MPD
MICROWAVE
PRODUCT DIGEST

Editorial Statement of Purpose

Microwave Product Digest serves RF and microwave design engineers, research and development engineers, applications engineers and engineering managers. These professionals, working in facilities that serve both the commercial and government markets, are involved with the design, development, application, and use of systems and subsystems, devices, and techniques involving frequencies from RF to light.

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VBPA

FROM THE EDITOR

Positive Increases in Proposed DoD Spending

Karen Hoppe
Editor, *MPD*

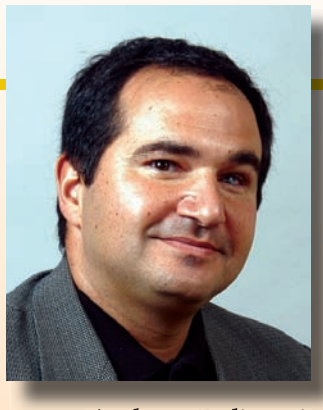
It appears that no matter what may happen in individual combat zones in the Middle East and elsewhere, a pullback in one spot will certainly mean an increased presence elsewhere. This is supported by the proposed defense budget for 2011, a total of $1.003 to $1.223 trillion. (Spending for fiscal year 2010 was estimated at $880 billion to $1.03 trillion.)

The DoD's procurement and RDT&E budget requests are generally higher for 2011, with the exception of the P-8A Poseidon, V-22 Osprey, CVN Refueling and Complex Overhaul, and Chemical Demilitarization programs. The greatest increases are in the requests for the Space-Based Infrared System (+54.4%), the Predator and Reaper Unmanned Aerial System (+57.8%), and the Carrier Replacement Program (+95.8%). Nine other programs will have positive increases should the requests be approved. (Information from the DoD's Fiscal Year 2011 Budget Request: Program Acquisition Costs by Weapon System.)

On the whole, it would appear that this would be a positive budget for many of the companies involved in the military arena. None of the proposed decreases exceed 7.0%, and there are relatively few of them. Now is not the time to cut defense spending, and this projected budget backs that up.

The GaAs versus GaN "War" Debunked

IN MY OPINION



Anthony Balistreri, Defense & Aerospace Marketing Director, TriQuint Semiconductor

Everyone loves a contest, whether it's competing with the house in the 1,500 casinos in the US, rooting for the home team, or watching CNN's World Poker Tournament. The groups within the RF and microwave industry and the semiconductor sector in particular have fostered their own contests such as the competition between silicon devices and upstart GaAs devices in the 1980s. Industry prophets back then forecast doom for silicon small-signal and RF power devices, but the ultimate result was that GaAs took a big bite from silicon's market share while leaving silicon LDMOS dominant in base station transceivers and other applications.

Today's competition is between gallium nitride (GaN) and gallium arsenide (GaAs), with some of the industry's clairvoyants foretelling GaN overtaking GaAs. To its credit, GaN offers exceptional power density (more power per square millimeter of die). It can operate at a higher power level at higher frequencies, and it offers higher efficiency. With attributes like these, it could be argued that GaN will be a slam dunk, replacing GaAs in the markets GaAs has served for years, if not decades. However, the results are likely to be similar as in the previous example, with each technology serving those applications to which it is best suited from a price/performance perspective.

To dispel any hint of proprietary bias, I feel compelled to point out that while TriQuint Semiconductor is known by many as a "GaAs company," we're also neck-deep in GaN and have leading surface acoustic wave (SAW) and bulk acoustic wave (BAW) filter portfolios as well as module expertise. We've spent more than a quarter century enhancing the performance of GaAs technology, which led in part to our wide selection of GaAs MMICs and world-class foundry services. However, since 1999 we have also been instrumental in the rapid development of GaN technology in partnership with universities, prime defense contractors, and US-government sponsored programs. We have been offering GaN foundry services and devices since 2008 and continue to grow a broad GaN portfolio. In May, we were selected by the US Air Force to provide GaN RF power transistor modules for UAVs. So while we're not exactly "technology agnostic," we are committed to ensuring the increasing performance and utility of not just GaAs, but of GaN as well.

The rise of GaN from a promising yet embryonic compound semiconductor technology with serious reliability issues has been meteoric. Dr. Mark Rosker, program manager for DARPA's Wide Bandgap Semiconductor Technology Initiative (WBGS-RF) in which TriQuint has been a lead participant in Phases 2 and 3, pointed out in MPD's March 2009 Military Microwave Digest supplement that at the beginning of the program (2001), "you could measure performance of the transistor

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and literally watch it degrade in front of you." However in only a few years, said Rosker, "We made a 10^{10} improvement in operating lifetime from minutes to 10^{7} hours". As a result of efforts such as these, GaN RF power transistors are now *de rigueur* in IED jammer RF power amplifiers and other defense systems. Their use in commercial applications such as base station transceivers and hybrid line amplifiers for cable systems has been feverishly promoted as well.

GaN is not now and will not soon become a replacement for silicon or GaAs in the majority of applications. Cellular handsets, for example, are not readily able to take advantage of GaN's benefits due to their low operating voltage. A GaN RF power transistor currently costs substantially more than a similarly sized GaAs device, although this is mitigated by the fact that fewer of them are needed to achieve a specific power level. Nevertheless, pure-play GaN-based companies are actively promoting the technology for use in commercial applications currently served by GaAs and even silicon, such as base station transceivers and hybrid amplifiers used by the millions in hybrid-fiber coax cable systems. GaN offers obvious benefits in both cases, but from the perspective of a company that offers both technologies, it seems that GaN will in the short term be a difficult sell in many commercial applications where there isn't a strong need for significantly higher power levels. Further, competing technologies in the cellular frequency range such as LDMOS, high-voltage pHEMT, and high-voltage HBT offer high power density at competitive costs.

That's why the first application of GaN RF power technology was in defense systems where cost was not as prominent a factor as performance. In commercial applications, acceptable performance is assumed and cost becomes the driver, which currently makes GaN less competitive than GaAs for many applications, regardless of the latter's technical merits. GaAs benefits from decades of refinement and mass production; its performance and cost are well suited for most applications while the width and breadth of GaAs device and MMIC portfolios is immense. For these reasons, we believe that GaN and GaAs will coexist (although perhaps not peacefully from a marketing perspective) for years to come. However, as its cost decreases, GaN will be chosen more for high-power and higher frequency applications where its attributes overwhelm those of GaAs. This will increasingly occur in defense systems and eventually in many commercial applications. For functions other than power amplifiers and for low-voltage systems, GaAs will continue to dominate thanks to its long record of reliability, lower cost, wide availability, and excellent overall performance.

That's not to say the two technologies won't sometimes compete for the same applications, because there will always be exceptions in which a specific figure of merit for one or the other will be paramount and defy the aforementioned generalization. In addition, as the quantities of GaN devices increase and its processes evolve, manufacturing cost will tumble, narrowing the gap between the two. Regardless of the ultimate outcome, TriQuint will continue to advance the performance of incumbent and insurgent technologies to satisfy the greatest number of requirements. After all, the customer ultimately chooses which technology 'wins,'—a market reality that best serves consumers and compels manufacturers to continually up their game.

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