

ETRI Develops Modem Synchronization Technology for Fourth-Generation Mobile Telecommunications System

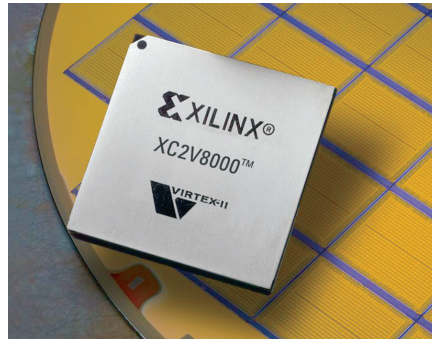
Fourth-generation (4G) mobile telecommunications systems hold great promise in supporting data transmission rates of up to 100 MB per second and providing wireless device users with near-ubiquitous connections. However, with ever-changing specifications and standards, developing a prototype that proves the 4G system's capabilities requires a flexible design process.

The Electronics and Telecommunications Research Institute (ETRI) is a non-profit, government-funded research organization in Korea that is at the forefront of information technology development. They used MathWorks products for Model-Based Design to develop a prototype of an end-to-end, 4G, high-speed mobile telecommunications system.

"The project would not have been successful if we had used a design method based on C," says Juyul Lee, a researcher for the high-speed wireless modem research team at ETRI. "Applying Model-Based Design with Simulink® saved us a lot of time and helped us meet our deadline."

THE CHALLENGE

The ETRI team needed to prove the feasibility and benefits of the 4G system using an FPGA prototype. The system needed to maintain clear mobile connections for commuters taking public transportation and high-speed data transmission to handle voice and video.



Synchronizer FPGA.

The most critical success factor was time: the entire development cycle, from algorithm development to system-level verification, had to be completed within a year to keep up with other research and commercial communications companies that are proposing 4G standards.

A C-based approach did not provide a flexible environment to design the entire system. ETRI needed an integrated software development environment for modeling the entire system, performing design iterations, and considering performance tradeoffs, so that they could be confident in their results.

THE SOLUTION

ETRI used Model-Based Design with MATLAB® and Simulink to design the modem synchronization algorithm for both the transmitter and receiver. They modeled and simulated the system and verified the HDL code before implementation on the FPGA.

"Using frame-based processing and the multirate sampling capabilities of Simulink and the Signal Processing Blockset enabled us to model a system that was very close to the actual hardware implementation," Lee notes.

THE CHALLENGE

To design and prove a 4G mobile telecommunications system using a real hardware prototype

THE SOLUTION

Use MathWorks tools for Model-Based Design to model and simulate the telecommunications system before implementation and verification on an FPGA

THE RESULTS

- Shortened development cycle
- Secured intellectual property
- Achieved reliable test results

“The intuitive block diagram environment of Simulink enabled us to implement our base station system design precisely and ensure optimal synchronous performance.”

Juyul Lee, The Electronics and Telecommunications Research Institute

ETRI engineers used Simulink to develop their floating-point model. They incorporated legacy C code into the model using Simulink S-functions and designed the model's variables with MATLAB.

They accelerated their system design using a variety of signal processing techniques in the Signal Processing Toolbox and the Signal Processing Blockset and graphical plots, channel models, and other communications algorithms in the Communications Blockset and the Communications Toolbox.

“MathWorks tools provide a rich library of blocks and functions that give us a head start in designing our system,” says Lee.

Using the Fixed-Point Toolbox and Simulink Fixed Point, ETRI then specified all the fixed-point data type properties of the design by easily modifying their existing floating-point models.

“Moving from floating point to fixed point was very easy,” says Lee. “Simulink makes that process painless.”

After they completed the HDL coding for the receiver, ETRI used the fixed-point model as an executable specification to verify their code before implementation on a Xilinx Virtex-II FPGA.

“To verify the HDL implementation of the receiver, we generated a transmitter signal using an existing Simulink model. This stimulus generated using the Simulink model included a modulated signal and channel effects, such as fading,” explains Lee. “Using MathWorks products, we quickly generated near-real data to verify the HDL implementation.”

ETRI successfully completed the development of the prototype and demonstrated its capabilities. They are continuing to use MathWorks tools to increase the data rate and coverage of the system.

THE RESULTS

■ Shortened development cycle.

With MathWorks tools for Model-Based Design, ETRI reduced development time by 50 percent over their previous C-based methods.

■ Secured intellectual property.

ETRI converted their ideas to technology quickly to create the next-generation high-speed mobile telecommunications system. This enabled them to patent their intellectual property.

■ Achieved reliable test results.

ETRI performed functional verification and analysis on a model that closely resembled the prototype hardware system, reducing debugging time and ensuring accurate test results.

For more information on ETRI, visit www.etri.re.kr

APPLICATION AREAS

- Algorithm development
- Communications
- Model-Based Design
- Signal processing
- Simulation

PRODUCTS USED

- MATLAB
- Simulink
- Signal Processing Blockset
- Signal Processing Toolbox
- Communications Blockset
- Communications Toolbox
- Fixed-Point Toolbox
- Simulink Fixed Point

www.mathworks.com