

Q&A: SIMULATION'S VITAL ROLE IN WIRELESS TESTING

by Mike Hockett

As electronic testing technologies become more and more complex, achieving goals requires continuous re-design within solutions—incorporating better microchips, OEM equipment, individual devices, and other internal improvements. This is prompting vendors to rethink or re-evaluate their testing. With 5G infrastructure now being laid, the need for efficient redesign for wireless test will only escalate over the next handful of years. With this, the role of simulation software has taken on a crucial role over the past decade, saving test instrumentation vendors invaluable trial-and-error costs and helping speed up time-to-market.

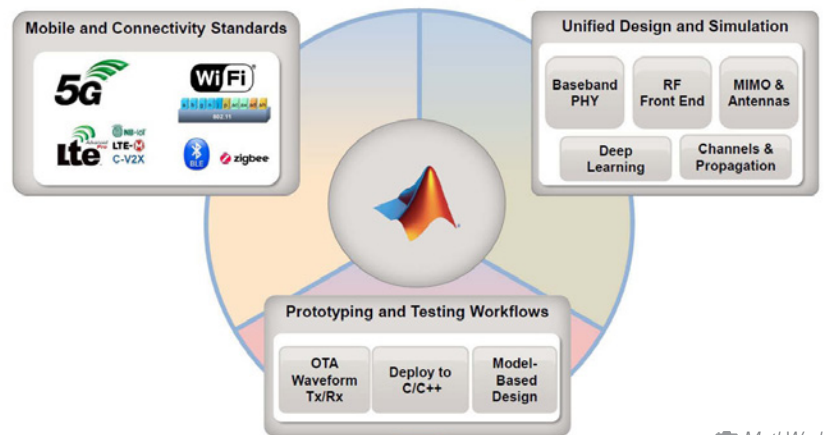
I recently interviewed Ken Karnofsky, senior strategist for signal processing applications at MathWorks, and got his thoughts on the evolution of wireless testing in recent years and the increasing part simulation has played along the way. See our discussion below, edited for brevity and clarity.

Mike Hockett: To start off, can you give me a little background on the relationship between wireless testing and simulation?



Ken Karnofsky: In 5G, we've been told the number of waveform combinations to test a 5G chip is something greater than a magnitude of 4G, since there's so many parameters you must account for. It's very ambitious, and unfortunately for the engineers, also very complex. It's not just 5G, as this applies to other markets as well. Like in Military/Aerospace and doing custom designs, the goal there may be to produce some kind of custom radio design within budget to get prototypes

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deployed and tested. Over the last several years, we've introduced products that conform to many different standards for Bluetooth, Wi-Fi, 5G, etc. It lets customers build simulations, and then use our tools to make sure their simulations are meeting requirements.

With simulation of various components, one of the ways that higher speeds will be achieved is by higher frequencies in the spectrum. In order to do that (more bandwidth), not only is the digital processing for that different, but the RF/antenna is different. There are lots of architectural considerations there. Some of us MathWorks guys recently got back from a trip to the (U.S.) West Coast, and customers were saying they're having to deal with nonlinear behavior and having to use nondigital tools for that.

Today, different design engineering teams are working together, as opposed to the older method of each group working within their own specialty. And testing means slightly different things to different people. Sometimes it's a custom test environment; sometimes it's COTS. At MathWorks, we want to unify that approach by enabling reuse of test.

MH: Why have today's wireless communication standards grown so complex?

KK: The standards themselves—a lot driven by greater capacity and lower latency requirements that have become more difficult. There's an increased forced integration the RF and digital world. You have to understand how one area of your design will affect another. We also now have the coexistence of multiple standards, and some of these standards will occupy the same frequency ranges. If you've got a Bluetooth signals, there may be Wi-Fi signals all around at the same time that may interfere.

MH: As wireless communication standards continue to evolve, what are the specific challenges you're seeing companies face in terms of designing next-generation communication systems?

