NASA Facts

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The Spartan Project Develops New Carriers

Spartan spacecrafts are designed to provide easy access to Earth orbit via the Space Shuttle for flying science experiments. Spartan uses proven technologies to provide a relatively inexpensive route to space for the scientific community. This is accomplished using basic carriers which, with the addition of a science experiment, become a complete spacecraft capable of fulfilling the science objectives of each mission. Spartan missions support stellar, solar, or Earth fine-pointing experiments, experiments requiring microgravity, and experiments requiring space environments away from the Space Shuttle.

In keeping with current needs of the science community, a new generation of Spartan carriers is in the design phase. Manifested to fly around the turn of the century, the next generation of Spartan carriers include Spartan 400, Spartan 250, and Spartan Lite. Goddard engineers working on these advanced Spartan carriers have updated the electronics, avionics and communications in order to improve and simplify satellite operations and ground communications.

The Spartan Project Office, located at Goddard Space Flight Center in Greenbelt, Md., uses small teams of experienced lead engineers to develop the carriers for specific missions. They are responsible for carrier system hardware and software, and for the integration and testing of the spacecraft. The Spartan Project Office is the sole interface with Space Shuttle personnel at Johnson and Kennedy Space Centers for all aspects of integration, operations and flight and ground safety. Spartan personnel operate the spacecraft through early orbit operations and check-out. For Spartan 400 and Spartan Lite, the spacecraft is turned over to the principal investigator (PI) after initial checkout. For Spartan 250, project personnel operate the spacecraft for the entire duration of the mission.

Shown above is the Spartan 201 spacecraft which flew four times carrying modified instruments for solar observations.

Spartan has flown their established 200 series carrier seven times in the last decade.

The Spartans Project Office works with science teams during all aspects and phases of spaceflight science missions. Spartan's lead engineers work with principal investigators to successfully propose, study, design, develop, launch and operate a specific science mission using the appropriate Spartan carrier. The carriers utilize available Goddard resources, designs and processes to minimize costs. Flexible Spartan carrier designs permit subsystem modifications to accommodate different missions without requiring major design changes to the spacecraft.

Spartan's New Technology Approach

The application of new technology and use of traditionally non-flight Commercial-Off-The-Shelf (COTS) elements provides enhanced capabilities and cost reductions for the development and operation of the Spartan spacecraft. COTS components provide access to many proven designs which have integrated hardware, software and user interfaces that effectively limit design engineering costs and schedules. These components also allow for the assembly of inexpensive flight-like simulators for subsystem engineers and experimenters to use prior to flight integration. The combination of industry standard interfaces, flexible prototyping systems and modular software greatly reduces the cost and time associated with integration at the subsystem and spacecraft levels.

The Spartan project is moving towards widely used, commercially supported environments. Their goal is to take advantage of flexible, real-time operating systems which, in turn, will enhance the ability of the Spartans' scientists to develop and operate the carriers more economically.

The baseline architecture of the Spartan carriers includes the use of an on-board Global Positioning System (GPS) to determine the spacecraft's position, velocity and time. This feature enables autonomous ground station data transfer. As technology progresses, the GPS design will be modified to include attitude determination and control.

The Spartan project is also committed to the future use of space-based cellular phone communication systems to broadcast signals between the principal investigator and the spacecraft. These newer systems will augment an existing radio frequency communications system. An outstanding feature of this system is the ability to offer more frequent contacts with the spacecraft than with the use of existing ground stations. Although space-based cellular phone communication systems provide lower data rates than typical radio frequency communication systems, they could possibility eliminate the traditional ground station infrastructure. The immediate impact to the Spartan project will be frequent housekeeping, quick-look science data and timely problem reporting.

The new Spartan carriers are targeted to the individual needs of the science community. Spartan 400, Spartan 250 and Spartan Lite expand on ground systems and flight hardware which was developed for Goddard's Small Explorers Project, and incorporate additional innovative technologies to effectively lower the cost of development.

