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TMYTEK

TMYTEK Cuts Design Time for mmWave RF Front-End Components with AWR Software

Key Challenges

The 5G New Radio (NR) millimeter-wave (mmWave) standard, unlike previous ones, uses dynamic beam steering to maximize connectivity by aiming as much of the signal directly to the mobile device as possible. As a result, beamforming antennas represent a new area of development for many commercial manufacturers. TMYTEK uses the AWR Design Environment platform to develop RF front-end components in its groundbreaking BBox™ beamformer box product line (Figure 1), a highly modulized 28/39GHz beamforming system that enables 5G designers to successfully develop innovative antenna designs and baseband technology.

The BBox system is a scalable and flexible system that includes a standard antenna kit, phase and amplitude controller, channel selector, up/down conversion, and control host. It provides reliable steerable beams to test and support development of phased array antennas and associated electronics, which must undergo rigorous calibrations and measurements under a large number of configurations through advanced over-the-air (OTA) testing to ensure optimal connectivity.

TMYTEK designer Su-Wei Chang was developing a 47/53GHz filter, one of the key components for the company's mmWave instrumentation equipment, as well as a 28GHz phased array antenna for 5G mmWave beamforming using antenna-in-package (AiP) modules. The modules were being designed for base station and user equipment.

Application
▸ Front-end module

Software
▸ Cadence® AWR Design Environment® Software Portfolio, including:

  – Cadence AWR® iFilter™ Filter Synthesis Wizard

  – Cadence AWR Microwave Office® Circuit Design Software

  – Cadence AWR Analyst™ 3D Finite-Element Method (FEM) Simulator

  – Cadence AWR Visual System Simulator™ (VSS) System Design Software

Benefits
▸ Innovative features

▸ Reduction in design time

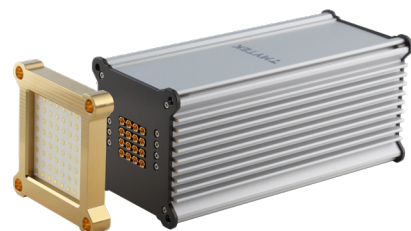▸ Co-simulation ability

Figure 1: TMYTEK BBox beamformer box

The specifications for the 47–53GHz filter passband and rejection band were proving difficult. In addition, the minimum feature was only about 20μm, so accurate simulation was key since the fabrication cost was high.

For the 28GHz phased array antenna, the system performance (Figure 2) of the beamforming and beam shaping required system-level simulation, including antenna design, power combiner design, beamforming system design, and electromagnetic (EM) extraction of the layout.
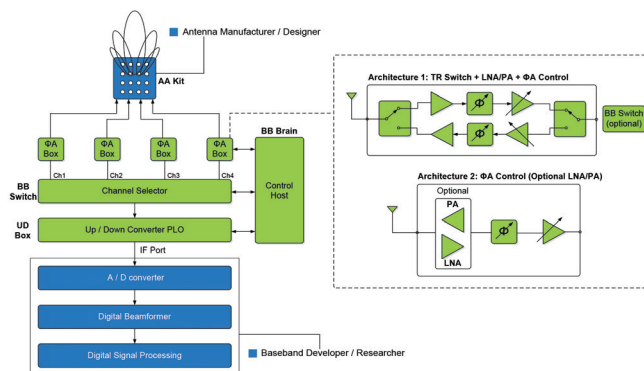

Figure 2: The BBox system diagram

The Solution

The iFilter filter synthesis wizard within the AWR Microwave Office software helped the designer to synthesize the filter with the desired specifications. It generated the circuit model and the layout and enabled him to perform electromagnetic (EM) simulation of the layout file using the Analyst simulator.

Together, these tools helped the designer to finish the design within a short timeframe and delivered excellent agreement between the simulated and measured results. The phased array generator wizard in the AWR VSS software was used to quickly evaluate the results for the 28GHz phased array antenna.

The designer was able to implement a single antenna radiation pattern, which could be either EM simulation results or measured results and used the phased array wizard for the beam steering and beam shaping (Figure 3).
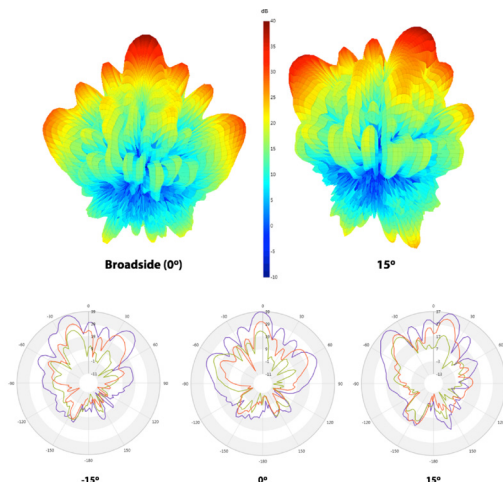

Figure 3: Simulated antenna radiation patterns for the BBox beamformer system

The tool provides different beam-shaping tapering methods, which helped him build the AiP module with only basic knowledge of the beamforming system. After building the module, the layout was imported into the AWR Microwave Office software and the Analyst simulator was used to verify the design.

Summary

The designer appreciated the integrated technologies and user interface of the AWR software, which streamlined the design process. The iFilter synthesis and phased array generator tools saved significant time on the initial design. The integrated system, circuit, and EM simulators provided performance verification and RF link analysis at the system level. Overall, the AWR software saved the designer an average of 20-30% in design time.

> *AWR software is a very useful tool that helps us in each phase of a design project. It has many good technologies that streamline our design process.*
>
> Su-Wei Chang, TMYTEK

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