"Green" Printed Electronics for Low-Cost Wireless Modules

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RF technologies are increasingly used as a means of short-range, high-bandwidth communications utilizing very low power levels where transmitted signals are spread over a significantly large portion of the radio spectrum. Interestingly, numerous recent applications of rf/microwave radios target sensor data collection, precision localization, and tracking applications. The term IoT, has become a buzz word in the engineering community, announcing the rise of the "Internet of Things". Such new trends necessitate the deployment of a large number of antennas to meet system requirements. To this end, it is important to keep the cost per antenna as low as possible to maintain an adequate operational cost for the respective systems.

A quick look at some of the common techniques for the fabrication of antennas reveals that photolithography has been the most dominant technology. However, this method involves multiple steps such as etching, masking, and electroplating, rendering it a time-consuming, labor-intensive, and expensive process. In addition, since the solvent used in the etching process is corrosive, the choice of substrates is limited, and the photolithography process generates high volumes of hazardous waste that are environmentally detrimental. Considering these negative aspects, an alternative technique is clearly needed.

In this talk, inkjet-printed structures on paper and other polymer substrates are discussed as means for low-cost mass-production of next generation wireless devices and Wireless Sensor Nodes. Prior to this work, the maximum demonstrated frequency for any printed structure was less than 5GHz. Here, we will re-visit our ink-jetted UWB antenna on paper-based substrates covering up to 10GHz. Given that the developed techniques were subsequently applied to paper and LCP substrates, where ink-jetted antennas were realized up to 80 GHz, select sample system prototypes will be discussed. The first system demonstrates a gas sensing prototype for home land security applications, where printed carbon nanotubes (CNTs) are integrated with antennas to produce high-sensitivity gas sensors. The second system prototype shows the feasibility of using the inkjet printing technology for enabling wireless communications in the mm-Wave frequencies.