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NYU WIRELESS
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This experimental license request expands upon propagation measurements at New York University (NYU). The current license at NYU is file number: 0040-EX-ML-2012, with confirmation number: EL142949, and call sign: WF2XQM. Thus far, propagation measurements for research purposes have been conducted at 28 GHz, 38 GHz, and 60 GHz with 1 GHz RF passband bandwidth at each of these carrier frequencies. In addition to these carrier frequencies, this application requests 72 GHz with 5 GHz RF passband bandwidth (i.e. 69.5 GHz - 74.5 GHz) to be added to the current license and to increase the bandwidth for 28, 38, and 60 GHz to 5 GHz RF passband bandwidth.

Millimeter-wave communications in frequency bands above 20 GHz are the next frontier of the wireless age. At these frequencies, immense uncompressed data rates are possible (1-10 Gbps). The unprecedented data rates possible at millimeter-wave frequencies are not available in lower frequency bands, which are spectrally crowded due to the rapid expansion of traditional wireless technologies. Several major corporations have already committed resources towards creating products for the unlicensed 60 GHz band, and several short range indoor devices are already on the market. Future uses of millimeter-wave bands such as 28 GHz, 38 GHz, 60 GHz, and 72 GHz, include vehicle-to-vehicle or base-station to mobile applications in the sub-1 km range.

The physical circuit challenges of operating at these frequencies are important for communication systems, and have been explored extensively for the past decade. However, reliable wireless communication systems must operate in more than a highly controlled laboratory environment. In this context, channel sounding, or channel propagation measurements, are required to provide knowledge that will be used in the design of any wireless millimeter-wave communication system.

The research group at New York University (NYU) and Polytechnic Institute of NYU (NYU-Poly) possess one of the few systems in academia capable of performing channel measurements at 28 GHz, 38 GHz, 60 GHz, and 72 GHz at a distance of a few hundred meters. Professor Theodore Rappaport, who served on the FCC technological advisory board for several years, has utilized this system for both indoor and outdoor propagation measurements (See References 1-7). These preliminary investigations received many citations and are currently of great interest to communication system engineers planning and designing millimeter-wave radios.

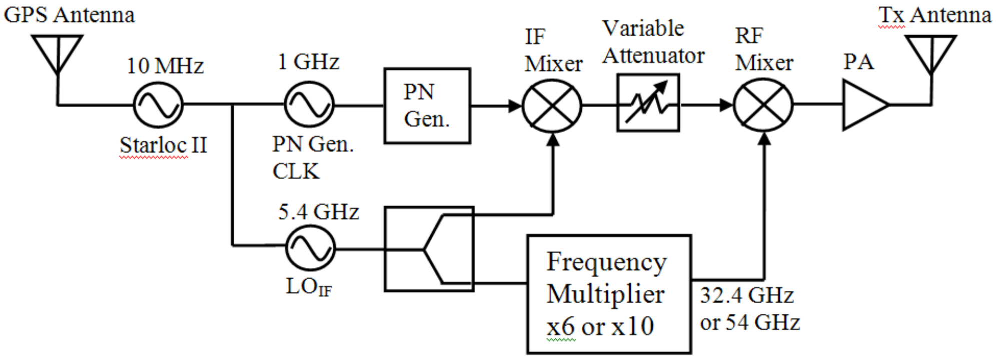
The proposed 48-month project involves outdoor stationary and mobile measurements around NYU and NYU-Poly main campus in Manhattan and Brooklyn, New York, respectively, with transmission range not exceeding this campus area. Various types of multipath measurements will be acquired including power delay profiles, angle of arrival and departure, foliage and fog attenuation effects, Doppler shifts, small and large scale fading effects, and co-polarized and cross-polarized links. In addition, we desire to conduct backhaul, peer to peer and future cellular coverage, building penetration and multipath at all these frequencies. Such measurements are vital for understanding link budgets, range, and spatial frequency re-use distances. In addition, this license would allow Professor Rappaport to conduct research on his new NSF (National Science Foundation) Advancing Innovative Research award. This award (#1237821) was given to Professor Rappaport on July 1st 2012 to pursue his research[1]. The requested 72 GHz frequency band will have a transmission power of +15 dBm (31.62 mW) peak power before antenna. The transmitted signal is a spread spectrum type with the signal being spread over a bandwidth of 5 GHz. A swept time delay cross-correlator channel sounding technique utilizes the direct sequence spread spectrum signal to perform a wideband measurement. Various directional antennas will be used with gains not exceeding 40 dBi. These antennas, built by DBS Microwave and SpaceK Labs, are listed in the table below with their corresponding boresight gains and beamwidths.

