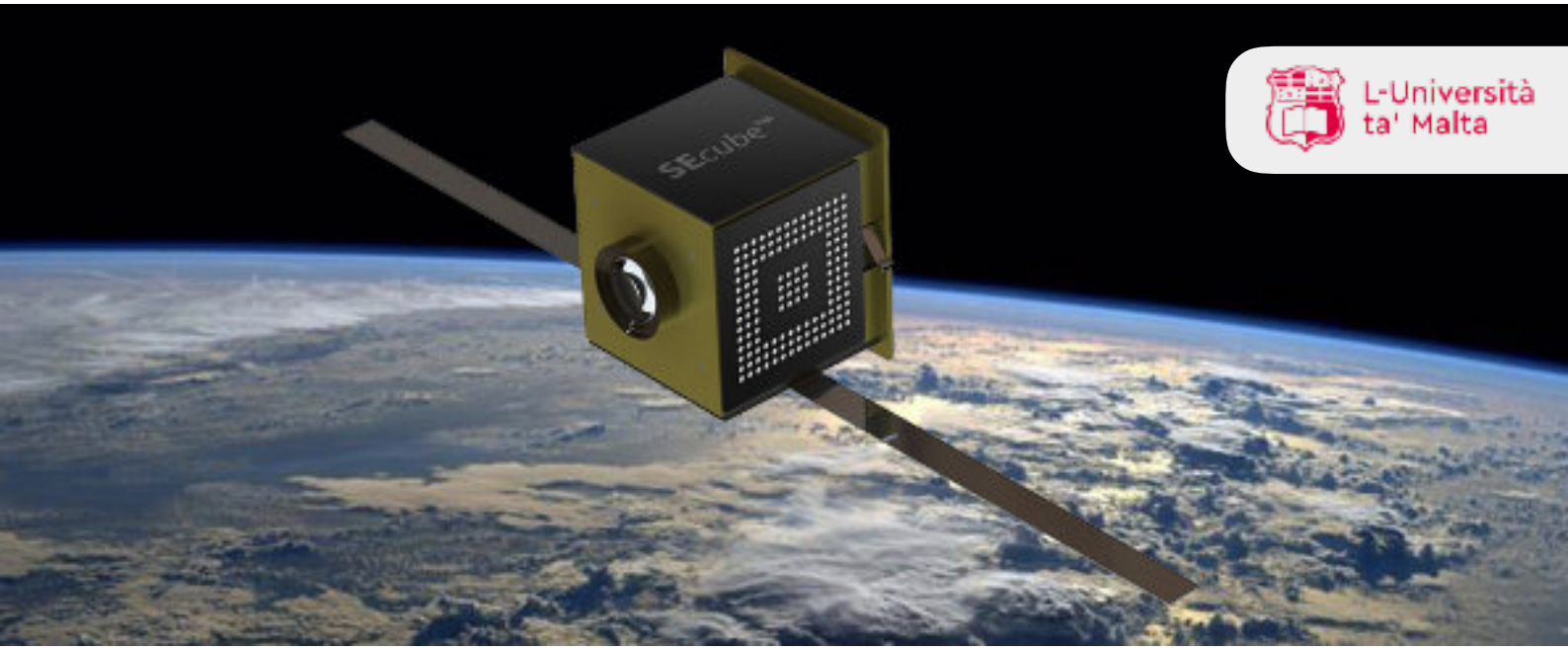
Case Study

SEcube™

Pico-satellites for In-Orbit Validation of tomorrow's spacecraft technology



Background

Drawing from the widely successful Cubesat standard, the PocketQube is among the smallest of a growing taxonomy of small satellites that have enabled cheap commercial access to space, and is particularly useful for massive constellations in low earth orbit (LEO) where it can be placed for less than $25k per satellite. Its cubic 5x5x5cm size and 250 g mass limit is particularly relevant since it reflects the volume and mass limit of typical modern smart phones, and with that it has access to all the low-cost, mass-produced, miniaturisation technologies that were, and will continue to be developed for portable electronics

Challenge

The low cost objective of small satellites is particularly challenging when coupled with the need for high reliability and quick design turnaround. Expensive rad-hard technology is out of reach for most CubeSats. Instead, developers rely on lower cost commercial off the shelf (COTS) components that have already received some level of in-orbit validation (IoV) through their use in prior missions. IoV is considered the gold standard method for de-risking new technology for spacecraft. However, the selection of validated devices is small and frequently does not include the latest technologies. Dedicated missions for validating modern COTS are still too expensive

Industry

Space
Low Earth Orbit CubeSats

Challenges

- Cost sensitivity excludes RadHard devices
- Quantified reliability of latest devices
- Space-validation of COTS components
- Lowering the cost of in-orbit validation
- Shorter time-to-market

Goals

- Maximise volume and power leveraging on miniature integrated and configurable components for the engineering of a"lab in space" test platform for IoV of COTS devices

Solution

- SEcube™ is a space resilient System-on-Chip suitable for adaptive and reconfigurable communication system, whereby reduced volume and power consumption, together with improved computational capacity, are important factors in the design of small satellites

Solution

The combination of operational and environmental conditions found in orbit are almost impossible to faithfully replicate in a terrestrial laboratory. For this reason, ASTREA developed the "PicoLab-in-Space" which is based on the PocketQube and other novel IP to permit low cost, short turn-around, space missions for the characterisation of electronic devices in the realistic orbital context. This 250gram highly integrated platform incorporates dual-band digital communications, active attitude control, solar panels, battery bank and efficient power management, radiation tolerant memory and a wealth of on board computational resources based on the SEcube™ - a highly compact System-on-Chip (SoC) by Blu5.

SEcube™ was chosen as the initial test-bed for it combines a powerful ARM microprocessor with tightly coupled FPGA fabric and a smart card security algorithm accelerator on a single and compact (9x9mm) BGA device, thus addressing the major satellite design constraints in terms of miniaturisation, high performance and low cost processing in space. The implementation of SEcube™ on the PocketQube, makes it the ideal platform for complex and computationally intensive tasks and secure software defined radio communications (SDR). Adaptive and configurable platform, SEcube™ allows software implementations without changing any hardware device or feature.

Benefits

- System-on-Chip (ARM - SC - FPGA)
- Small Size and reduced PCB footprint (9x9mm)
- High reliability
- Low power
- Adaptive and reconfigurable
- Advanced Functionalities (authentication, encryption and forward error correction)
- Established development environment

> "The combination of reliability, functionality, low power and well established development environment makes the SEcube™ the obvious choice to help ASTREA meet its goals"
>
> Marc Anthony Azzopardi,
> ASTREA Research Group Coordinator

ASTREA is an independent research group created by academics from the University of Malta and combines the expertise of a multidisciplinary team of engineering and science researchers and practitioners, academics and students. In collaboration with the University, Blu5 Labs and other European entities, ASTREA seeks to address the various challenges faced by the small satellite industry by developing and commercialising valuable intellectual property

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