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Making the Transition from Circuit Design to System Design

Editor:

I am a relatively new engineer (I got my BSEE in 2001) and I've been pretty good at circuit design, mostly low noise amplifiers. Our company has started working with a new CAD system that combines system-level and circuit-level designs. I'm still working mostly on circuits, but it has been kind of hard to learn how all the system blocks work together. Do your experts have any suggestions how I can learn more about system design? We had one class in school called "Communications Systems" but it was mostly about telephone networks and datacom.

Thanks!

A. Najim
San Jose, CA

Start With Your Colleagues

Mr. Najim:

The engineers you work with who are the system-level specialists are your best source of information. They will know what things are important in the system your LNAs are going into, so start by asking them how the specifications were developed for your piece of the project. Then you can explore how other parts of the system operate, and how the performance of your circuits affects later stages.

As you have discovered, new EDA tools that combine system and circuit simulation (and measurements) are intimidating at first, because they involve a lot more than just your area of specialization. As you get more accustomed to using these comprehensive tools, you will gain valuable understanding of end-to-end system design, and how each piece affects overall performance.

We also recommend that you examine books that are intended for continuing professional development rather than university textbooks. There are many RF and microwave books that include system-level information as well as circuit design material. Without knowing the type of system you are working on, it's hard to make a specific recommendation, but we want you to be aware that system-level instruction may not be obvious from a book's title. It may be mixed in with circuit-level design, or a book may have one key chapter that covers system-level considerations.

RF and Digital Design Comparisons

Since our readers have shown interest in high-speed digital design techniques, the following information may be useful. It is quoted from Volume I of Practical RF Circuit Design for Modern Wireless Systems, *which is reviewed on page 54 of this issue. This is from Chapter 9s:*

"There are major differences between digital and RF analog designs:

· *Bandwidth:* Traditional RF applications tend to be high frequency but narrowband. Digital applications traditionally are lower frequency, but in the majority of applications, where dc also needs to be transmitted, the relative bandwidth is high.
· *Input power:* RFICs tend to have matched inputs and outputs. RF input power is needed for proper operation, and there is a large variation in input and output voltage/current/power levels.
· *Interconnect density:* In contrast to high-density digital circuits, RF and analog circuits have lower circuit and trace density, lower number of layers on printed-circuit boards, and the majority of printed circuit board interconnects are microstrips or coplanar; there is little need for signal vias. In lower-density RF interconnects, traces tend to be wider than traces on digital boards, and therefore, dielectric loss matters more.
· *Discontinuities:* In RF circuits, reactive loading and vias are eliminated or minimized. The remaining imperfections are bends, junctions, and surface roughness of conductors.
· *Circuit schematic:* In digital circuits, schematic does not show interconnects as separate circuit elements; they may need to be added and their delay and dispersion considered separately in prelayout and postlayout analysis. In RF, layout becomes an integral part of circuit schematic because many circuit elements are formed of printed circuit board patterns.
· *EMC:* In RF systems, there are large differences in input/output power levels of RF cells. Therefore, RF circuit subsystems require good shielding to avoid interference within systems. This protective shielding reduces the susceptibility and radiation. In contrast, digital levels are standardized within a narrow range, so interference protection is rarely needed within a system. This comes with a higher chance of radiation, which is is harder to stop on the box level, as every part of the box may become radiator."