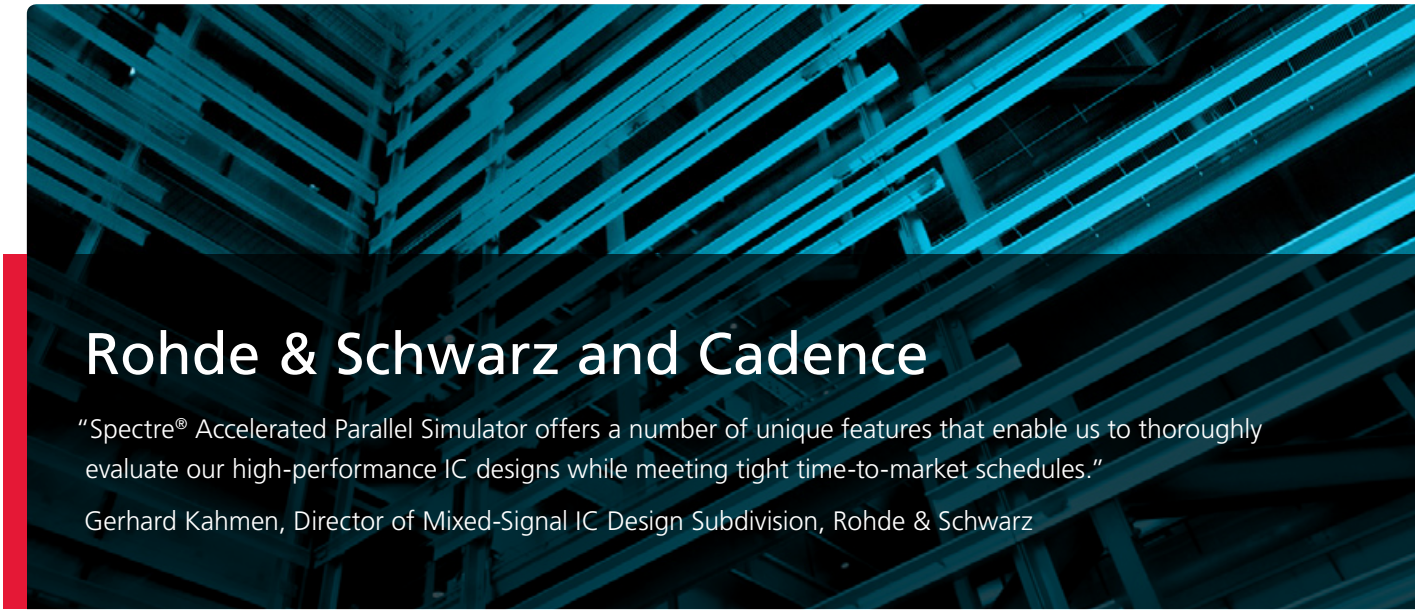
cadence®



Rohde & Schwarz and Cadence

"Spectre® Accelerated Parallel Simulator offers a number of unique features that enable us to thoroughly evaluate our high-performance IC designs while meeting tight time-to-market schedules."

Gerhard Kahmen, Director of Mixed-Signal IC Design Subdivision, Rohde & Schwarz

The Customer

For nearly 80 years, Rohde & Schwarz has stood for quality, precision, and innovation in the wireless communications industry. The company focuses on four key areas: test and measurement, broadcasting, secure communications, and radiomonitoring/radiolocation. Rohde & Schwarz is the world's leading manufacturer of wireless communications and electromagnetic compatibility (EMC) test and measurement equipment, as well as of broadcasting and test and measurement equipment for digital terrestrial television. Their electronics design group is headquartered in Munich, Germany.

The Challenge

As a vendor for high-end test and measurement solutions used in mobile radios and radio communication, Rohde & Schwarz depends on the availability of proprietary application-specific integrated circuits (ASICs) that deliver key functionality and performance. Developing high-frequency circuits is time-consuming, and tight time-to-market schedules are routine. To streamline the development process, the company requires fast, accurate, and robust simulation technology.

The Solution

Rohde & Schwarz's IC design engineers use Spectre® Accelerated Parallel Simulator (APS) to perform complex simulations required to meet the demanding specifications of high-frequency circuits.

Spectre® APS, a key part of the Multi-Mode Simulation, simulates analog and high-frequency circuits for next-generation products. It provides scalable performance and capacity at full Spectre® accuracy across a broad range of complex analog, radio frequency (RF), and mixed-signal blocks, and subsystems with millions of transistors and passive and parasitic elements. Its proprietary parallel simulation technology delivers scalable multi-core processing capability on modern multi-core compute platforms.

