NASA STTR 2017 Phase I Solicitation

T11.02 Distributed Spacecraft Missions (DSM) Technology Framework

Lead Center: GSFC

Participating Center(s): ARC

Technology Area: TA11 Modeling, Simulation, Information Technology and Processing

A Distributed Spacecraft Mission (DSM) is a mission that involves multiple spacecraft to achieve one or more common goals; some DSM Instances include Constellations, Formation Flying missions, or Fractionated missions. Apart from Science goals that can only be attained with DSM, distributed missions are usually motivated by several goals, among which: increasing data resolution in one or several dimensions (e.g., temporal, spatial, spectral or angular), decreasing launch costs, increasing data bandwidths, as well as ensuring data continuity and inter-mission validation and complementarity. Constellations have been proposed in several NASA Decadal Surveys and recent studies; in Earth Science (e.g., a multi-spacecraft Landsat for increasing temporal resolution), in Heliophysics (e.g., the Geospace Dynamics Constellation) or in Planetary Science (e.g., the Lunar Geophysical Network). Many constellations and Formation Flying missions have also been proposed more recently in cubesat-related research projects. For the purpose of this subtopic, we do not assume the spacecraft to be of any specific sizes, i.e., we do not restrict this study to cubesats or smallsats.

The goal of this subtopic is to mature NASA capabilities to formulate and implement novel science missions based on distributed platforms. Technologies solicited in this call are the following:

- Novel DSM-enabling technologies such as:
  - Technologies for high-bandwidth and efficient inter-satellite communication.
  - Metrology systems capable of sensing and controlling relative position and/or orientation of multi-element DSMs to sub-milli-arcsecond angular resolution and sub-micro-meter positional accuracy.
  - Autonomous and scalable ground-based constellation operations approaches including science operations and data management, and compatible with the Goddard Mission Services Evolution Center (GMSEC) (open source software developed at NASA Goddard).
- Scalable DSM flight software systems such as:
  - Software components compatible with the Core Flight System (CFS) (open source software developed at NASA Goddard), enabling to control and navigate DSM formations and constellations; for example, discrete event supervisors offering a means to autonomously control systems based on selected mission metrics (e.g., spacecraft separation distance, number of active spacecraft, etc.).
  - Technologies for onboard collaborative processing and intelligence, including but not limited to, inter-spacecraft collaboration for collecting, storing and downloading data as well as multi-platform Science observation coordination and event targeting.

Research proposed to this subtopic should demonstrate technical feasibility and should discuss how it relates to NASA programs and projects. Proposed work is expected to be at an entry Technology Readiness Level (TRL) between 2 and 5, and to demonstrate a TRL increase of at least one level during each phase of the project.

Proposals will be evaluated based on their degree of innovation and their potential for future infusion.