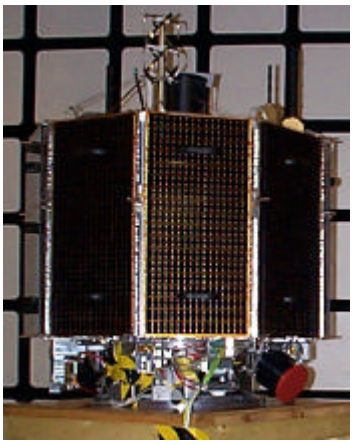
Surrey Minisatellite: Mission to the Moon

The SSTL minisatellite platform has been modified to accommodate a propulsion system capable of delivering over 1500 m/s delta-V, enabling it to support a wide range of missions beyond low Earth orbit. This low-cost Lunar and NEO platform comprises a range of flight-proven technologies and experimental systems ready for demonstration and verification in lunar and interplanetary orbits. The first application of the platform will be a low-cost mission to the Moon.

The Minisatellite

The SSTL minisatellite has been designed and built to an innovative and highly modular design to meet the need for satellites that can be readily adapted to accommodate different payloads and mission objectives - rapidly and at low cost.

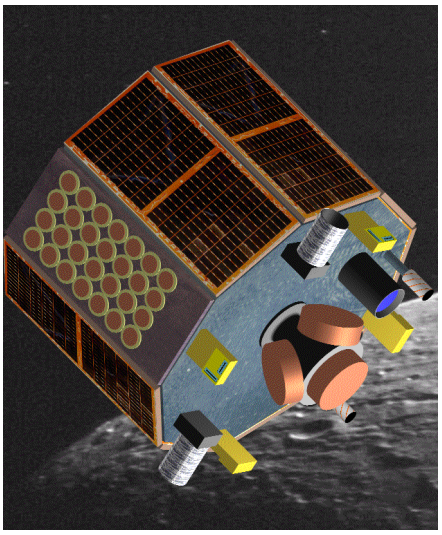
The interplanetary bus is a derivative of the UoSAT-12 minisatellite platform, launched in April 1999, and benefits from over 20 years of successful use of commercial components and small satellite engineering experience in Earth orbit.



UoSAT-12 Minisatellite: Launched 21st April 1999 from Baikonaur Cosmodrome

Mission to the Moon

The platform is a 9-sided prism measuring up to 1100 mm in height and in diameter. The 400 kg minisatellite can support 20 to 70 kg of payload in lunar orbit (launch dependent), nominally providing 100 W orbit average platform power. Payloads may be housed in an internal payload stack and module trays in the two platform stacks. Additionally the external frame can support telescopes, antennas, sensors and other payloads.



Six internal tanks hold up to 180 litres of propellant. Traditional and experimental propulsion systems may be accommodated. The platform will be spin stabilised during major propulsive burns.

In lunar orbit, the platform will be three axis stabilised. Star cameras and sun sensors will allow position to be determined to 0.02 degrees, and reaction wheels will provide control accuracy to better than 0.1 degree in all three axes.

One Gigabyte on-board data storage is available and payload data is delivered to a low-cost 3.6 metre ground station, at the Surrey Space Centre, via a 10 Kbit/s S-band downlink.

A wide range of payloads are compatible with the platform, enabling remote investigation of the Moon at unprecedented low cost.

The total mission cost is £15 Million (GBP). Over a third of the required capital has already been raised. Phase B/C is planned to start in Autumn 2000 and launch is anticipated in 2003.

affordable access to space

Applications

- Lunar Orbiter
- Lunar Drop Probe
- Missions to Near-Earth Objects
- Lagrange Point Missions

Lunar Spacecraft

- 400 kg total (wet)
- 20 to 70 kg payload mass to lunar orbit (launch dependent)
- Launch to GTO, Intermediate Orbit or Direct Injection
- Design Life: one year in lunar orbit

Heritage/Experience

Over 70 years in-orbit experience

- 15 microsatellites
- 1 minisatellite

Experience Beyond LEO

- Flown on STRV-1a,b,c,d in GTO: Power unit; batteries; payload
- In-house mission studies: Lunar; Venus; Mars; L1
- LunarSat mission study for ESA
- MMS mission study for NASA
- Rosetta momentum wheel study