Accordingly, the Spartan carriers serve as an efficient, three-axis stabilized, free flying spacecraft capable of delivering experiments into space quickly and easily.

Spartan 400

Spartan 400 is a recoverable, high performance, low-cost carrier that is designed to support large and/or heavy instruments. It will accommodate a 2,000 pound, 250 watt instrument. The spacecraft is Shuttle deployed, left in space operating on its own power for up to three years and retrieved on a different Shuttle mission. The spacecraft operates from altitudes of

162 nautical miles to 324 nautical miles (300 kilometers to 580 kilometers) with inclinations between 28 and 57 degrees.

The carrier's structural configuration consists of the science instrument, a platform to which the instrument and electronics modules are attached, an optionalpropulsion module, a keel truss, and gimbaled, deployable solar arrays. This design produces a robust structure with nearly unrestricted access.

The Central Unit Electronics (CUE) provides command and data handling functions as well as attitude control and determination. The CUE, in conjunction with the radio frequency communications system, can telemeter 375 megabytes of data to each ground station per day and support 72 hours of autonomous spacecraft operations using stored commands.

The Spartan 400 design allows the science community to add a new technology experiment to the carrier, even late in the development flow, because the mass and volume are less constrained on the Space Shuttle than on expendable launch vehicles. Power and standard data interfaces are in place so that piggyback experiments can be added on a non-interference basis after the primary instrument is selected.

Spartan 250

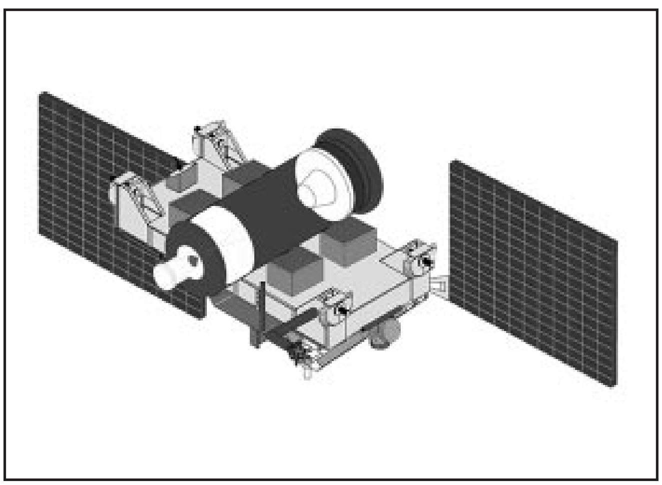
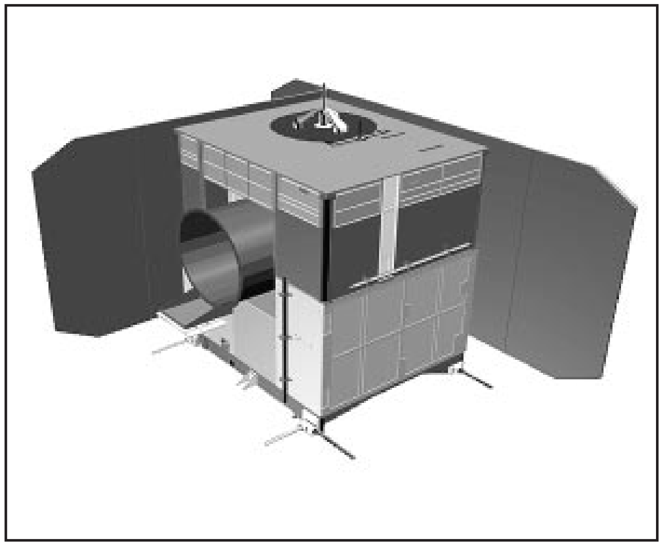


Illustration of the Spartan 400 spacecraft

The Spartan 250 carrier is carried into space by the Space Shuttle, deployed and operated via ground commands as a sub-satellite, retrieved on the same mission and returned to the principal investigator for subsequent reuse. Mission duration for the Spartan 250 carrier is between two to 14 days.



