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EXECUTIVE SPOTLIGHT: JOHN COWLES

John Cowles, general manager of ADI's RF and Microwave business unit (baseband, IF, RF and microwave amplifiers; power detectors; phase shifters and radar-focused products) recently gave his opinion on the defense market to *Electronic Design* in regards to the fundamental changes it has undergone in recent years to address new global threats. John explains how new systems such as UAVs and phased array radar are opening multiple opportunities for ADI's core technologies, and how the acquisition of Hittite's portfolio and expertise at the component, module, and system levels has uniquely positioned ADI to support these new platforms with full solutions at optimal SWaP+C (size, weight, and power plus cost).

Defense Market

The defense market has been experiencing volatility in recent years due to the withdrawal of U.S. and allied forces from Iraq and Afghanistan, concerns over sequestration and defense spending cuts, and the planned pivot by the U.S. to the Pacific region. However, a forecasted increase in the DoD budget and the outline of long-term strategic plans resulted in 2015 being a strong recovery year. This trend should continue into 2016, albeit at a more moderate growth rate of 5% to 6% as electronic content continues to increase in next-generation radar, electronic warfare, and tactical radios. Within the scenario, RF semiconductor content is expected to significantly outpace overall defense growth, driven by next-generation power amplifiers, low noise amplifiers, high power switches, DDS/synthesizers, and high speed data converters. These technologies and capabilities are synergistic with commercial applications that are heading into the microwave and millimeter wave regimes, driving the long-term costs down while retaining performance.

Advanced defense systems are pushing the boundaries of performance even as they continue to reduce size, weight, and power (SWaP). In addition, the need for multifunction systems and the need to reduce system development costs (SWaP+C) is driving system designs to be more modular and platform-centric, further pushing semiconductor integration levels and device configurability. Advanced SiGe, CMOS, and GaN technologies are well-aligned with these goals, providing higher levels of integration, the inclusion of digital signal processing, and improved efficiency.

John Cowles, general manager of RF and Microwave business unit at Analog Devices.

In particular, the adoption of electronically steerable and reconfigurable phased arrays is expected to revolutionize bulky and expensive mechanical radar and communications systems in both defense and commercial aerospace applications. The number of elements needed to realize the needed equivalent isotropically radiated power (EIRP) and angular resolution will drive the semiconductor content exponentially. The ability to integrate multiple beamforming paths in silicon-based technologies from X to W bands will enable cost-effective and compact phased arrays to be implemented with added functionality such as calibration, transmit power control, and other diagnostic capabilities. Highly integrated transceivers and data converters sitting behind the RF beamformers will be critical to the overall system SWaP+C, as will the careful distribution of timing references for clocks and synthesizers. Bringing these signal chains together with digital beamforming will add further flexibility such as finer angular resolution, multiple beam capability, and instantaneous beam steering.

Complementary to the silicon-based RF beamformers for phased arrays is GaN technology, poised to revolutionize the next generation of power at microwave and millimeter wave frequencies. Thanks to its unique material properties, GaN delivers higher power densities, superior efficiency, and wider bandwidth than GaAs. These technological advantages are ideally suited to military phased-arrays requiring large numbers of elements where efficiency and output power are key requirements. Supporting the expected volumes for GaN power amplifiers will require larger scale manufacturing than exists today with special focus on quality, yield, and packaging. In addition to phased arrays, GaN technology is enabling wideband amplifiers for solid-state traveling wave tube (TWT) replacements, in addition to low noise amplifiers and switches required to survive high incident power.

Companies that can combine the benefits of all these technologies will be able to extract synergies from signal chains and transfer overall system performance advantages to the defense ecosystem.

About the Author

John Cowles has over 20 years of experience in the semiconductor industry. He spent five years in defense electronics at TRW following his Ph.D. program developing advanced III-V semiconductor technologies for internal programs. He joined ADI 17 years ago as an RF IC designer under Fellow Barrie Gilbert. Within five years, he became the design center manager for Northwest Labs responsible for high performance RF IC product development targeting infrastructure applications. During that time, he was also responsible for directing ADI's broad investments in microwave radios. In late 2014, he became general manager within the RFMG business unit, created out of the legacy ADI and Hittite semiconductor businesses. He is responsible for a broad line of baseband, IF, RF, and microwave amplifiers; power detectors; phase shifters, and radar-focused products. John earned his B.S.E.E. in 1987 from the University of Pennsylvania and his Ph.D. in EE in 1994 from the University of Michigan.

Analog Devices, Inc.
Worldwide Headquarters

Analog Devices, Inc.
One Technology Way
P.O. Box 9106
Norwood, MA 02062-9106
U.S.A.
Tel: 781.329.4700
(800.262.5643, U.S.A. only)
Fax: 781.461.3113

Analog Devices, Inc.
Europe Headquarters

Analog Devices, Inc.
Wilhelm-Wagenfeld-Str. 6
80807 Munich
Germany
Tel: 49.89.76903.0
Fax: 49.89.76903.157

Analog Devices, Inc.
Japan Headquarters

Analog Devices, KK
New Pier Takeshiba
South Tower Building
1-16-1 Kaigan, Minato-ku,
Tokyo, 105-6891
Japan
Tel: 813.5402.8200
Fax: 813.5402.1064

Analog Devices, Inc.
Asia Pacific Headquarters

Analog Devices
5F, Sandhill Plaza
2290 Zuchongzhi Road
Zhangjiang Hi-Tech Park
Pudong New District
Shanghai, China 201203
Tel: 86.21.2320.8000
Fax: 86.21.2320.8222

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