News

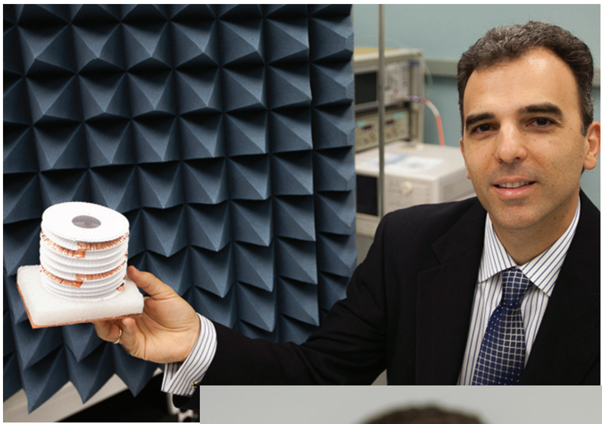
Teams Apply Paper-Folding Techniques To NEXT-GENERATION ANTENNAS

The traditional Japanese paper-folding art of origami is currently being applied to an entirely non-traditional idea: the creation of compact and efficient antennas. Researchers at Florida International University (FIU) and Georgia Technology Research Institute (GTRI) have joined forces to work toward the development of unique antenna shapes. When folded flat, they only take up a couple of centimeters. Yet these antennas can expand into much larger spaces to provide powerful, ultra-broadband capabilities.

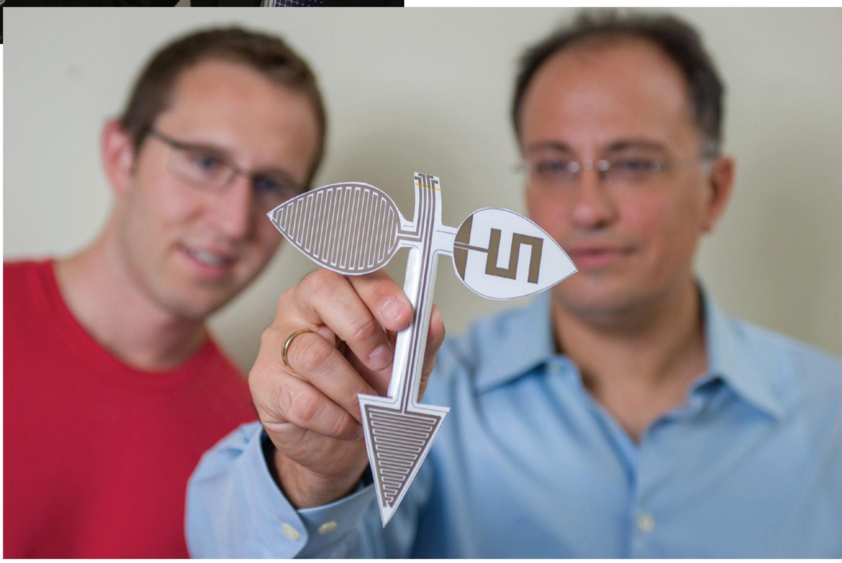
Support for this research is provided by a $2-million grant from the National Science Foundation. The teams are led by Stavros Georgakopoulos, assistant professor at FIU's Department of Electrical and Computer Engineering, and Manos Tentzeris, a professor in the Georgia Tech School of Electrical and Computer Engineering. Like traditional origami, this approach uses paper. To create antenna elements with the necessary capabilities, an inkjet printing technique is used to deposit conductive materials, such as copper or silver, onto the paper. Other materials also are being explored for use, such as plastics, fabrics, carbon fibers, and flexible dielectrics and organics.

Various self-activation mechanisms are being studied that would allow the antennas to rapidly unfold in response to incoming signals—without the use of electronics or electrical power. One potential solution—the harvesting of ambient electromagnetic energy in the air—has already shown promise. Tentzeris' team recently demonstrated that antenna deployment could be powered by built-in circuits, which collect energy from ambient airborne signals provided by TVs and radios. Another potential approach uses chemicals that produce movement in ways that mimic nature, such as plants unfolding in response to light stimuli.

Currently, the teams are challenged by the need to maximize the number of



Above, Professor Stavros Georgakopoulos with a prototype origami antenna. In regard to uses for the technology, Georgakopoulos said that it could potentially allow a soldier to carry a powerful antenna, folded into his back pocket, into combat. (Photo courtesy of FUI.)



Below, Professor Manos Tentzeris (right) and Ph.D. student Benjamin Cook (left) with an inkjet-printed, "zero-power" leaf wireless sensor that can sense and report groundwater moisture content. (Photo courtesy of Rob Felt at Georgia Tech.)

shapes that can be achieved in a single folding structure. Mathematicians are developing derivatives of classic origami principles that could result in the formation of 16, 32, 64, or more different types of antennas from a single device that is less than one square inch when folded. The key advantage of collapsibility is ideal for a variety of applications where traditional, large-scale antennas are not an option. This includes a range of both military and commercial uses, such as communications equipment, wireless sensors, health-monitoring sensors, and portable medical equipment. ■

T-MOBILE, VERIZON Spectrum Trade Exposes LTE Market Shifts

COMPARED TO THE high-band sections of the mobile spectrum, the low band has the capability to improve in-building and rural coverage at greater distances. The Long Term Evolution (LTE) landscape is subsequently shifting and growing—especially after T-Mobile's recent acquisition and swap of spectrum with Verizon Wireless. This and other factors have led Strategy Analytics to predict that LTE will account for 50% of wireless connections in the U.S. by the end of this year.

