SWaP+C Will Drive Military System Designs in 2016

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The defense market has experienced 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 U.S. Department of Defense (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 the electronic content continues to increase in next-generation radar, electronic warfare, and tactical radios. Within this 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 long-term costs down while retaining performance.

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Advanced defense systems are pushing the boundaries of performance even as they continue to reduce size, weight, and power (SWaP). In addition, the demand 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.

Phased-Array Phenomenon

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 required equivalent isotropically radiated power (EIRP) and angular resolution will drive exponential growth in semiconductor content.

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, ısmit power control, and other diagnostic capabilities.Highly integrated transceivers and data converters ing 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.

Impact of GaN

Complementary to the silicon-based RF beamformers for phased arrays is gallium-nitride (GaN) technology, poised to revolutionize the 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 gallium arsenide (GaAs). These technological advantages are ideally suited to military phased arrays that need large numbers of elements, in which 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.

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