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Author: Mr. Pedro Rodrigues
Tekever, Portugal

Dr. Ricardo Mendes
Tekever, Portugal
Mr. Pedro Sinogas
Tekever, Portugal
Mr. André Oliveira
Tekever, Portugal
Mr. Karim Mellab
European Space Agency (ESA), The Netherlands

ENABLING INTER-SATELLITE LINK PLATFORM FOR MULTI-SATELLITE MISSIONS

Abstract

The Space community is witnessing an outstanding revolution in terms of mission concepts. Current approaches are distancing themselves from the traditional and expensive single-spacecraft missions to more affordable architectures involving multiple and smaller satellite platforms. This already established concept of involving multiple platforms in a collaborative fashion has found support in different applications, from scalable space telescopes and on-orbit servicing to Earth observation missions involving fractionated sensors hosted by satellite constellations. Great improvements in mission flexibility, cost and risk management are foreseen from involving multiple spacecraft. One thing is however certain: the paradigm of space missions is changing and technology is expected to keep up with the needs.

One common asset required in multiple spacecraft missions is in-space communications between platforms, widely known as Inter-Satellite Links (ISLs). This capability is used to exchange data between the different elements of the constellation or network, either for synchronisation, relative position determination or even telemetry relay to Ground. Since ISLs are used in a very specific context, their requirements are fairly different from those of traditional telemetry, tracking and command subsystems, which are more directed to Ground-satellite communications. ISLs are used to exchange critical data and therefore require lower latencies and transmission error rates and usually operate without any Ground intervention. For this reason, the Space market demands a new enabling generation of communication solutions that can cope with these requirements.

GAMALINK is a multifunctional Software-Defined Radio communications and networking platform, born in the terrestrial domain, spun into space for the small satellite market and now upgraded to meet the specific requirements of Inter-Satellite Links. One of its applications is the PROBA-3 mission, whose scientific goal is to study the Sun corona, using two satellites flying in formation. The critical ISL subsystem will provide time correlation and synchronisation between the two satellites, enable the exchange of formation control data among the platforms and determine their relative distance during the precise formation flying manoeuvres. Apart from the challenging performance requirements, the ISL must also be able to survive the harsh radiation environment.

This paper will present a detailed analysis of the key challenges and requirements of Inter-Satellite Links for these new distributed mission concepts and then focus on the design evolution, development and test of the PROBA-3 Inter-Satellite Link. Based on the outcome, the market potential of this ISL solution will also be studied in light of the existing roadmaps for future Space missions.