Embrace Circuit Nonlinearity to Get Transmitter Linearity and Energy Efficiency

by

Dr. Earl McCune
Besser Associates
Santa Clara, CA 95050, USA

Abstract

Wireless communications signals have evolved greatly over the past century, from the use of Morse Code to very complicated digital modulation schemes used in wideband CDMA (WCDMA) and 3GPP Long-term evolution (LTE). This progression challenges the design of transmitters to be simultaneously energy efficient, low distortion, and spectrally clean. The increasing peak-to-average power ratio (PAPR) characteristic of these signals is a particular problem. Because it is important to understand why this is happening this presentation begins with a discussion of the physical implications of Shannon's Capacity Limit combined with the Fourier Transform.

A 'backwards' design perspective is then presented, where we begin design from a maximally energy efficient circuit (a switch) and then make it generate the required signals, instead of the conventional approach of beginning with linear circuitry and then finding ways to improve its energy efficiency. This directly leads to the design and implementation of polar-modulation to improve both the energy efficiency of the power amplifier and effective linearity of the transmitter. Design of intentionally compressed circuitry is very different from conventional linear amplifier techniques, and these new design techniques will be discussed.

Speaker's Bio

Earl McCune received his BS/EECS degree from UC Berkeley, his MSEE (Radioscience) from Stanford University, and his Ph.D. EE from UC Davis in 1979, 1983, and 1998 respectively. He is a serial Silicon Valley entrepreneur, founding two successful start-up companies since 1986: Digital RF Solutions (1986-1991, merged with Proxim) and Tropian (1996 - 2006, acquired by Panasonic). He is now retired from his position as a Technology Fellow of Panasonic, and is an author, instructor, and independent consultant. He is currently an instructor for Besser Associates presenting courses on Practical Digital Wireless Signals and Frequency Synthesis Principles. He holds 63 issued US patents, and is the author of Practical Digital Wireless Signals (Cambridge 2010).