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Fujitsu Chooses SPW to Meet Aggressive Schedule For Its Latest LTE-Compatible RF Transceiver Design

Synopsys' SPW consistently enables us to reach tape-out on schedule and within budget, despite the increasing complexity and required flexibility of our multi-standard transceiver solutions."

Vivek Bhan
Executive Vice President, Fujitsu Semiconductor Wireless Products, Inc.

Business

Fujitsu Semiconductor Wireless Products, Inc. is an innovative leader in RF transceivers for mobile cellular handsets and other portable wireless devices. Its engineering group's long experience and expertise nurtured since the 1980s have resulted in several notable innovations in the cellular industry, including the industry's first SAW-less 2G/3G transceiver architecture as well as the first SAW-less multimode transceiver integrating 2G/3G/LTE modes in a single device. The engineering group has also been involved in the standardization and commercialization of every major cellular standard, and has shipped close to half a billion chipsets for application in these standards.

Challenges

- Address 5x increase in complexity to support the LTE (Long-Term Evolution) standard in the latest RF transceiver design
- Achieve consistency between the algorithm design and RTL
- Minimize development time and cost

System-Level Design Solution

- SPW algorithm design tool and model libraries

Benefits

- Uses a model-based approach with access to >3000 models, including LTE models
- Enables an algorithm design flow with seamless integration to implementation & verification flows
- Enables the fastest & most accurate refinement of floating-point algorithms into fixed-point algorithms

Overview

Fujitsu's latest MB86L11A 2G/3G/4G multimode, multiband transceiver chip supports benchmark performance for current drain and RF parameters. The transceiver includes many innovative features in a smaller package with enhanced power control, envelope tracking (ET) and antenna tuning (AT). Envelope tracking technology helps to significantly lower the radio system power consumption, while improving transmitter efficiency. Antenna tuning optimizes the total radiated power output from the antenna. Both features optimize the battery life of mobile devices.

An advanced programming interface (API) feature minimizes factory calibration time, provides flexible port mapping and adds customized key performance indicator (KPI) features. The MB86L11A is built using the SAW-less architecture pioneered by Fujitsu,

The accurate prediction of system performance through the fast simulation and first-time right RTL generation technology offered by SPW are essential competitive advantages in our fast-moving wireless market."

Mahib Rahman
Transceiver Systems Group Manager, Fujitsu Semiconductor Wireless Products, Inc.

which also eliminates the need for external low noise amplifiers (LNAs). Other features of the MB86L11A include eight RF outputs on the transmitter, nine primary RF inputs and six diversity RF inputs on the IC, giving greater flexibility to map ports and bands for different market requirements. The transceiver uses an open standard MIPI DigRF^{SM} interface to the baseband, and has both DigRF 4G and DigRF 3G interfaces to work with existing 2G/3G baseband platforms as well as with newer multimode 4G basebands. The device supports all global FDD and TDD bands, including 1-21, 23-25, and 33-41. The MB86L11A, like earlier Fujitsu LTE multimode, multiband transceivers, supports 2G/3G/4G networks up to 20MHz bandwidth.

Leading Algorithm Design Solution

In order to support the LTE standard while meeting schedule and cost pressures, Fujitsu's transceiver systems team had to design algorithms with a higher simulation complexity per test case and a larger number of test cases overall. The team estimated that these requirements increased the design complexity by at least 5X.

Developing RF transceiver technology that is cost- and power-efficient is a complex challenge, but necessary for LTE adoption. Initially, the silicon must support multiple standards, air interfaces and radio technologies for backward compatibility with 2G and 3G, spanning a range between 450MHz (700MHz) and 4GHz. This requirement to support multiple bands and legacy standards contributes significantly to the design complexity.

In order to meet these complex specifications, the Fujitsu Transceiver systems team needed an algorithm design solution that supports multiple wireless standards and a reliable flow from algorithm to RTL implementation. They have been long-time SPW users and knew that the algorithm design tool and model libraries offer an integrated solution for the latest standards.

The design team started by creating a floating point design in SPW of both the environment as well as the transceiver design itself. They then replaced the floating-point design with bit-true models from the SPW HDS library. The resulting system model was simulated extensively to determine if system performance remained acceptable despite the finite word length implementation dictated by die size targets. The team also used the finite-state machine design capabilities to design control sequences in the multi-mode chip that were being initiated by the built-in microcontroller. They generated RTL from that setup as well. The generated RTL, when executed against the same testbench, did not produce a single implementation error, achieving a very stable and reliable flow for first-time success.

"Without the availability of Synopsys' LTE and WCDMA model libraries early on, we would have increased our schedule and cost risk by 30%."

Mahib Rahman
Transceiver Systems Group Manager, Fujitsu Semiconductor Wireless Products, Inc.

High-Quality Models and Support

Synopsys' extensive model libraries include the latest standards such as LTE and WiMAX, providing designers with the framework and testbenches needed for hardware and/or software implementation. Fujitsu took advantage of the LTE and WCDMA (3GPP) libraries supported by Synopsys' extensive expertise in wireless communication standards.

The Synopsys LTE model library enables the efficient design of physical layer implementations as well as exploration of overall network performance. The library enabled the design team to quickly build complete system models. Appropriate portions of the system model were refined to generate RTL and the testbench could be shared with other team members. The model library also includes fixed-point algorithmic design capture and datapath performance analysis that the team used to help meet performance goals.

Fujitsu's SAW-less transceivers have since been a success in the market, helping mobile devices reach the next level of technical sophistication. The transceiver systems design team plans to continue using SPW as they work on the next generation of wireless technologies.

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