Artistic Concept of NASA's Spartan 250

Spartan 250 is a low cost, reusable, three-axis stabilized, free-flying carrier which provides mission flight opportunities for a variety of scientific studies in low Earth orbit. The carrier is designed to be a multipurpose system which evolves in response to the requirements of each mission. Spartan 250 will accommodate instruments in a volume that is 60 x 50 x 30 inches, or the instrument can be a telescope 120 inches long by 22 inches in diameter. An additional eight cubic feet is allocated for supporting electronics.

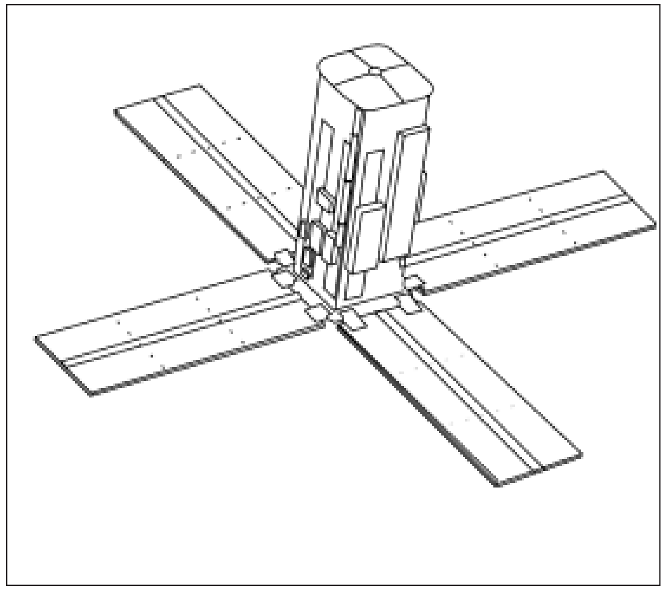
Power for Spartan 250 is provided by an onboard battery System augmented by solar arrays. While berthed in the Shuttle's cargo bay by a cross-bay structure known as the Spartan Flight Support Structure, a hard-wire link allows the spacecraft to be turned on and checked out prior to its release. After deployment, the spacecraft operates with real-time commanding and telemetry to the principal investigator. Only a few operational interfaces with the Shuttle are required.

Spartan Lite

Spartan Lite is a small, Shuttle ejectable spacecraft designed for a three to twelve month mission lifetime. This non-recoverable carrier will accommodate a 100 pound, 40-watt instrument. Spartan Lite is a compact, cost-effective, three-axis stabilized satellite which the scientific community can use for solar, stellar, and Earth-pointing missions. The carrier can either be launched on an expendable launch vehicle, or deployed by the Space Shuttle.

To minimize costs, a controlled application of new technology supplements existing flight-proven systems and the best commercial technology to form the spacecraft's core, single string subsystems.

For Shuttle deployment, Spartan Lite utilizes an ejection system that is mounted on either side of the Shuttle bay. After deployment, a turn-on sequence is initiated which begins powering up the Electrical Power Subsystem and the CUE. A timer onboard the carrier enables the release of solar arrays after the spacecraft is at a safe distance from the Space Shuttle. Following solar array deployment, the spacecraft is commanded into nominal science configuration and the principal investigator assumes spacecraft operations for the duration of the mission.



Spartan Lite with its solar arrays deployed

For missions requiring an extended lifetime, an optional propulsion system can be employed which boosts SpartanLite 53 nautical miles (85 kilometers) higher than its original deployed orbit in order to ensure an adequate orbit lifetime for the achievement of science objectives.

For more information on Spartan's past, present and future missions, visit the following NASA Web site:

http://spartans.gsfc.nasa.gov/