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PHONESAT: A SMARTPHONE-BASED SPACECRAFT BUS

Abstract

Motivated to find transformation reductions in cost and development time of spacecraft, we examine the use of smartphones as the basis of a satellite bus. Today's smartphones have most of the core capabilities of a spacecraft: a fast processor and large memory capacity; a range of sensors such as accelerometers, rate gyros, magnetometers and GPS; batteries and power management; several radios; and high resolution cameras. Companies investing in smartphones have spent billions of dollars to squeeze sophisticated capability into a small, physically robust form-factor, and they now mass-produce devices in enormous volumes, lowering costs substantially.

Beginning in mid-2009 as a student-let effort, the PhoneSat project at NASA Ames set out to test the hypothesis of whether such COTS hardware can be used as the basis of workable ultra cheap satellite busses. In this paper we outline an approach whereby smartphones can be used as a wholesale replacement for the core computer systems, as well as most of the core sensor capabilities, of a spacecraft. We detail the bus design and ground-based environmental testing that has been performed; we provide the results from integrated field tests on balloons and sub-orbital rockets; finally we share lessons learnt on the engineering approaches taken, including the projects adoption of rapid prototyping techniques. We show that it is possible to design and build from scratch a spacecraft within 2 weeks and for under $10,000. Spacecraft based on this low-cost approach could enable a myriad of new spacecraft missions, and a whole new class of missions involving large constellations could become viable.