IAF SPACE SYSTEMS SYMPOSIUM (D1)
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EO-ALERT: A NOVEL ARCHITECTURE FOR THE NEXT GENERATION OF EARTH OBSERVATION SATELLITES SUPPORTING RAPID CIVIL ALERTS

Abstract

Satellite Earth Observation (EO) data is ubiquitously used in many applications, providing basic services to society, such as environment monitoring, emergency management and civilian security. Due to the increasing request of EO products by the market, the classical EO data chain generates a severe bottleneck problem, further exacerbated in constellations. A huge amount of EO raw data generated on-board the satellite must be transferred to ground, slowing down the EO product availability, increasing latency, and hampering the growth of applications in accordance with the increased user demand. This paper provides an overview of the results achieved by the EO-ALERT project (http://eo-alert-h2020.eu/), an H2020 European Union research activity. EO-ALERT proposes the definition and development of the next-generation EO data processing chain, based on a novel flight segment architecture that moves optimised key EO data processing elements from the ground segment to on-board the satellite, with the aim of delivering the EO products to the end user with very low latency (quasi-real-time). EO-ALERT achieves, globally, latencies below five minutes for EO products delivery, achieving latencies below 1 minute in some scenarios. The proposed architecture solves the above challenges through a combination of innovations in the on-board elements of the data chain and the communications. Namely, the architecture introduces innovative technological solutions, including on-board reconfigurable data handling, on-board image generation and processing for the generation of alerts (EO products) using Artificial Intelligence (AI), on-board data compression and encryption using AI, high-speed on-board avionics, and reconfigurable high data rate communication links to ground, including a separate chain for alerts with minimum latency and global coverage. The paper presents the proposed architecture, its performance and hardware, considering two different user scenarios; ship detection and extreme weather observation/nowcasting. The results show that, when implemented using COTS components and available communication links, the proposed architecture can deliver alerts to ground with latency lower than five minutes, for both SAR and Optical missions, demonstrating the viability of the EO-ALERT concept and architecture. The paper also discusses the implementation on an avionics test bench for testing the architecture with real EO data, with the aim of demonstrating that it can meet the requirements of the considered scenarios in terms of detection performance and provides technologies at a high TRL (4-5). When proven, this will open unprecedented opportunities for the exploitation of civil EO products, especially in latency sensitive scenarios, such as disaster management.