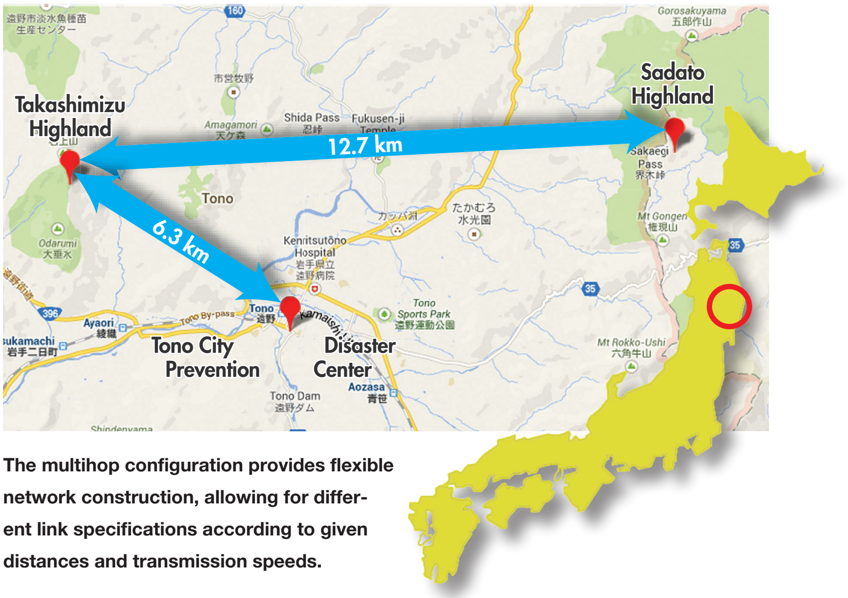
The "Worldwide Cellular User Forecasts, 2013-2018" report forecasts that the U.S. will lead the world in 4G LTE in 2014—accounting for more than one in three of the expected 528 million LTE connections. When combined with its existing holdings, T-Mobile's purchase of select 700-MHz A-Block spectrum licenses position it as a leader in the market. T-Mobile will now have low-band spectrum coverage for approximately 158 million people in regions such as New York, Los Angeles, Dallas, Houston, Philadelphia, Atlanta, Washington, D.C., and Detroit.

In exchange for those 700-MHz licenses, Verizon received a selection of advanced-wireless-service (AWS) and personal-communications-service (PCS) licenses. The additional airwaves provide coverage where the company has been struggling to relieve network congestion—urban areas including Los Angeles, San Francisco, Dallas, Atlanta, and Detroit. As Verizon looks to build out its coverage, two-thirds of its traffic is now represented on the LTE network. ■

WHITE-SPACE SPECTRUM Shows Potential For Long-Range Communications

THE TV WHITE-SPACE spectrum has proven that it can increase broadband-communication services in difficult areas. Yet it has not been fully vetted for long-range communications. When an unlicensed portion of radio spectrum with a low probability of interference is used on existing infrastructures, the lower frequency (470 to 710 MHz in Japan) typically has a low impact on distance decay (compared to higher-frequency legacy systems). Recently, a long-range broadband-communications field trial in Japan's TV white space was completed using IEEE 802.22- and 802.11af-based systems.

The IEEE 802.22 standard for wireless regional-area networks (WRANs) covers a radius of 10 to 40 km for rural-area broadband service. The IEEE 802.11af standard, in contrast, specifically targets white-space operation. In this demonstration, a multihop network was constructed using an IEEE 802.22 backbone link. That link was connected to an IEEE 802.11af wireless link, thereby expanding the connection area. The multihop configuration uses a relay terminal to connect terminals that cannot directly transmit on their own. A wireless local-area network (WLAN), based on conventional IEEE 802.11b/g/n in the 2.4-GHz band, was attached to the IEEE 802.11af link. It allowed off-the-shelf devices to access the network's connection.



The multihop configuration provides flexible network construction, allowing for different link specifications according to given distances and transmission speeds.

The trial was performed in Tono City in Japan's Iwate Prefecture by the National Institute of Information and Communications Technology (NICT) and Hitachi Kokusai Electric. It showed successful downstream and upstream data transmission—at speeds of 5.2 Mb/s and 4.5 Mb/s, respectively—at a distance of 12.7 km between an IEEE 802.22-based base station and customer premise equipment. With its potential to bring broadband service to rural areas, this technology could be especially useful in supporting communications during disasters. The multihop configuration provides flexible network construction, allowing for different link specifications according to given distances and transmission speeds. Applications include video monitoring of roads and cliffs and video-phone capabilities in mountainous areas, where network connections are either limited or completely unavailable. ■