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FROM A BLUEPRINTEDITOR TO AN INTELLIGENT PAYLOAD DATA PROCESSING ONBOARD: SPACEDGE FLIGHT SW FRAMEWORK

Abstract

SpaceEdge™ is an Artificial Intelligence (AI)-augmented onboard Flight Software (FSW) framework, aimed at bringing into the Earth Observation (EO) market a new concept of payload data processing. The processing framework is composed of an on-board infrastructure, integrated with NASA's core Flight System (cFS), whose main capability is to execute processing workflows based on the composition of basic functions, wired into a graph structure, thus allowing complex computing flows, involving also inference capabilities. The overall solution offers the final user a simplified Integrated Development Environment (IDE) providing a blueprint editor to compose graphs and then generate, on-ground validate, and in-space deploy resulting code suitable for onboard execution. This enables users from multiple verticals (EO, AI, FSW) and with different viewpoints on data processing chains, to develop and test a flight-ready solution starting with minimal effort and then tuning the overall efforts gradually, even without triple-A coding capabilities. Furthermore, the on-board side of the framework, being built upon the vast heritage and the flexibility of the cFS' modular architecture, is exploited to interconnect the different SpaceEdge™ constituent technologies and provide data handling services in the direction of CCSDS Mission Operations concepts. The resulting on-board software architecture creates an intelligent and autonomous payload processing node, that can function synergistically with the platform's central SW, moving from the usual TeleCommands (TC)sink role of a payload node in a spacecraft (S/C) network, to an active node that can issue requests via TCs to the platform FSW, to request sensor data and to orchestrate complex operations. cFS' inherent modularity allows the implementation of an expandable infrastructure, in which any classical or Neural network's-based applications for EO data processing can be loaded and executed, without affecting the execution of the others. Such an AI-enabled computing continuum from the Ground to the Edge, the SpaceEdge™, is meant to provide on-demand, in-orbit data processing resources to turn raw data into actionable knowledge.