HIGH FREQUENCY
ELECTRONICS

Editorial Director
Gary Breed
gary@highfrequencyelectronics.com
Tel: 608-845-3965
Fax: 608-845-3976

Publisher
Scott Spencer
scott@highfrequencyelectronics.com
Tel: 603-472-8261
Fax: 603-471-0716

Associate Publisher
Tim Burkhard
tim@highfrequencyelectronics.com
Tel: 707-544-9977
Fax: 707-544-9375

Associate Editor
Katie Landmark
katie@highfrequencyelectronics.com
Tel: 608-845-3965
Fax: 608-845-3976

Business Office
High Frequency Electronics
7 Colby Court, Suite 7-436
Bedford, NH 03110

Editorial and Production Office
High Frequency Electronics
403 Venture Court, Unit 7
Verona, WI 53593

Also Published Online at
www.highfrequencyelectronics.com

Subscriptions
Sue Ackerman
Tel: 651-292-0629
Fax: 651-292-1517
circulation@highfrequencyelectronics.com

BPA WORLDWIDE

High Frequency Electronics (USPS 024-316) is published monthly by Summit Technical Media, LLC, 3 Hawk Dr., Bedford, NH 03110. Vol. 6 No. 10, October 2007. Periodicals Postage Paid at Manchester, NH and at additional mailing offices.

POSTMASTER: Send address corrections to *High Frequency Electronics*, PO Box 10621, Bedford, NH 03110-0621.

Subscriptions are free to qualified technical and management personnel involved in the design, manufacture and distribution of electronic equipment and systems at high frequencies.

SUMMIT
Technical Media LLC

Coping with a Rapidly-Growing 'Knowledge Gap'

Gary Breed
Editorial Director

Advancing technology always creates changes in the knowledge required by its practitioners. In radio engineering, an obvious series of changes was from spark to vacuum tubes, to transistors, to ICs—along with accompanying advances in materials and processes. Microwave specialists moved up in frequency and down in size, and are constantly adding a whole host of devices, materials and applications. Digital engineering didn't even exist until the 1940s, and has undergone an evolution of historic proportions—with operating speeds that are beyond what was considered "microwaves" 50 years ago. Optical communications, once considered to be completely different, is now part of the overall communications technology package and is moving to chip-level implementation.

Then you can add the complexity of the systems involved. We have digital radio signals transmitted with dynamically linearized power amplifiers and received with direct-conversion receivers using extensive digital signal processing. Microwave systems are used for detailed imaging with ultra wideband modulation that operates in the time domain. In the THz region, the no-mans land between microwave and optical technologies is now being explored by more than just a handful of scientists.

It has never been easy to stay on top of all important aspects of an engineering specialty. Now it's virtually impossible.

Today's design work requires a lot of information, and any gaps in that information will either slow down the design process or increase the odds of an unforeseen problem. Excellent engineers can fail to consider the effects on circuit operation of some system specification detail. They can unknowingly use insufficient models in simulation. Troubleshooting and fixing the shortcomings that appear will be harder, as well.

How can we deal with this large and growing knowledge gap? Well... learn as much as you can and know where to find the rest! Basically, this means honing your skills in the *process* of learning, beyond simply accumulating facts. Based on lots of conversations with many engineers who recognize the situation, I'll offer a few suggestions and comments.

The first suggestion is so obvious it is often missed—Make sure you know the fundamentals of physics, math and engineering. There is no bet-

ter way to solve a knotty problem than thinking it through from the ground up. That's why I hear top engineers say things like, "To get the RF performance I needed from that new ASIC, I had to go all the way back to the physics of the transistor junction." Many well-experienced engineers start their research on a new project by reviewing the fundamentals in their favorite reference text, which may have been written last year—or in the 1930s.

Which leads to the next suggestion, your personal reference library. Relying heavily on the Internet is necessary, but not yet sufficient, since every book and paper may not be available. Written records like books or conference and journal papers (including magazine articles, of course) remain essential, especially when you take the bottom-up approach noted above. Use the latest references for the details on specific applications, but be sure you understand the foundations they are built on.

Another strong recommendation is learning to rely on your professional friends and colleagues. Sometimes knowing where to find an answer means knowing who to ask! Curiosity is contagious. People who want to know new things are also willing to share what they already have learned. Engineers are often accused of not being social, but that does not mean they can't stay in touch, professionally, with past classmates, professors and work colleagues.

Finally, remember that all the talk about lifelong learning is true. The most successful engineers realize that they will never learn everything, but that doesn't keep them from trying. University courses, extension courses, short courses, and company-sponsored training are only part of the process. You will also learn things on your own and from others. At some point in your career, you will be asked to teach less-experienced engineers, write papers, prepare application notes or contribute to a book. Take the opportunity to re-learn whatever you are teaching to fill in any gaps in your knowledge of that subject.

There will always be a gap between what you know and what is needed. As advancing technology widens that gap, you need to find new information to fill it. That's an ongoing part of engineering—and a challenge that keeps really great engineers interested and enthusiastic about their work!

From October 2007 *High Frequency Electronics*