

Key Technology of Space Exploration (8)

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## THE FULL DUPLEX EFFICIENT IMPLEMENTATION METHOD OF CCSDS PROTOCOL FOR MARS EXPLORATION

### Abstract

Mars is the next milestone in our exploration of solar system. Because of the really long distance between earth and mars, the optimization of the mass and power consumption and the enhancement of reliability become extraordinary critical. As the key payload, UHF transceiver (Electra) is responsible for transmitting/receiving collected data according to CCSDS protocol, which is really complex and ensures automatic communication with no error. The common implementation of CCSDS protocol is based on CUP and DSP, such as Mars Reconnaissance Orbiter (MRO) and Mars Science Laboratory (MSL). However, the drawbacks are obvious: 1) CPU and DSP are sensitive to SEE (single event effect), which will decrease the reliability of the system; 2) the power consumption of CPU/DSP is not small. In this paper, the full duplex efficient implementation method of CCSDS protocol is presented, which uses limited FPGA resource to implement the CCSDS protocol. Thereby, the CPU/DSP could be avoided. The presented method consists of 6 parts: I/O module, ARQ module, MAC module, flow management module, reception processing module and coherent management module, which are protected by TMR (triple modular redundancy) and timing scrub to decrease the SEE influence. By using the conception product which embeds 1 Xilinx VIRTEX4 chip, real test result shows that the presented method performs well and the resources needed are 8% ALMs, 5% DSP and 9% RAM.