Why Wireless Millimeter Wave Radios Will Fuel the Coming Microcell Boom

With proliferation of micro and picocell base station installations, wireless millimeter wave radios are being used to solve backhaul connectivity challenges

As carriers continue to roll out LTE networks to meet the overwhelming demand for mobile broadband data services, small cellular base stations, called micro and picocells, are expected to proliferate across the landscape over the next several years.

In cellular networks, these small cell towers, or base stations, are used to extend coverage to indoor areas where outdoor signals do not reach well, or to add network capacity in highly populated locations.

Although micro and picocells cover only a limited area, they require less power and have a much smaller footprint than larger “macro” cell towers. Costs are also reduced as small cells circumvent the need to deploy expensive new macro base stations. This makes them ideal for indoor locations such as a popular entertainment venues, shopping malls, airports, train stations, office buildings, and hotels.

Still, despite its lower cost and ease of installation, analysts estimate that this market could boom to $5 billion or more by 2015, with small base stations outnumbering traditional cell towers by as much as 20 to one.

But the advent of LTE networks is creating a new backhaul connectivity problem. The question is how to connect the growing number of smaller base stations to the core, either through wired or wireless high speed connections.

This is exacerbated by concerns over frequency congestion and interference in dense cell deployments where 4 or more picocells could be mounted on light poles in a single parking lot or on a rooftop, for example.

The most obvious solution for high speed transmission of data-intensive content would be to establish a physical connection using fiber optic cabling. However, the cost and challenge of implementing fiber to each micro or picocell site is prohibitive, particularly in urban areas where streets and sidewalks cannot easily be trenched.

As a result, outdoor, "fiber optic quality" wireless products are currently being considered as a cost-effective, highly scalable backhaul connection solution.

Millimeter Wave Wireless

Although the use of microwave wireless has been touted broadly in general, it is specifically the 60 GHz (unlicensed) and 80 GHz (light licensed) bands of the millimeter wave spectrum that hold the most promise.

Millimeter waves operate within a frequency range of 30-300 GHz. Millimeter waves are a subset of the Microwave band, which in turn is part of the larger radio wave band.

What makes millimeter waves so attractive for wireless is the available bandwidth. Standard wireless at lower frequencies can only deliver 2-5 MHz of bandwidth. The millimeter wave band can deliver data at speeds of up to 10 GB/s currently, with projections increasing to as much as 40 GB/s by 2014.

"If you can't run fiber optic cabling, millimeter wave wireless is the fastest, quickest, smallest and least expensive solution," says Wayne Pleasant, former Chairman of the Wireless Communication Industry Association (WCIA) committee charged with helping the FCC establish guidelines for the 80 Gigahertz light licensed millimeter wave band.

"In many key ways millimeter wave devices can be more reliable, and even faster, than fiber optics," says Pleasant. "Due to a reduction in latency, transmission speed is improved. As for reliability, data shows that currently available commercial millimeter wave radios can achieve gigabit speeds while providing carrier-grade 99.999% uptime."

According to Pleasant, who is currently a business development consultant for Renaissance/HXI, a company that recently released several millimeter wave radio products for this market, the interest is coming from the cellular companies, installation providers that build the infrastructure and lease or operate it for a cellular company, as well as picocell manufacturers interested in building the wireless radios required into the picocell housing.

“The questions we get are invariably are, ‘How small can you make it?,’ ‘How inexpensive can you make it?’ and ‘How easy is it to set up?,’” says Pleasant.

Unique Properties Suit Picocell Backhaul

The strength of the millimeter band is its unique set of properties, many of which might be perceived as limiters but for short range, direct point to point wireless are considerable strengths.

Compared to lower frequency bands, radio signals in the millimeter band are extremely prone to atmospheric attenuation, restricting transmission to several kilometers. However, with typical link distances for picocell backhaul estimated to a few hundred meters between sites, and microcells less than two kilometers, this is ideal.

Because the wavelengths in this band are so short, millimeter wave radios require only very small antennas, measured in inches rather than feet for Wi-Fi and other wireless options.

This also addresses another concern over potential “visual pollution” caused when mounting a large quantity of such products to light poles, billboards, or the sides of buildings.

“Narrow beam antennas allow systems in these bands to be engineered in close proximity to one another without causing interference. Since a greater number of highly directive antennas can be placed in a given area, the net result is higher reuse of the spectrum, and higher density of potential users,” says Pleasant.

Products Emerge

In anticipation of the coming boom, the first millimeter wave products in the 60 GHz band for unlicensed and light licensed commercial applications – are now being introduced that specifically target the micro and picocell market.

Renaissance Electronics & Communications (REC), for example, has recently introduced a millimeter wave based product for cellular backhaul applications called GigaLink Light Speed radios.

These millimeter wave transmitter/receiver units are available in light licensed and unlicensed versions with a full duplex throughput of 1.25 Gbps and higher, offering plenty of IP-based bandwidth.

These radio links are designed to minimize latency, or lags in data transmission, which is critical to the next generation of data centric devices that must accommodate Voice over IP (VoIP), live digital streaming, large file downloads, and video conferencing through mobile handsets.

“The latencies with millimeter wave wireless are so minimal it’s very difficult to measure accurately,” says Pleasant. “We can only say for sure they are less than 20 nanoseconds, billionths of a second, from the input of one radio to the output of the second radio back to back. We have calculated that the latency for each radio is 2 nanoseconds or less.”

For more information, contact Renaissance Electronics at phone (978) 772-7774 or on the web at www.rec-usa.com. They are located at 12 Lancaster County Road, Harvard MA 01451.