

How the lessons learned from the flight of the Belgian OUFTI-1 CubeSat are leading to an improved successor OUFTI-2 still featuring D-STAR amateur-radio communications

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OUFTI-1 is an educational, one-unit (1U) CubeSat featuring, as main payload, a D-STAR repeater designed to operate in space, and fully homemade. D-STAR - the short for "Digital Smart Technologies for Amateur Radio" - provides voice & data digital communication through both radio links and the Internet. OUFTI-1 was launched on 25 April 2016 on Soyuz Flight VS14 from Centre Spatial Guyanais (CSG) in Kourou, French Guiana, under the "Fly your Satellite!" educational program of ESA. The CubeSat made it safely to orbit, and its Morse code beacon (BCN) immediately started to operate according to plan, but it suddenly stopped its transmissions to Earth after 12 days in orbit. Then, when we sent telecommands (via AX.25) to the satellite, we did not get any response from it. As a result, we were unable to activate the D-STAR communication system. The reasons for this sudden failure could not be identified.

In light of this experience, and following a debriefing with ESA at Redu, Belgium, with the two other FYS teams (from Denmark and Italy), the authors decided, in early July 2016, to launch a new educational nanosatellite project also featuring D-STAR as the main payload. They performed a thorough analysis of the OUFTI-1 design/architecture, and this exercise identified several tens of improvements that should lead to a more reliable satellite. These improvements then guided the design of the new OUFTI-2 CubeSat. This paper examines the main of these improvements, and presents the architecture of OUFTI-2 as it exists at the beginning of 2017.

Here is - briefly - how OUFTI-2 differs from its predecessor. The OUFTI-2 structure and solar panels are from ClydeSpace. OUFTI-2 uses two identical homemade On-Board Computers (OBCs) rather than one off-the-shelf, commercial and one simplified version thereof; each OBC uses one MSP430F1611 microcontroller. As in the predecessor, the communication (COMM) system provides (1) D-STAR voice & data user communication, (2) AX.25 telecommand & telemetry, and (3) automatic, periodic BCN Morse-code transmissions. However, the D-STAR system now also provides a BCN mode, and the Morse-code BCN now has a higher power efficiency. The Electrical Power System (EPS) uses a semi-regulated bus, rather than an unregulated one, leading to a better control of the charge of the two batteries, thus improving the length of their lives. The removal of some redundant elements led to some real estate becoming available, which allowed us to add new secondary payloads: one designed to test the effect of various shields against ionizing radiations, and one to make inertial measurements.

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