IAF SYMPOSIUM ON ONGOING AND NEAR FUTURE SPACE ASTRONOMY AND SOLAR-SYSTEM SCIENCE MISSIONS (A7)
Science Goals and Drivers for Future Exoplanet, Space Astronomy and Space Physics (2)

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PROTOTYPE DESIGN OF SCIENCE TRAFFIC SHAPER FOR DEMONSTRATION OF STRATOSPHERE BASED ASTRONOMICAL OBSERVATORY.

Abstract

ESBO-DS(European Stratospheric Balloon Observatory Design Study) is an European project that is developing a balloon based observatory with the operations concept to provide access to observation time similar to the one practiced on ground based observatories. The central part of the project is the development of the flight prototype STUDIO, which will be carrying a telescope with aperture 50cm and instruments for the ultraviolet and visible spectral ranges. This prototype will enable the testing of critical technologies and initial scientific observations, and is scheduled to fly in the year 2022.

While scientific data collected during flight can be in an ideal case recollected after landing, It is ideal to downlink parts of the data during the observation. On the one hand, this downlinked science data can help to detect faults on ground, calibrate the instruments, and replan the observations if necessary. On the other hand, balloon landings are still a critical phase and the mechanical loads during landing can in the worst case lead to loss of onboard data. Therefore, one of the major components in STUDIO is the optimal design of traffic shaper that will enable transfer of science and housekeeping data in 2 modes of communication to ground: line of sight and beyond line of sight. These two modes provide very different bandwidth, and the traffic shaper should react to this change, by automatically replanning the science data downlink. This paper describes in detail the construction of the software components to control the data being sent to the ground from the STUDIO payload. These components will enable the most feasible transfer of data stored between the onboard SSD's and the ground station using one or two Ethernet links. The traffic shaper designed will set a dynamic limit on each of the virtual channels based on bandwidth and the amount of data in line in each virtual channel, along with the operational mode of the observatory and observations being conducted, prioritizes the channels, connects to the different data stores and sends the data to the communication system using the UDP/IP protocol according to the priority and weight attached to the data being transmitted.

To satisfy the service-based and extensible concept of operation for ESBO-DS requires a significant amount of flexibility in software design and implementation. All the software components for traffic shaper are implemented in accordance with the core onboard software framework, which by providing core functionalities and communication ways among different components, helps in enhancing the overall flexibility onboard . It would be a possibility in future to easily add or remove communication links, change the data store implementation, number of virtual channels, or the protocols in use, without the need to change any other components of the system.

The paper concludes with the functional testing of the components and integration of the same with the Flight Software Framework at the IRS, University of Stuttgart. The designed software is implemented in C++ with the operating system being Linux based.