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A SURVEY ON FLEXIBLE PAYLOD OF COMMUNICAITONS SATELLITES

Abstract

Traditional communications satellites provide customers services with fixed beam coverage, fixed transmission power, and fixed bandwidth. However, those service requirements may change rapidly due to the dynamic markets even if the satellites are launched. Moreover, from the perspective of payload manufacturers and system operators, the capabilities of satellites are not expected to be 'frozen' during the 15-year or longer life span. Hence the resources of in-orbit satellites should be adjustable which originates the conception of flexible payload, and attracts a great deal of considerations among research institutes around the world. Nowadays, flexibility in terms of beam coverage, transmission power allocation, and frequency band assignment is considered mandatory for communications satellites, and many techniques have been developed in payload design and manufacture to realize the flexibility, and Eutelsat Quantum is a perfect extension from conception to engineering implementation.

This survey examines the RD (Research and Development) activities of flexible payload all around the world, and further summarizes the key techniques for engineering implementations.

The RD activities of ADS (Airbus Defense and Space) are firstly introduced. Hylas-1 was launched in 2010 and adopted GFP (Generic Flexible Payload) supported by ESA's ARTES program, in which AIDA (Agile Integrated Down converter Assembly) is used such that Hylas-1 can change the frequency plan in orbit. Following Hylas-1, Eutelsat Quantum was developed in 2020 which features in 'fully software-defined' via introducing on-board digital processing. It also adopts MPA (Multi Port Amplifiers) and active re-configurable antenna to reallocate power and frequency resources among re-configurable beams in accordance with dynamic markets.

Secondly, the activities of TAS (Thales Alenia Space) are examined. It emphasizes the importance of digital processing, and indicates that DTP (Digital Transparent Processors) and OBP (On Board Processors), along with MPA and flexible RF-IF converters could be used to implement the flexibility. Particularly, DTP could build any-to-any uplink-downlink connections to facilitate single-hop scenarios, and OBP is responsible for improving link margin. Moreover, since the boundaries of MSS, FSS, BSS and HTS are blurring in the future, a mixture structure incorporating both DTP and OBP is suggested such that the payload can support multi tasks in orbit.

Besides that, activities of other companies such as Lockheed Martin Company and GMV Tres Cantos are introduced.

Finally, the survey summarizes the key techniques including flexible active antenna, flexible frequency converter and filter, and flexible digital processing, and highlights the future issues.