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VIDANA – An Extremely Fault Tolerant Data Management System for Satellites

Sergio Montenegro, Alexander Hilgarth, Tobias Mikschl, Michael Ruffer, Thomas Walter

Computer Science VIII: Aerospace Information Technology, University of Würzburg, Germany

(e-mail: sergio.montenegro@uni-wuerzburg.de, fon: +49 931 3181 400)

A data management system (DMS) in spacecraft is of central importance. It does not only manage all relevant data for the mission objectives but also handles all instantaneous values of sensors and actuators. The goal of the VIDANA-project is a DMS tailored to the needs of nano-satellites as it considers limited resources. It adopts the approach of maximum modularity and decentralization and facilitates the cooperation between satellites, as it is required for example in the formation flight or when coupling components (assembly). The hardware of the resulting project platform will be based on commercially available components and will not depend on space certified hardware. Thus the required reliability of the overall system is intended to be achieved by the architecture of hardware and software. The most important architecture decision is that hardware, software and network should be considered as a unit. The concepts and methods to be developed include "Task Distribution", "Error Detection and Recovery", "Task-Context Backup and Recovery", system monitoring and redundancy management. The VIDANA-system consists of many locally distributed cooperating standard microcontrollers. The number of momentary cooperating nodes is dynamic and depends on the current mission requirements. In order to save energy nodes can be turned off. Other nodes can be activated if there is a need for additional computing power or redundancy. When distributing tasks to individual nodes the mission specific demand for redundancy is automatically considered. Errors can be recognized by using redundancy and majority voting when comparing the replicated tasks. Once a node has been detected as defective it will cause the migration of its tasks to a redundant node automatically. A satellite system consists of several subsystems, wherein each subsystem can have its own computer nodes. With an appropriate networking VIDANA allows the logical combination of all existing computing nodes into a distributed supercomputer.