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CUBESATS TO POCKETQUBES: OPPORTUNITIES AND CHALLENGES

Abstract

In the last two decades, CubeSats have changed the perception of satellite missions: aided by standardization and usage of COTS, CubeSats have proven the feasibility of low cost and short development time space missions. The PocketQube with a form factor of 5x5x5 cm has been proposed as the next class of spacecraft to benefit from miniaturisation. This paper presents a comparison between the two standards and analyzes the impact of miniaturization on spacecraft design and performance.

At satellite level, the reduction of volume has a tremendous impact on the available power and makes energy management and efficiency critical. Thermal issues become important due to the reduced thermal capacitance, leading to higher thermal swings and larger temperature variations than CubeSats. The other important impact on the satellite bus is the reduced communication capacity due to several reasons: the reduced volume limits the available antenna size and also the available power available. At mission level other factors have an important impact: de-orbit time becomes a major criterion in the launch selection process to comply with orbital debris policy. The volume reduction also affects the radar cross-section making the satellite more difficult to detected for space surveillance radars.

Despite these challenges, PocketQubes are an attractive standard currently for academic and research groups as a way to reduce the cost and development time considerably. Payload capabilities also can force a paradigm shift from single to multiple satellites more than it was already happening with CubeSats: PocketQubes could better fit certain niches where high spatial or temporal resolutions are required instead of absolute resolution. Distributed space weather monitoring could be an interesting application where specific phenomena could benefit from multi-point sensing. All these strong points could also be coupled with a bigger satellite to complement and enhance its capabilities.

Delfi-PQ is a PocketQube currently being developed at TU Delft, contrary to the typical V-design approach, the design is done under agile development. Shorter life cycle development benefits students, allowing them to get more involved in every iteration. The reduced cost and development cycle increases the launch frequency: incremental engineering becomes fundamental, also providing benefits on the reliability side because flight experience becomes more frequent. End-to-end development motivates students and provides them a good insight in real-world engineering opportunities and training experiences. With this strategy, technical and educational objectives are more aligned and the integration of such a project in a university curriculum is facilitated.