NOMA, MIMO USED TO BOOST SPECTRUM EFFICIENCY

WITH MOBILE TRAFFIC expected to surge significantly over the next 10 years, demands will intensify for more efficient use of available frequency spectrum, increased network speeds, and opening of additional frequency spectrum for wireless applications. In the white paper, "Non-orthogonal Multiple Access and Massive MIMO for Improved Spectrum Efficiency," Anritsu examines 5G wireless access systems and describes two technology solutions to enhance spectrum efficiency: non-orthogonal multiple-access (NOMA) and multiple input, multiple output (MIMO).

Next-generation 5G access systems, for example, are being investigated to provide the required solutions. Proposals for 5G systems aim to increase spectrum efficiency by various methods. A NOMA implementation for 5G systems is being discussed, as it improves spectrum efficiency by extending the user multiplex domain. This implementation requires encoding and interference cancellation technologies that were considered difficult to implement in the past. However, recent central-processing-unit (CPU) performance improvements are enabling the development of these technology solutions.

NOMA can be grouped into three categories: NOMA with successive interference canceller/semi-orthogonal multiple-access (SIC/SOMA), sparse code multiple-access (SCMA), and interleave division multiple-access (IDMA). Each of these methods uses a different user multiplex domain to improve spectrum efficiency. NOMA with SIC/SOMA utilizes the new power domain, for example. The SCMA method takes advantage of the power and code domains, while the IDMA method utilizes the code domain.

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MIMO is an important aspect of today's wireless-communications systems, as it achieves high throughput and reliability by using multiple antennas. Massive-MIMO technology is targeted as a solution for future 5G systems. Massive MIMO uses as many as 100 antenna elements to support simultaneous communication with multiple mobile terminals, thereby significantly improving the spectrum usage efficiency. In addition, millimeter-wave frequencies are being investigated for 5G to enable high-speed communications. However, transmission losses are greater at these higher frequencies. The white paper describes how a beamforming (BF) technique can be used with massive-MIMO antenna configurations to counter increased transmission losses.

FIND THE KEY TO BROADBAND PA DESIGN

A SIMULATION-BASED METHODOLOGY for broadband power-amplifier (PA) design can be accomplished using load-line, load-pull, and real-frequency synthesis techniques. Thus, by taking advantage of simulation software and nonlinear transistor models, the design process can be streamlined. In the application note, "A Simulation-Based Flow for Broadband GaN Power Amplifier Design," National Instruments presents the design of a Class F PA using a gallium-nitride (GaN) high-electron-mobility transistor (HEMT). The design is achieved by utilizing a nonlinear model of the transistor with the NI AWR Design Environment.

A schematic was first created to bias and stabilize the transistor. After establishing the biasing and stability conditions, initial load-line analysis and harmonic impedance tuning was performed. After determining the impedance of the fundamental frequency, the second- and third-harmonic impedances were tuned to a short circuit and an open circuit, respectively. The fundamental impedance of the input tuner was set to a conjugate match, providing maximum gain. When all impedances were tuned, a final harmonic-balance (HB) simulation was performed to confirm the desired mode of operation.

The application note goes on to describe a load-pull impedance extraction method, which was performed at three different frequencies: 1.8, 2.0, and 2.2 GHz. Load-pull simulations were executed to generate contours for maximum power and then for maximum drain efficiency. The maximum power and efficiency contours at the fundamental frequency were both superimposed on a Smith Chart.

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By using this approach, a region of mutually acceptable power and efficiency could be determined. Load-pull simulations for the second- and third-harmonic frequencies were then performed.

The Amplifier Design Wizard (ADW) tool synthesized the broadband matching networks after determining all impedances. Both the output and input matching networks were designed and subsequently exported to the Microwave Office software. Linear, HB, electromagnetic (EM), and dc simulations were executed to fine-tune the design. The actual power amplifier was later built and tested without any bench tuning, therefore demonstrating agreement with the simulation results.