Race to 5G wireless heats up with new measurements, models, and math

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It's a race that is being conducted on the rooftops of New York and other global megacities, and the prize is the future of 5G, the next generation of wireless technology—capable of a thousand-fold increase in today's rates and fast enough to revolutionize wireless medical equipment, democratize Wi-Fi, and display high-definition movies on mobile devices without those annoying buffering delays.

In the *Microwave Journal* this month, New York University researchers recount how their new measurement tools and soundings from the Manhattan and Brooklyn rooftops of NYU are positioning the United States to take advantage of high-frequency radio waves. This millimeter-wave (mm-wave) spectrum was previously discounted because its tiny waves travel only short distances and were believed to be obstructed by rain, leaves, buildings, and bodies. Instead, the researchers of NYU WIRELESS, a research center of the NYU Polytechnic School of Engineering, report promising findings that could enable 5G mm-wave cells to be as large as several hundred meters—the same size as 4G cells in dense urban environments. This is an important economic incentive for carriers, which pay dearly for the rights to install each antenna covering a cell.

Professor Theodore (Ted) S. Rappaport, director of NYU WIRELESS, and student co-authors outlined their new tool, which uses National Instruments technology to measure mm-wave channels: a sliding correlator channel sounder system, which measures over very large bandwidths, even beyond line-of-sight conditions. The researchers tested in the 28 and 73 gigahertz bands, both outdoors and in the complex interior environment of a simulated office. The measurements, as well as the mathematical channel models, will help engineers design future mm-wave wireless communications systems and will assist in the standardization of these networks.

The article introduced extensive wideband mm-wave propagation measurements, as well as directional and omnidirectional path loss models and multipath spread characteristics. The measurements and modeling also revealed potential for some simplified receiver structures, as well as for the formation and combination of specific transmitting beams to improve the signal-to-noise ratio.

The Federal Communications Commission recently gave impetus to the race to 5G by opening up a two-month public comment period to explore the feasibility and implementation of high-frequency radio waves in the mm-wave spectrum. The Notice of Inquiry cites the research of NYU WIRELESS.

"Small Wavelengths—Big Potential: Millimeter Wave Propagation Measurements for 5G" was co-authored by doctoral students Sijia Deng, Christopher Slezak, and George MacCartney. The full paper can be viewed here.

New York University's Polytechnic School of Engineering launched NYU WIRELESS in August 2012. Focused on mass-deployable wireless devices across a wide range of applications and markets, NYU WIRELESS is the first university center to combine wireless, computing, and medical applications research. NYU WIRELESS includes more than 20 faculty members and 100 graduate students from the NYU School of Engineering Electrical and Computer Engineering Department, NYU Courant Institute of Mathematical Sciences, and the NYU Langone School of Medicine.

During its seminal mm-wave research, NYU WIRELESS is functioning as a hub linking its 11 industrial affiliates as well as researchers at other universities. Its measurements and theoretical modeling work continue to uncover unexpected potential. The center is also developing antennas and other 5G technology, including medical applications that will become possible with massive increases in data capacity.

More information: "Small Wavelengths – Big Potential: Millimeter Wave Propagation Measurements for 5G." www.microwavejournal.com/articles/23274

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