Connection One - Center for Communication Circuits & Systems Research Center (CCCS)

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Universal RF Transceiver and Sensors

The ultimate goal of communication and computing systems is ubiquity; wireless devices that can be used in many applications ranging from biomedical sensors, environmental sensors, wireless mobile phones, and RFID tags. For example, In order to develop an RF wireless system that can be used as an implanted biosensor inside the body, transceivers must be small (less than few millimeters) and capable of staying inside the body for 5-10 years without changing batteries. These needs also apply to mobile systems like multi-mode universal mobile and smart phones. Such systems require multiple standards (like GSM, CDMA, and UMTS) and must adhere to stringent power and size requirements - the entire transceiver including the antenna, has to be integrated into very small areas. Current smart phones require integration of RF, antenna, signal processing, Video and Image processing, and microprocessors all on the same system. This has been a major roadblock for this technology. Connection One researchers have developed a multi-mode transceiver that is completely integrated on one chip.

In terms of power, two major components in transmitter architecture are the power amplifier (PA) and the PA modulator. PAs accounts for over 70% of power consumption in handsets and consume a significant portion of the handset's volume. Therefore, altering the power amplifier topology to lower the demand on their bulky passive filters while simultaneously increasing the efficiency and linearity is essential when realizing high-efficiency monolithic transmitter architectures. A new method using a noise shaping technique

to modulate the controller integrated circuits in switched-mode converters and power amplifiers reduces the demand on the output filters of the structures.

> **Economic Impact:** This breakthrough technology has impacted communications generally and multi-mode phones specifically. As a result of this Connection One work it is now possible to reduce the overall size of communications transmitters and products. The new architectures are more efficient than other techniques. This research has resulted in over 50% overall improvement in efficiency (improved battery life by 30-40% - reduced transmitter power by over 40%). As a result of this work the overall complexity and size of transceivers, PAs, antenna and power management components have been reduced by 30-50%. This has been very important to a number of center sponsors, including Qualcomm, Texas Instruments and Broadcom, and to the communications industry generally as new efficient topologies for transceiver chip sets are developed.

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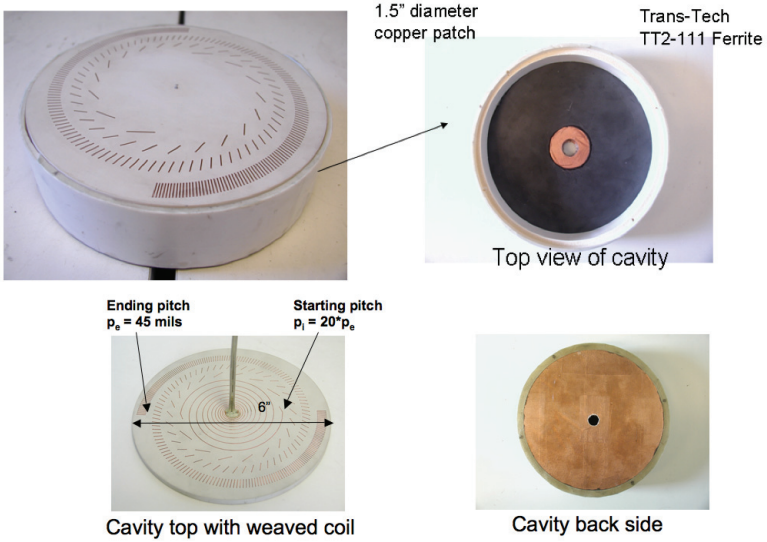
Meta-Ground Plane for Airborne Radar and Electronic Warfare Systems



Researchers at the Center for Communication Circuits & Systems Research Center (CCCS - Connection One) have developed a meta-ground plane for Ultra low-profile UHF wideband sensors used in airborne radar, electronic warfare systems and homeland security applications that require wideband, low frequency (UHF) antennas for roadside mine detection. These sensors offer a small, lightweight and low loss solution to a persistent problem. TV and cell-phone base station antennas can be glued on the fuselages, rooftops, or sidewalls of buildings. An application of this small UHF antenna is for sensors capable of locating targets concealed under trees and forests. The meta-ground plane will drastically reduce the profile of such bulky antenna systems on UAVs, thus, increasing their ability to accomplish their missions. No prior art existed to solve this problem without penalties in weight, gain, and efficiency. The entire aerospace industry is interested in these novel conformal antennas because they are both small, but can also operate when installed on airframe surface without protrusion. Also, ground personnel can carry them in their backpack and used them for communication at all frequency band and

wideband information reception, including videos, and high-resolution images without relying on large and heavy reflectors that are not portable.

Economic Impact: This antenna is a transformational technology as it provides for extremely wide bandwidth in a very small size antenna. It is already marketed by a small company in Virginia and has attracted the attention of the U.S. Air Force and Boeing for automated guidance systems. A potential and highly touted commercial application is that of wideband communications. Specifically, this small and very thin antenna can cover all television, cellular, satellite and ground to air communications. As it replaces the large whip antenna and other non-conformal antennas, it is best suited for automotive applications. Specifically, this simple, small but very wideband antenna can replace the multiple automotive antennas required in modern automobiles. Currently, over 14 individual antennas are used to cover the automotive bands. This antenna can replace all of them using a small 6" aperture that is both light and small for inconspicuous placement. The cost reduction is tremendous. Further, because the antenna is small, several of them can be placed at different locations of the vehicle for ubiquitous coverage and for implementing "Multiple Input Multiple Output" scenarios for uninterrupted high bandwidth (instantaneous) video communications. That is, the developed antenna is a breakthrough technology with high impact in all aspects of communications for commercial and defense applications.

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