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FLEXIBLE, MULTI-FUNCTIONAL, MULTI-BAND AND RECONFIGURABLE SPACE RF EXPERIMENTAL PAYLOAD FOR MANNED SPACE SCIENCE AND APPLICATION SYSTEM

Abstract

The increasing complexity of the space science and applications, in particular those onboard the already manned spacecraft, communication and earth resources satellite etc. has challenged how to load and extend a variety of tasks on a common platform, address the management and optimization of the payload resources. Although there are some researches on software loading and upgrading technologies based on software radio technology, they are still limited to function upgrades under a certain functional framework and hardware scale, and do not reach the software defined level of overall resource reorganization and function refractory.

This paper details Southwest China Instituted of Electronic Technology's (SCIECT) the Space RF Experimental Payload (SRFEP) Testbed solution, the SRFEP Testbed is a large-scale, digital phased array based, multi-band, multi-functional and highly reconfigurable system, system operating frequency covers S, C, X, and K band, composed of five software defined radios, integrated into a flight system, support space-based large-scale signal and information processing, it is expected to be installed in Chinese manned space science and application system. Specifically, to offer the future promise of in-flight reconfigurability, digital phased array system is used as the sensors scheme, using multiple MEMS optical switching matrixes to achieve full interconnection and redundancy backup for each array element and processing equipment; a FPGA+DSP+CPU heterogeneous processing platform was adopted as the signal and information hardware architecture; at the software level, blueprint deployment was introduced, which is common in integrated avionics, it allows developers to build a variety of RF system functions like building blocks, it provides an operating environment to abstract the communication waveform application from the underlying platform specific hardware such as digital-to-analog converters, analog-to-digital converters, oscillators, RF attenuators, automatic gain control circuits, FPGAs, DSPs, general-purpose processors, etc. and the interconnections among different radio components. In order to solve the problem of hundreds of electronic modules's high-speed interconnection under space environment, a SPACE VPX based improved dual redundancy RapidIO high-speed serial bus with ECC capability is proposed. A prototype was produced and a test environment was built, taking communication mode and earth resources mode as an example, obtained results demonstrate that the reconstructed time of the two functions is 24.6 seconds, the storage capacity up to 64T bits, transmission speed is reached 16Gbps, and the error rate is 1E-9, the transmission packet efficiency is 96.7%