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SiGe System on a Chip (SoC)



The SiGe System-on-Chip (SoC) ManTech project includes development and demonstration of a receive antenna that will provide the capability to meet the low cost, weight and reliability requirements for phased array antenna solutions on the DDG1000 and MMA (Multi-Mission Maritime Aircraft).

These antennas will be designed for operation in the Ku band which is suitable for SatComm communications in both surface and airborne applications. ACI, in partnership with Boeing (Phantom Works, Seattle, WA) as the subcontractor, will demonstrate manufacturability of the SiGe System-on-Chip (SOC) devices, and the flip-chip-on-board (FCOB) interconnect technology suitable for use in Ku band antennas.

The first major deliverable is a test cell module

incorporating flip-chip technology. The final deliverable of phase 1 will be a multilayer circuit board with the SiGe SOC, also using flip chip technology.

Transmit and receive antennas have typically used GaAs chipsets. This approach uses Silicon Germanium BiCMOS technology instead of GaAs, which provides inherently lower cost. SiGe also offers higher levels of integration, combining functions formerly accomplished by multiple GaAs chips and a separate CMOS-based control chip, onto a single SiGe ASIC. MMIC technology is a significant cost and size driver in phased array antennas, so this approach further reduces phased array antenna cost.

The packaging approach is based on the use of Flip Chip-on-Board (FCOB) technology to provide a solid-state replacement for the



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expensive traditional approach based on MCM modules and metallic waveguide structures.

Two Navy applications for implementation of this technology are the CDL datalink and wideband SatComm applications in the Multi-Mission Maritime Aircraft (MMA) and DDG1000. Specifically, light-weight, low-drag, low-cost, antennas for SatComm and CDL-compatible line-of-sight data links are desired in spiral technology developments on MMA. In addition, DDG1000 technology insertion improvement plans call for enhanced future performance and lower cost. The SOC and FCOB technologies enable use of low-cost PAA architectures which will produce significant cost savings for Ku-band CDL in the DDG1000.

Cost savings of as much as 50-65% and weight savings of as much as 15-25%, compared to current phased array antenna technology, can be achieved using the flip chip-on-board

approach based on the use of GaAs technology. The use of SiGe technology can further reduce semiconductor chip-set costs by up to 90%. In addition, the FCOB technology currently in development at Boeing is limited to 15-20 GHz due to the lattice spacing requirements and the size of GaAs chips necessary to perform the module functions. SiGe has the potential to reduce the chip-set footprint thus extending the practical frequency range for this architecture to 40 GHz or beyond.