## Nokia Solutions and Networks and NYU WIRELESS bring the first-ever 5G Summit to Brooklyn

If you had any doubts that Brooklyn was fast becoming one of the hottest locales in the tech industry, look no further than the 5G Summit, held from April 23 to 25 at the New York University Polytechnic School of Engineering. Co-organized by the NYU WIRELESS research center and Nokia Solutions and Networks (NSN), the conference, planned to be an annual event from now on, brought together industry leaders from across academia, business and government to explore the future of Fifth Generation—more commonly called 5G--wireless technology.

“Our vision is to make 5G a platform for innovation, a platform that can be used to improve business, life, and society,” Hossein Moin, the chief technology officer of NSN, explained to the audience. Recalling the 2002 earthquake in his native Iran, Moin asserted, “Networks were set up within 24 hours, and they undeniably helped save lives. That’s how powerful wireless can be.”

John Stankey, the group president of AT&T, who gave a keynote address titled “Better, Stronger, Faster: Unleashing the Next Generation of Innovation,” heartily concurred, and he additionally pointed out that mobile communication is a significant contributor to the global economy, projected to add more than $10 trillion to the worldwide GDP between 2013 and 2017 alone.  “There is insatiable demand for mobile connectivity,” he said. “No one wants to run wires or be tethered to a desk anymore.”

That insatiable demand shows no sign of being quenched. Thanks to steadily increasing levels of video gaming, Web browsing, and media streaming on mobile devices, demand for capacity reportedly doubles annually. “This is the reality, so in order to meet those demands, our future ecosystem must change and grow,” Stankey said. He found no dissenters among the many attendees, who were treated over the course of the conference to discussions of such topics as the evolution of millimeter-wave technologies (from Ali Sadri of Intel) and what lies ahead for cellular system design (from Professor Andrea Goldsmith of Stanford University). Other talks centered on antenna design, 5G spectrum availability and regulatory issues, and more. The key conclusion: if properly engineered, will be

Ted Rappaport, the founding director of NYU WIRELESS and the driving force behind the landmark gathering, said, “The Brooklyn 5G Summit has brought together the top minds from around the globe to accelerate our drive for wireless communication solutions.” He continued, “It’s gratifying to see so many of the industry’s leaders working together to address the challenge.”

The Institute of Electrical and Electronics Engineers (IEEE), the world’s largest engineering organization, provided live coverage of the event through its television network, enabling those who could not attend the chance to hear the vital information being discussed. Katherine Fleming, NYU’s deputy provost, stressed the value of that information when she formally welcomed the participants. “NYU is proud to be hosting you,” she said. Recalling that as a child she was sometimes admonished for fiddling with rubber bands or other such activities with the warning that “small minds engage in small activities,” she proclaimed, “Today, we are seeing big minds engage in incredibly big activities.”

Equally complimentary was New York State’s Lieutenant Governor Robert Duffy, who addressed the assembled over lunch. “I’m just an end user of what you’re creating here,” he quipped. “And speaking as someone who simply wants to hit a button and have my device work, I find the synergy and talent in this room awe-inspiring. You are truly helping to change the world.”

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(magnetic resonance imagery)

## Prof John Viventi Receives $402,483 Grant from Army Research Office

Jonathan Viventi, an NYU WIRELESS Professor and Professor of Electrical and Computer Engineering at NYU was the recent recipient of a $400,000+ grant from the Army Research Office. Viventi is exploring uses for high-density neural recording to understand some of the brain’s most basic capabilities. His project aims to demystify the human auditory system, specifically examining the signals associated with paying attention and absorbing information in the presence of noise.

For example, the research could help determine how we can carry on a conversation in a noisy restaurant. The project is a collaboration with Yale Cohen in the Department of Otorhinolaryngology, Head and Neck Surgery at the University of Pennsylvania School of Medicine.

## LTE-like Transmission in the Millimeter Wave Frequencies

NYU WIRELESS PhD students Russell Ford and George MacCartney have demonstrated the center's first LTE-like transmission in the millimeter wave frequencies.  Millimeter wave (mmW) bands between 30 and 300 GHz are a new frontier for cellular wireless communication that offers the possibilities of orders of magnitude more spectrum than current cellular allocations.  These bands have been the focus of considerable interest for Beyond 4G and 5G cellular systems and are one of the key research areas of NYU WIRELESS proceedings and It will work paper:

Link: <http://ieeexplore.ieee.org/xpl/articleDetails.jsp?tp=&arnumber=6515173> and Link: <http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=6732923>).

In collaboration with National Instruments, an NYU WIRELESS industrial affiliate, Profs. Rangan and Rappaport and their students have been developing a high-performance software defined radio platform that can provide one of the first systems for experimentation in 4G and 5G cellular systems in a university research lab.  Using this platform, the students were able to demonstrate end-to-end transmission of high-definition video stream in the 60 GHz range.  The system included modules for synchronization, equalization and turbo decoding, as well as a MAC and upper layer protocol functionality.  The successful transmission on this system is a significant first step for NYU WIRELESS to make mmWave systems a reality!

