about 1.5 kilometers. Typical link distances for picocell backhaul are estimated to a few hundred meters between sites, while providing carrier-grade "five-nines" availability. Beyond those distances, the signal is severely degraded to the point where an unwanted signal falls below the threshold of the wanted receiver.

–Antenna directivity: High gain and narrow beam width antennas can be implemented using relatively small, low cost designs compared to their microwave counterparts. In addition, these "pencil-beam" antennas provide significant interference immunity, allowing for co-location of multiple antennas on a structure.

–Antenna size and shape: Relaxed regulations at 60 GHz still yield high-performance antennas, while their design can unobtrusively blend in with the environment, such as on top of street poles, billboards or sides of buildings. This is crucial in metro areas where aesthetic and environmental considerations deem the wireless solution not look like a wireless solution.

–Frequency re-use: At times, the challenges of implementing a wireless backhaul solution are due to frequency congestion and interference. These challenges are further exacerbatedwith dense cell deployments. The 60 GHz spectrum offers excellent frequency reuse due to the short distance transmission range due to oxygen absorption, abundance of spectrum and highly directive antennas.

–Licensing costs: Due to the limited distance and excellent antenna directivity afforded by the use of 60 GHz, many regulators have chosen to allocate this spectrum on a "license-free" basis, helping to keep the operating expense low for large scale deployments.

–Component costs: WiGig 60 GHz indoor solutions are driving the silicon volumes up and costs down to a point where radio manufacturers will be able to leverage economies of scale to further reduce solution costs.

60 GHz matters for small cell backhaul

As next-generation mobile networks are being rolled out, ubiquitous, high-speed 4G coverage requires divergence from the 3G macrocell model. Operators' implementation of picocell architectures on their networks will solve the question of capacity to the handset, while 60 GHz solutions can provide a cost-effective, highly scalable backhaul connection from the picocell back to a macrocell, or back to the network core.

2 Responses to "Reader Forum: Why 60 GHz matters for small cell backhaul"

1.  *Jessica* says:
October 11, 2011 at 3:09 pm

60 Ghz is one of the best options for LOS backhaul for small cells because an operator can roll it out quickly, anywhere. Mobile Experts has published a report with a five-year forecast, predicting that 60 GHz backhaul links will grow very rapidly with small cells. See http://www.mobile-experts.net.

Reply

2.  *Frank Rayal* says:
October 18, 2011 at 8:22 pm

Agree that 60 GHz will play a role in small cell backhaul mainly due to its large capacity. However, I also believe that non-line-of-sight will play a very large role as well and the two solutions can be complementary. This is because NLOS backhaul is easy to plan and deploy. It allows operators deploy small cells that have small radii exactly in the spots where they are needed. Also, NLOS business model works well because of declining marginal cost per link. You can read more about it on my blog at http://www.blinqnetworks.com/blog.

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