STRV 1 c&d microsatellite research vehicles

Written for DERA, before being privatised as QinetiQ

Excerpt

Introduction

The DERA Space Technology Research Vehicle (STRV) programme is designed to evaluate new space technologies by exposing them to the high radiation levels in the Geo-stationary Transfer Orbit (GTO).

The alternative - placing components and experiments in the Geo-synchronous Earth Orbit (GEO) or Low Earth Orbit (LEO) - would take many years and is very expensive.

The DERA STRV programme allows technologies such as infra-red detectors, advanced microprocessors and solar cells to be tested quickly and accurately, so they can be used with confidence in other space projects.

Objectives

The objectives of the STRV programme are to:

- enhance the capabilities of future military and civil communications, navigation and surveillance space systems, and reduce cost and risk by demonstrating the successful application of emerging technologies.

- execute a low cost, fast delivery microsatellite programme for the flight proving, accelerated life testing and prototyping of new techniques to improve communications and spacecraft autonomy.

- help industry achieve commercial benefit from investment in emerging technologies, and to develop the synergy between government, commercial and civilian space applications.

- promote international collaboration with the US, Canada and the European Space Agency, and national collaboration with UK industry and universities.

STRV 1 c&d

The decision to develop and launch STRV 1 c&d follows the success of STRV 1 a&b - two DERA microsatellites which spent over three years in orbit and are still transmitting data from the experiments on board.

DERA is responsible for the design, assembly and testing of STRV 1 c&d which are currently in the construction phase. STRV 1 c&d will be launched in 1999 as an auxiliary Ariane 5 payload. Discussions with the launch authority,

Arianespace, have indicated that a number of GTO launch opportunities will be available in this time-frame.
Currently, a one-year mission is being planned. However, the lessons learned from STRV 1 a&b indicate that there may well be a requirement to extend the mission, and that will be an option. STRV 1 c&d are part of an ongoing programme which will see DERA develop and deploy further microsatellites in the future.

Payload

All the experiment sponsors who participated in the STRV 1 a&b missions are flying experiments on STRV 1 c&d, and a number of new participants have joined the programme.

The new mission includes 25 experimental payloads and developmental spacecraft bus technologies from military, civil and commercial sponsors in UK, USA, Canada and Europe.

The STRV missions contribute to the research and development of new communications standards, spacecraft and ground segment automation, the survivability and performance of new technologies in the space environment and an improved understanding of the environment itself.

Data handling

A comprehensive On-Board Data Handling System (OBDHS), in conjunction with experimental hardware and software, offers a space-based test bed for new communications standards and protocols.

The OBDHS is also a flexible, responsive system to control, operate and manage the data from the platform systems and experiment payloads. The satellites' on-board computers are capable of being reprogrammed in orbit.

Link sessions, every six orbits are used to download data to DERA, with experiment sponsors in all countries receiving their data within two hours of this download.

Geo-synchronous transfer orbit

The STRV microsatellites exploit the varying altitudes and harsh environment of the GTO. See fig X. The variable altitude is particularly useful in evaluating the effects of different communications transmission path lengths and quality.

The GTO also means that the space vehicles pass through the Van Allen radiation belts four times a day. This means they are exposed, in twelve months, to levels of radiation equivalent to eight to ten years in GEO or LEO. The GTO also gives exposure to other environmental effects, such as atomic oxygen erosion and electrostatic charging.

The third benefit of the GTO is relative ease of access. The launch of large communications satellites into GEO provides regular opportunities for microsatellite access to GTO using a piggy-back technique.
The launcher places the large communication satellites into the GTO from where they use their own propulsion to circularise their orbits into GEO. The STRV microsatellites stay in the GTO.

Arianespace developed the Ariane structure to accommodate auxiliary payloads which permit these low-cost, piggy-back launches. Consequently, access to GTO tends to be more frequent and more affordable than many other orbits. The disadvantage is that the spacecraft design must be sufficiently robust to survive in the particularly stressful GTO environment.

Costs

The main financial objective for DERA is to cover the cost of the programme which is defined by the size and complexity of the payload experiments.

Participation in the STRV 1 c&d programme is based on a payload sponsor contribution of, approximately, £250K for each kilogram of payload. This cost covers all associated design activity and payload control software development work, the integration of the payload into the spacecraft, testing, launch and the first year of operations. The contribution also covers the downloading and dissemination of data to sponsors.

DERA will exploit the benefits of emerging technology and its 'whole mission capability' to provide these services at lower cost in the future.