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IN-ORBIT DATABASE AND DISTRIBUTED COMPUTING BASED ON TINY 2 LANGUAGE

Abstract

The NetSat formation flying mission will demonstrate the autonomous control of a formation of four pico-satellites. The outcome of the NetSat mission is a broad range of scientific contributions in different areas and its success will enable new approaches for commercial and scientific distributed satellite systems.

The Tiny 2 predecessor (Tinytus) was successfully tested in-space on board of the UWE-3 satellite from the University of Würzburg and is still active to date. It is a part of the On Board Data Handling and Attitude Determination and Control software. It enables complex tele-commanding and continuous execution of high-level attitude control algorithms. Tiny has a footprint of several kilobytes and extends the functionality of a low-power microcontroller (from 16 bits) without the need of the hazardous in-space software image update. The sand-box design eliminates the threat of the potential software crashes. This concept dramatically improved the outcome of our scientific research - since more ADCS algorithms could be tested during the UWE mission. Thus the idea of a sand-box interpreter is now expanded to fulfil the requirements of the NetSat formation flying mission: distributed formation control, in-space database and operations of the formation.

This contribution starts with a short introduction of the NetSat mission requirements and objectives. Then the concepts of the language will be introduced: byte-code, portability, sand-box design, access to and from C/C++ code. Due to the narrow data link or limited on-board storage, the in-space data acquisition usually takes place on demand, e.g. by defining a specific time period for data capture with subsequent downlink. Since the data is the most valuable good during the orbit phase, an in-space low-power database with continuous data recording will be introduced with NetSat. The operator can select and aggregate data afterwards with Tiny Query scripts. With distributed functionality the operator can define one single script, in which particular sections are executed on different (sub)systems - thus providing a basis for distributed formation control. Moreover, it is possible to outsource heavy tasks (e.g. image processing) to a more powerful (sub)system, that can be powered up on demand. The communication required for the remote execution is handled by the Compass protocol stack, which is also developed for the NetSat mission. Compass ensures an enduring deterministic state of the distributed execution by activating appropriate communication techniques (e.g. buffering, hand-shaking, ECC) for individual segments of the communication chain.