SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Space Navigation Systems and Services (4)

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A NOVEL EMERGENCY SYSTEM FOR LOW EARTH ORBIT SATELLITES USING GALILEO GNSS

Abstract

Low Earth Orbit (LEO) satellites typically have a limited contact time with their ground segment. This fundamentally constraints a timeliness reaction of the Mission Control Centre (MCC) in case of emergency situations onboard the LEO spacecraft. To enable a timeliness reaction, it is proposed to use a Search and Rescue (SAR) beacon onboard that spacecraft to transmit an alert message via existing or future satellites which support SAR through the Cospas-Sarsat system to the satellite MCC.

Currently, SAR is only applied to distress situations of humans in terrestrial, maritime or aviation environments. However, often spacecraft are a very precious asset in space as well corresponding to values of a few hundred million dollars. Extending existing or planned SAR services to handle LEO spacecraft anomalies is therefore an innovative and challenging proposal. An emergency situation onboard a spacecraft is given e.g. when the spacecraft enters safe mode. Then typically Fault Detection, Isolation, and Recovery (FDIR) measures or automated procedures are activated. However, when the emergency occurs, the satellite may still be hours from the next contact to its ground station. With the proposed transmission of a SAR message via SAR-supporting satellites and the Cospas-Sarsat system, a fast response time for the satellite's MCC is realized. This can be used to prepare ground operations for the contingency, include other ground stations or even contact the spacecraft through a return link.

We have looked at existing and future space systems which could support such an approach and identified the SAR functionality of the Galileo Global Navigation Satellite System (GNSS) as a potential candidate. On the LEO satellite a beacon could be used to forward the emergency message via SAR transponders on several Galileo spacecraft to Medium Earth Orbit Local User Terminal (MEOLUT) ground stations which will identify the originator of the emergency and inform the MCC accordingly.

The paper will present a systems architecture for this innovative concept. It will address both non-technical as well as technical opportunities and challenges. Key opportunities are more robust operations of spacecraft, securing valuable assets in space with a potential impact on mission reliabilities and even insurance cost. Key non-technical challenges have been in particular identified in the legal and regulatory frame e.g. frequency usage and allocation for SAR services, acceptance and integration within Cospas-Sarsat. Furthermore, a particular technical challenge is the potential Doppler compensation of the signal send by the satellite in an emergency situation.