



National Aeronautics and
Space Administration



Communications

Autonomous Positioning and Navigation Network

Developing a M2M architecture for on-board
navigation and positioning

Engineers at NASA's Marshall Space Flight Center have developed a machine-to-machine (M2M) network navigation protocol to enable spacecraft to perform autonomous navigation and positioning even in the most challenging of environments. Designed to facilitate deep space communication between spacecraft without the need for ground system support, this enhancement of on-board navigation capabilities allows assets to operate accurately in GPS-denied areas, determine position fixes relative to other assets, and minimize reliance on operator intervention. Additionally, implementation of the network architecture may be as simple as a software update, with no requirement of extensive designated hardware. Through providing these benefits, the NASA technology could improve the operational capabilities of aircraft navigation systems; advance autonomy, coordination, and safety features in unmanned aerial vehicles; and serve as a substitute or supplement for GPS positioning.

BENEFITS

- ➔ Versatile: Provides navigation and positioning guidance without needing GPS or external infrastructure
- ➔ Scalable: Improves effectiveness with the addition of assets into the network
- ➔ Ease of Use: Does not require extensive designated hardware or on-board equipment to implement
- ➔ Precise: Provides more ready communications and higher link time for navigation
- ➔ Emergent: Is on the leading-edge of M2M communications and autonomy development

APPLICATIONS

- ➔ Robotics: Autonomy, swarm coordination, local/relative positioning precision
- ➔ Aerospace: Autopilots, navigation systems, UAV flight controllers
- ➔ Wearables: Positioning capabilities, embedded systems networks

technology solution



THE TECHNOLOGY

As space operations grow in both the number of systems deployed and the distances at which those systems operate, reliance on overloaded Earth-based navigation support has increasingly become a liability to mission performance. The Multi-Craft Autonomous Positioning System (MAPS) is a network-based, satellite-to-satellite navigation protocol designed to improve the autonomy of deep space assets, but is applicable to a variety of transport vehicles, aircraft, and other equipment here on Earth.

An asset with MAPS is that it operates by embedding specific state information into its data packet transmission headers. Other assets then use this information combined with transmission and reception times to determine their own position fixes autonomously. Additionally, assets within the network act as relays, passing along information to recipients that would not otherwise be able to establish a direct communication link to a sender.

The NASA-developed protocol essentially creates a decentralized Internet architecture for M2M communications capable of providing navigation information without the need for external intervention, though such intervention is still possible. By enabling assets to communicate with one another and calculate positioning autonomously, the technology opens a whole new set of operational capabilities with assets that have safer autopilots, higher degrees of coordination, and more versatile applications.

PUBLICATIONS

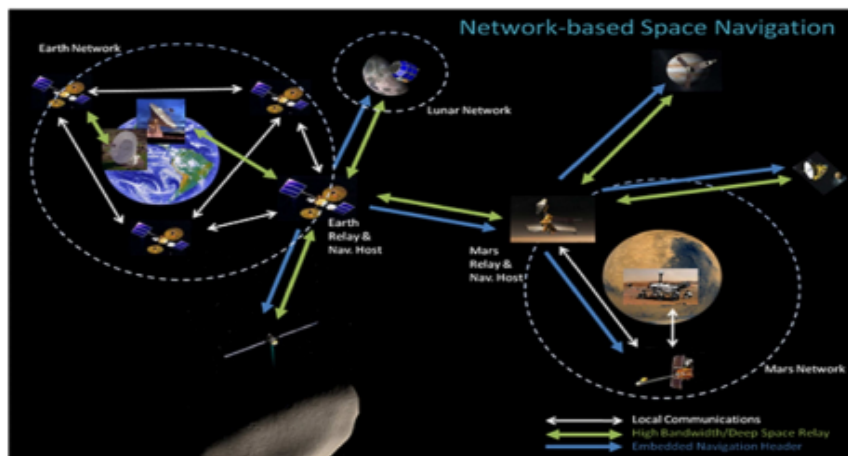
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Networked-based Space Navigation