## NYU WIRELESS Prof. Justin Cappos’ Group Devises New Scheme to Make Cracking Individual Passwords Impossible

NYU WIRELESS Professor Justin Cappos and his research group have devised a new scheme called [PolyPassHash](http://polypasshash.github.io/PolyPassHash) for storing password hash data so that an attacker cannot individually crack passwords. Instead of a password hash being stored directly in the database, the information is used to encode a share in a Shamir Secret Store. This means that a password cannot be validated without recovering a threshold of shares, thus an attacker must crack groups of passwords together. The solution is fast, easy to implement (with [C](https://github.com/PolyPassHash/PolyPassHash-C) and [Python](https://github.com/PolyPassHash/PolyPassHash/tree/master/python-reference-implementation) implementations available), requires no changes to clients, and makes a huge difference in practice. To put the security difference into perspective, three random six-character passwords that are stored using standard salted secure hashes can be cracked by a laptop in an hour. With a PolyPassHash store, it would take every computer on the planet longer to crack these passwords than the universe is estimated to exist.

**NYU WIRELESS Director Ted Rappaport Tells the EE Times “The 5G Spectrum is Needed”**

Professor Ted Rappaport, NYU WIRELESS Founder and Director, recently spoke with EE Times Silicon Valley Bureau Chief Rick Merritt about the 5G Spectrum currently on the horizon. Rappaport insists that there is a coming renaissance in wireless and in order to harness its potential, US regulators should be opening up licensing on the millimeter wave bands.

“We need a playground for carriers to develop the prototypes to show what can be done at 28, 38 and 70-90 GHz bands. There’s a big movement here, but I’m just afraid the US is behind in it,” said Rappaport.

In Rappaport’s view, other countries are currently moving to license these bands at a much faster rate than the United States. “Korea and China see this opportunity and appear to be more spectrum friendly in the use of millimeter waves for cellular mobility.” Prof. Rappaport had the opportunity to share the exciting work being done at NYU WIRELESS, particularly with regards to the propagation database of millimeter wave signals that each of the center’s industrial affiliates has access to, provide they sign an end user license agreement. “Our work showed directional antennas bouncing energy in an urban environment makes a good cellular link – better than today’s cell phones.”

## Prof. Dennis Shasha Named 2014 ACM Fellow

NYU WIRELESS Associate Director Dennis Shasha has been named a 2014 ACM Fellow for his technical and literary contributions to the field of data management. ACM (The Association for Computing Machinery) is the world’s largest educational and scientific computing society and delivers resources that advance computing as a science and profession.

Prof. Shasha describes his research as "puzzles on large data." This has included work on machine learning, fast data structures for data warehouses, distributed fault tolerant data structures, and applications like the design of the wireless propagation database. The literary part of the award citation refers to the books he has written including books on Database Tuning, Fast Algorithms for Time Series, and popular trade books on the interactions between computing and biology.

Along with Prof. Rappaport, Prof. Shasha has designed the wireless propagation database available to all affiliates and is working Drs. Sodickson and Otazo to make Magnetic Resonance Image reconstruction hundreds of times faster.

## Prof Shiv. Panwar Featured in IEEE Signal Processing Magazine

NYU WIRELESS Professor Shiv Panwar was featured in the January 2014 issue of IEEE Signal Processing Magazine for a feature story entitled “Fresh Approaches Promise Wireless Quality and Reliability Improvements.” Prof. Panwar and researchers worldwide have been working on resolving long-standing issues of wireless quality and reliability. While the lay person often takes for granted that their wireless applications usually run efficiently, quality and reliability hinge on numerous factors including transmission technology, user device, signal strength, interference and terrain.

Panwar says, “For wireless to fulfill its promise in the years ahead, users need to be confident in the quality and reliability of their applications.” Panwar has been focusing his research on a new technique called “streamloading” to address the issue of poor quality wireless video streaming. Streamloading relies on a video format which splits the streaming video into a pair of layers, a base layer which contains rough video and an enhancement layer which supplies the finer details. It operates in the background, predownloading the content’s enhancement layer onto the user’s device, leaving only the base layer to be streamed, which oftentimes is done with a slow wireless link. Through steamloading, Panwar estimates that as much as 75% of streaming content could be removed from overloaded cell networks while also cutting the high data usage charges for consumers. According to Panwar, discussions with wireless carriers are already taking place to explore the applications of streamloading.

<Link to full story: http://nyuwireless.com/wp-content/uploads/2014/04/Fresh-Approaches-Promise-Wireless-Quality-and-Reliability-Improvements.pdf>