Contact

Surrey Space Centre
University of Surrey
Guildford, Surrey GU2 7XH
United Kingdom

Tel: (44) 1483 259278
Fax: (44) 1483 259503
E-mail: sstl@sstl.co.uk
www: www.sstl.co.uk

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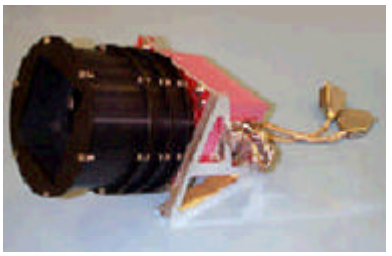
Surrey Minisatellite: Mission to the Moon

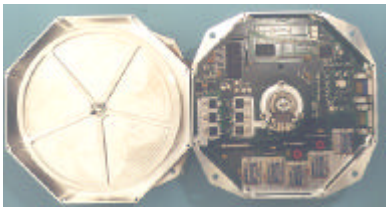
SURREY SATELLITE TECHNOLOGY LTD

Interplanetary Missions

The low cost lunar mission will validate a repeatable platform design, to meet the growing global requirement for affordable missions to the Moon, Lagrange Points, and other interplanetary trajectories. Missions to Mars, Venus and near Earth objects can be met by the next generation SSTL Interplanetary Platform (SSTL-4001-01). Together, the platforms will enable regular flight of payloads to the Moon and interplanetary space at low cost.

SSTL Mission Operations Centre, Guildford UK





SSTL flight hardware. Astrolabe Star Camera (top); Reaction Wheel (bottom)

Lunar Mission Baseline Specifications

Mission Timeline	Design-to-Launch	36 months (est.)
	Design Life	1 year in lunar orbit, potential to extend mission lifetime
Transfer	Transfer	Capability from GTO, Direct injection or Intermediate transfer orbits
Physical	Dimensions (stowed)	1100x1100x885 mm excluding external equipment
	Mass	400 kg Total (Wet) Mass
Power	Solar Panels	Eight body-mounted GaAs cell panels @~60 W each
	Battery	22 cell 7 Ahr NiCd battery (x3): 21 Ahr total capacity@28 V
	Redundancy	Failure tolerant via 3 separate power systems. Internal redundancy
ADCS	Sensors	2-axis Sun sensors (x4), Star Camera (x2), Gyro & accelerometer (x4)
	Actuators	Reaction Wheels (x4), Thrusters (x8)
	Attitude	3-axis stabilised zero momentum bias (nominal); momentum bias optional; Spin stabilised during major burns
	Pointing knowledge (3 ^{S})	$\pm$ 0.02°
	Pointing capability	Control $\pm$ 0.1°; 0.001° /s stability; slew 5 $^{\circ}$/s capability
Orbit Determination	Orbit Determination	Encoded pulse ranging (range), GPS-like ranging experiment (range and position)
Orbit Control	Propulsion	1000-1600 ms^{-1} deliverable by bi-propellant, monopropellant and hybrid options
Command & Data Handling	Processor	Dual redundant: 80386EX, 25MHz with co-processor
	Payload Data Interface	Triple redundant CAN 1Mbps packet (ISO-11898); A variety of payload interfaces including RS422, 1553; Hardwired digital and analogue command and status lines
	Memory	128-256 MB RAM per processor; 1 Gbyte payload data storage
	Operating System	In-house design OS. In-orbit reprogrammable
Communications	Uplink	Hot redundant S-band Rx. 1 kbps, BPSK no coding.
	Downlink	S-band 4 W RF Tx. 10 kbps. Viterbi coding, 3 dB link margin
	Antennas	15 patch array downlink antennas on side panel; Omni-directional patch antenna on +Z & -Z faces for uplink.
	Standard	CCSDS
Operations Scheduling	On board clock	Updated daily via groundstation, ±0.1s
Payload Accommodation	Mass	20 - 70 kg (launch dependent)
	Internal Volume	Payload module stack plus ~ 9 module trays in platform stacks
	External Volume	~ 250 mm height x 1100 mm diameter
Finance	Total Mission Cost	£15 Million (Target)

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