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NASA'S GODDARD SPACE FLIGHT CENTER'S DISTRIBUTED SYSTEMS MISSIONS ARCHITECTURE

Abstract

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Applying a distributed approach to missions, where the fusion of knowledge from components, systems, instruments, data, models, and observation locations works in concert with timely response and feedback mechanisms to transform the benefit to science and exploration. Previous studies showed the increased science value from multi-point observations over a monolithic singular observer. With the advances in reduced size, weight, and power for space-worthy components leading to the revolution in smaller spacecraft, the cost and timeliness proposition for launching multiple space assets also improves. Thus, the aerospace industry as a whole is undergoing a paradigm shift toward a proliferation of small satellites as a networked approach to meet mission objectives.

Distributed spacecraft architectures is not a new concept; government agencies and industry have operated distributed spacecraft for decades, with examples such as Iridium, Global Navigation Satellite Systems, the Earth Observing constellation, Gravity Recovery and Interior Laboratory, and the Magnetospheric Multiscale Mission. The novelty, therefore, is not in distributed parts themselves, but designing emergent behaviors that enable cooperative, event-driven operations. A necessary step to this goal is the need to provide a cohesive environment to architect, develop, model, test, and operate singular assets in a systemic manner to create a whole greater than the sum of its parts. An open mission framework that embraces successful aspects of "plug-and-play" provides a viable and intelligent means for content collection, data modeling and synthesis, and autonomous response across diverse platforms, and enables the flexibility needed to scale and evolve the system for subsequent improvements in achievable mission objectives. Goddard Space Flight Center's Distributed System Missions (GDSM) thrust builds on experience with multiple distributed mission life cycle development and operations, open source ground and flight software such as Goddard Mission Services Evolution Center (GMSEC) and core Flight System (cFS) that use a publish/subscribe model, and facilities such as the Formation Flying Test Bed. GDSM aims to create new opportunities for revolutionary science and exploration mission concepts through an extensible and evolvable open architecture and a consortium approach for advancing the technologies and capabilities necessary to achieve these goals. This paper will describe the impetus, goal, and path to provide an openly available framework as a unifying catalyst for broad-ranging DSMs contributors.