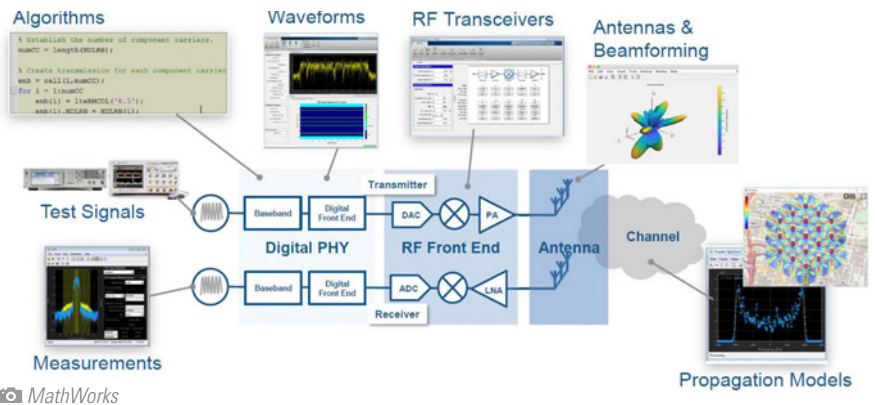
KK: Different effects have happened in different levels of companies. At Tier 1 companies on the leading edge, researchers are leading the standards. They have pretty comprehensive standards they've built. The problem is those people are

researchers—they're not in the business of supporting design. Their job is to build their IT, not to build tools to help. It's difficult to build those in-house simulations. Those downstream engineers are similar to the second-tier companies, and further down startups and smaller companies need to ramp up quickly on the standard. The good news is there is help available. In the past, we have seen quite a few customers who have done that using MathWorks' MatLab.

MH: How prevalent have simulation tools been for designers working in the wireless communications space up to this point? Why is this the case?

KK: I think the big change is being able to create behavioral simulation where you can consider the digital RF antenna components together. There's been simulation tools for each of those for a while now. Putting them into an overall system has been a challenge. If you are building a wireless space station and getting a power amplifier from your supplier, you likely need to develop common algorithms because power amplifier is nonlinear. Linearity is important because it saves power and keeps signals where you want them. There really haven't been tools that have enabled that kind of design, looping them together in the same simulation. Specialist tools are valuable for this. In the past, the only way to connect separate tools was to build a prototype board and test it in your lab. Being able to do that in simulations where you have models,

Unified Design and Simulation



multidomain simulation gives you enough confidence at the simulation level that you can reduce the testing time.

MH: What tools currently exist for designers to assist with their respective wireless communication development challenges that they may have been previously unaware of?

KK: It's a funny fact of human nature—if you're reasonably comfortable and not aware there's another way to do something, you're not going to look for one. Our waveform generation tool is a big productivity boost for RF/antenna engineers because all the knobs are right there in front of your face in such an instrument feature. We've also invested a lot in propagation models. We have ways of modeling that statistically, as well as showing it on a map, showing what coverage you get. With over-the-air (OTA) testing, we've all had the ability to generate waveforms for

years, but it's always been a programming function. Now, we're providing engineers graphical representation of it.

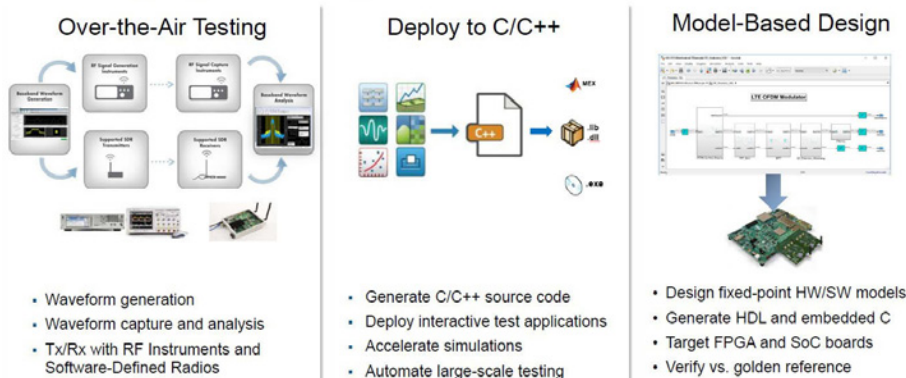
MH: You previously alluded to the benefits of a shared simulation environment for next-gen communication designers. Why may designers be unaware such an option exists, and how can test be best utilized within this kind of environment?

KK: There is certainly now a recognized need for a shared simulation environment, and parts of it have already existed. It is a complex task and takes different expertise to build an effective RF simulation tool, compared to the physical layer on the digital side.

Even on our own MathWorks teams, our RF guys and digital guys sometimes have trouble communicating with each other. You have to work hard to break down those silos. It's been a long-term investment and quest for us to do that. We're not completely finished, but if you look at where we were 5 years ago, it's pretty significant progress.

A shared simulation environment would be valuable to other customers who are entering the market. For example, we recently worked with a small company that was making a digital IP for a power amplifier for developing 4G chips. They're connecting to their instruments for OTA testing, and use algorithm validation on their boards. They used MathWorks' Simulink shared simulation program, that customer estimates that they've cut their development time in half. [EE](#)

Prototyping and Testing Workflows



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