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DATA MANAGEMENT SYSTEM OF THE RUSSIAN COMPUTER: 20 YEARS OF FAULT TOLERANT COMPUTER OPERATION, CONTINUOUS SUSTAINING MAINTENANCE AND OVERCOME OF OBSOLESCENCE ISSUES

Abstract

Nearly twenty years ago Swesda () equipped with the DMS-R Fault tolerant computing (FTC) system – a configuration of 3 identical fault containment regions (FCR) designed at Airbus DS Bremen- started its operational life in space. DMS-R the Data Management System Russia is the fault tolerant computing system responsible for the altitude regulation of the ISS as well as for the control of the life support system.

The system was designed to guarantee 15 years of life time in space by exchange on box level (FCR) including the number of spares produced. The DMS-R FTC computing system operates nearly 20 years without serious problems on the ISS now. However, the specified operational life time has already been passed. In 2015 serious analysis of the occurred failure types and rates took place with the result that a high number of failure occurrences could be traced back to the work memory (RAM) of the processor board.

RSC-E, ROSCOSMOS and ESA envisaged the need for additional computer spares being available to serve for ISS lifetime extension until 2020. Due to obsolescence of EEE parts a simple re-manufacturing was not possible. This was the trigger to think about alternative design approaches from board level up to new computer architecture on box level. Due to cost constraints a processor board alternative based on interface and SW compatibility to the largest extend possible was designed and implemented. The operational drawback to have an onboard ISS board level exchange to be performed by an ISS crew member had to be taken into account from the beginning.

To overcome communication issues whether the right decisions have been taken towards an onboard exchange procedure the excellent relationship between the developer and the end-user in an integrated team with direct day to day communication helped to setup a pragmatic approach. Today after the successful board level exchange on a workbench in the service module the re-integration of the renewed FCR box into a “mixed” fault tolerant computer configuration proves the concept chosen is the most effective to overcome obsolescence problems and budget shortcut. Looking towards a life time of the ISS until 2030 a New Computer Generation passed the project study phase replacing the current FTC from 2024 onwards. It is based on newest technology but keep the interfaces compatibility to the current FTC. Furthermore, the new FTC architecture and design enables the re-use of elements from other programs.