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COMMAND CENTRIC ARCHITECTURE (C2A): SATELLITE SOFTWARE ARCHITECTURE WITH A FLEXIBLE RECONFIGURATION CAPABILITY

Abstract

In recent years, as practical applications of microsatellites spread, missions of them have become advanced and it has been required that the development of them is short-term and low-cost. In order to achieve these requirements, two points of improvement, such as reliability of software due to high re-usability and flexible reconfiguration capability on orbit, are important in terms of onboard software (OSW). The conventional development of on-board software for microsatellites has been performed individually each satellite, and software which can achieve the two points mentioned above has not been developed. Therefore, as a framework to develop OSW for microsatellites that satisfies high re-usability and flexible reconfiguration capability, the software architecture named "Command Centric Architecture (C2A)" was proposed as a doctoral dissertation at The University of Tokyo. This software architecture has three characteristics: describing common functions among every spacecraft as commands and functions associated with them, modularizing unique functions for each satellite, and coupling common functions with unique functions via definition tables. With these features, the OSW realizes the flexible reconfiguration capability of itself, which is the middle of the parameter change and the memory rewrite from a viewpoint of the load for implementation, the risk of reconfiguration and the ability to deal with anomalies. Furthermore, this software framework separates functions common to spacecraft and spacecraft-specific functions and narrows hardware-dependent parts by modularizing spacecraft-specific functions. Thanks to them, it is possible to reuse many parts of the software in different spacecraft. C2A was applied to some Earth-orbiting microsatellites, UNIFORM, Hodoyoshi-3 and 4, and it was refined. After that, it was applied to PROCYON which is the first interplanetary micro-spacecraft. Porting C2A to PROCYON was quite easy because these four spacecraft use the same model of onboard computer. By using C2A on its OSW, development of the software was completed in only about 5.5 months. Also, we were able to deal with various events by utilizing C2A's flexible reconfiguration capability during operation of PROCYON. In addition, we have completed implementation of C2A to the OSW of EQUULEUS, which is 6U CubeSat currently under development. C2A porting from PROCYON to EQUULEUS was realized in a very short time despite EQUULEUS using a different model of onboard computer. In this way, C2A has various

advantages such as shortening development period of small spacecraft, improving the reliability of OSW, the flexibility of operation, therefore it gives great advantages to the mission using the small spacecraft.