66th International Astronautical Congress 2015

SPACE SYSTEMS SYMPOSIUM (D1)
Space Systems Architectures (4)

Author: Mr. Xiongwen He
Beijing Institute of Spacecraft System Engineering, China Academy of Space Technology(CAST), China, hexw501@hotmail.com

Mr. Bowen Chen
Beijing Institute of Spacecraft System Engineering?China Academy of Space Technology (CAST), China, shanshui_66@163.com
Mr. Dong Yan
Beijing Institute of Spacecraft System Engineering?China Academy of Space Technology (CAST), China, yandong200@163.com
Mr. Jianbing Zhu
Beijing Institute of Spacecraft System Engineering?China Academy of Space Technology (CAST), China, xgdzjb@163.com
Mr. Ming Gu
Beijing Institute of Spacecraft System Engineering?China Academy of Space Technology (CAST), China, gumingnr@163.com
Mr. Weiwei Liu
Beijing Institute of Spacecraft System Engineering?China Academy of Space Technology (CAST), China, akinglw@163.com
Mr. Panpan Zhan
Beijing Institute of Spacecraft System Engineering?China Academy of Space Technology (CAST), China, panpan3210@qq.com
Mr. Jia Tian
China Academy of Space Technology (Xi'an), China, jia_epfl_tian@163.com

DESIGN AND IMPLEMENTATION OF SPACECRAFT AVIONICS SOFTWARE ARCHITECTURE BASED ON SPACECRAFT ONBOARD INTERFACE SERVICES AND PACKET UTILIZATION STANDARD

Abstract

Integration of functions in spacecraft avionics system is a trend in the development of spacecraft especially in Chinese spacecraft currently, which brings the phenomena that special functions, non-standard interfaces and protocols appear in different spacecraft. How to solve the problem of spacecraft avionics software reuse under this condition is the main point of this thesis.

A spacecraft avionics software architecture has been designed and implemented, which is based on Spacecraft Onboard Interface Services (SOIS)recommended by Consultative Committee for Space Data Systems(CCSDS) and Packet Utilization Standard(PUS) recommended by European Cooperation for Space Standardization(ECSS).

The software architecture consists of Operating System Layer, Middleware Layer and Application Layer. The Operating System Layer supports different embedded operating systems and hides the various

device interfaces using the uniform device driver framework. The Middleware Layer is divided into three lays, including subnetwork layer, transfer layer and application support layer. The subnetwork layer contains Telecommand Space Data Link Protocol(TC SDLP), Advanced Orbiting System(AOS) and SOIS subnetwork services. The convergence protocol for different data links in the subnetworksuch as 1553B,Digital Serial(DS) interface and so on, are also developed in order to support the change of data links. The transfer layer use enhanced space packet protocol to support the data routing between various data links. The Application support layer contains SOIS command and data acquisition service, message transfer service,time access service and PUS services. The Application Layer software can be developed by different spacecraft users according to specific requirements.

Standard application interface for the services in each layer is designed in the software architecture. The onboard interface, protocol and services can be standardized and extensions can be easily realized through the use of SOIS standards. The ground operation is also standardized through the use of TC SDLP, AOS protocol and PUS standard. Through the flexible configuration of services and protocols, different requirements of future spacecraft can be easily supported, and the spacecraft avionics software can be standardized which will greatly increase the reusability of onboard software.

This thesis also gives a brief introduction to the implementation of the software architecture on a space avionics system prototype. The feasibility and the support to software reuse of the architecture have been validated. The results of the test and validation demonstrate that the software architecture has great effects on software reuse.