Business Challenge

- Meet stringent device specifications and tight time-to-market goals

Design Challenge

- Perform complex simulations required to meet the demanding specifications of high-frequency circuits

Cadence Solutions

- Spectre® Accelerated Parallel Simulator
- Spectre® Accelerated Parallel Simulator RF Option
- AMS Designer Simulator
- UltraSim Full-Chip Simulator

Results

- Thoroughly evaluated high-performance IC designs while meeting tight time-to-market schedules
- Improved productivity while increasing chances of first-time-right silicon
- Gained ability to run analyses at low frequencies that were previously impossible due to excessive simulation times
- Captured issues earlier in design cycle, avoiding potential reduced lifetime or destruction of device

Several features of Spectre® APS enabled Rohde & Schwarz engineers to obtain optimal results in a very efficient way: innovative periodic noise (pnoise) analysis, small-signal analysis mode, and support of analog asserts.

Pnoise Analysis

"Our low-noise frequency dividers and phase detectors are designed to operate over a large frequency range," says Gerhard Kahmen, Director of the Mixed-Signal IC Design Subdivision of Rohde & Schwarz. "This leads to special challenges when noise performance must be simulated for low-frequency signals."

In traditional pnoise analysis, noise contributions are only taken into account from a specified number of sidebands. Noise coming from higher frequencies than those specified will be neglected. This means that for low-frequency signals in wideband circuits, a large number of sidebands must be specified to cover the entire bandwidth and obtain accurate results. As the time required for pnoise analysis correlates with the specified number of sidebands, this can lead to extremely long simulation times.

Cadence addressed this challenge by introducing a full-spectrum option for pnoise analysis in Spectre® APS. With this new option, noise from white-noise sources is taken into account over the entire frequency spectrum. Noise from colored-noise sources (such as flicker noise) is still only taken into account from a specified number of sidebands, but in this case a low number of sidebands is usually sufficient for good accuracy.

> *"The new features recently introduced to Spectre® Accelerated Parallel Simulator have allowed us to improve our productivity even further and to increase our chance of first-time success."*

"The new full-spectrum option in Spectre® has reduced the time required for pnoise analysis with low-frequency signals by a factor of up to 20," Kahmen says. "We can now run analyses at even lower frequencies, which were impossible to run before due to excessive simulation times, in a reasonable time. This contributes to a good chance of first-time-right silicon."

Small-Signal Analysis Mode

Rohde & Schwarz also uses small-signal analysis mode to simulate circuits for a periodic state given by the results of periodic steady-state (PSS) analysis. Periodic AC (PAC) and periodic transfer function (PXF) analyses are small-signal analyses equivalent to the AC and XF analyses from Berkeley SPICE or its derivatives.

"Like pnoise analysis, these small-signal analyses modes include frequency-translating effects such as mixing and sampling, which makes them ideal for simulating circuits like mixers or switched-capacitor filters," Kahmen explains. "They also offer specialized analysis modes such as sampled analysis for jitter or modulated analysis for amplitude and phase modulation."

Cadence Rapid IP3 analysis technology in Spectre® has been very useful for the Rohde & Schwarz IC design team. It calculates the third-order intermodulation (IP3) of a weakly nonlinear mixer circuit with the computational effort of five PAC simulations. Alternative methods for calculating the IP3 of a mixer require a much higher computational effort because the circuit must be simulated with at least two signals applied simultaneously at different frequencies.

"We had to simulate the IP3 of a mixer that contained an extremely large number of parasitic components that had been extracted from the (physical) layout," Kahmen says. "Our attempts to introduce a second frequency caused the simulation to exceed the available computer memory. Using Rapid IP3 analysis, we were able to determine the third-order intermodulation of the mixer, which otherwise would have been impossible."

Analog Asserts

Another advanced feature of Spectre® APS that Rohde & Schwarz uses extensively to ensure circuit reliability is analog asserts. All components used in ICs have maximum voltage and current ratings that must not be exceeded in order to avoid destruction or a reduction of lifetime. However, violations of these maximum ratings are easily missed in normal simulations.

"Analog asserts allow our designers to specify these limits in a general way and perform an automatic compliance check for all components during all simulations," Kahmen says. "All violations are reported, together with the component name and the time at which the event occurred, so they can be examined in further detail."

Multi-Core Hosts

Spectre® APS also includes a parallel matrix solver that enables designers to use modern multi-core processor architectures and accelerate otherwise time-consuming simulations. A token-based licensing system offers flexible use of capabilities depending on simulation size, CPU load, and available license resources.

"We use the flexible licensing system to control costs while using additional Cadence products such as AMS Designer Simulator, a mixed-signal simulator, and UltraSim Full-Chip Simulator, a FastSPICE simulator," Kahmen says.

Summary

To realize high-performance test and measurement equipment specifications in its instrumentation product range, Rohde & Schwarz has to develop its own proprietary ICs if components with the required performance aren't available on the market. In the test and measurement sphere, this is often the case.

"Spectre® Accelerated Parallel Simulator offers a number of unique features that enable us to thoroughly evaluate our high-performance IC designs while meeting tight time-to-market schedules," Kahmen summarizes.