Antenna	Gain (dBi)	3dB Beamwidth (degrees)
U-band Tx Rectangular Horn (60 GHz)	25	6.25
Q-band Tx Sectorial Horn (38 GHz)	19	7.51
Q-band Rx Conical Horn Reflector (38 GHz)	39	16.91
Ka-band Tx Rectangular Horn (28 GHz)	24.5	7.8
V-band Tx Rectangular Horn (72 GHz)	23.4	8 – Typical
V-band Tx Rectangular Horn (72 GHz)	30-33	7.5 – Typical

The full system consists of pseudorandom noise (PN) code generators being converted to an intermediate frequency (IF) of 5.4 GHz and then upconverted to the final radio frequency (RF) of 28 GHz, 38 GHz, 60 GHz, or 72 GHz depending on which RF front-end equipment is used. The receiver down converts the signal with the same RF and IF frequencies. An IQ demodulator extracts the in-phase and quadrature-phase components of the signal, in order to collect the phase information of the received signal. Lastly, a correlation operation (multiplication and integration) is performed between the received signal and a time-swept replica of the PN code sequence.

Frequency synthesizers are used to generate local oscillators for the up and down conversion mixers, as well as the PN generator clock. These frequencies are all generated from a common reference of 10 MHz provided by Datum’s Starloc II GPS-disciplined ovenized oscillator. A diagram of the described system is seen below.

Transmitter



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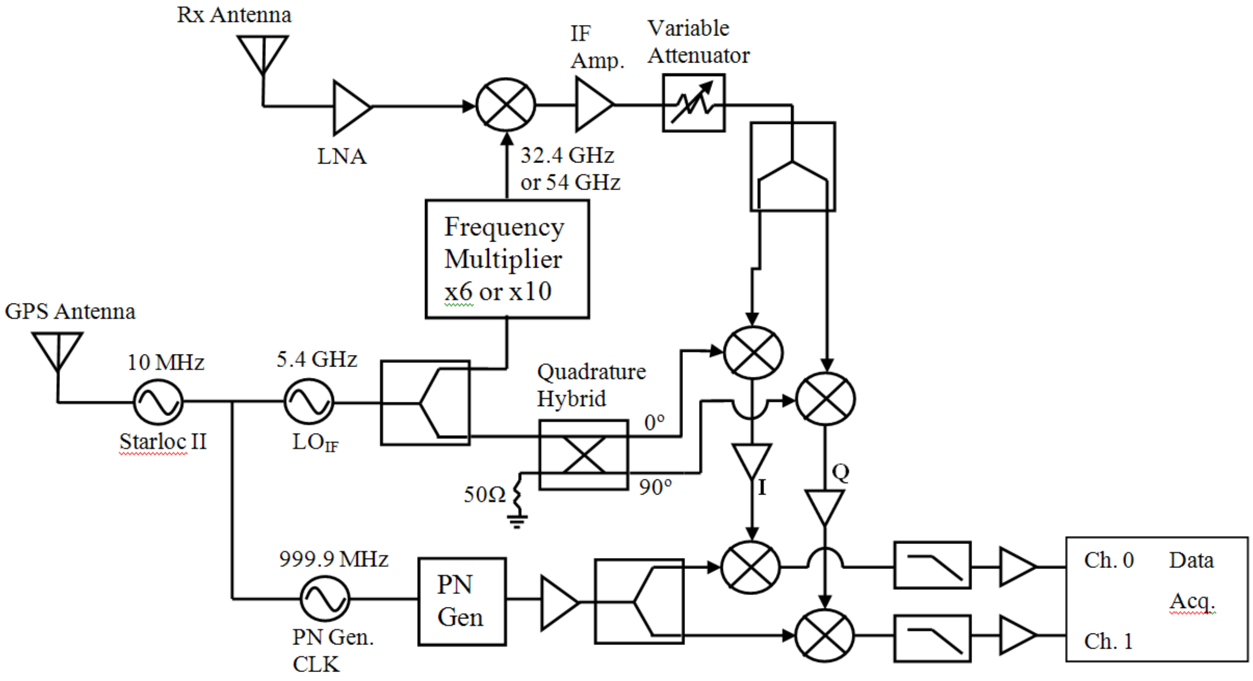
[1] A link to the press release: http://www.poly.edu/press-release/2012/07/19/searching-1000-times-capacity-4g-wireless

Receiver



Once data is collected, it will be processed and integrated into channel models. This information will be published in scholarly journals to assist industry, academics, government regulators, and other researchers and designers in developing advanced communication systems.

References

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