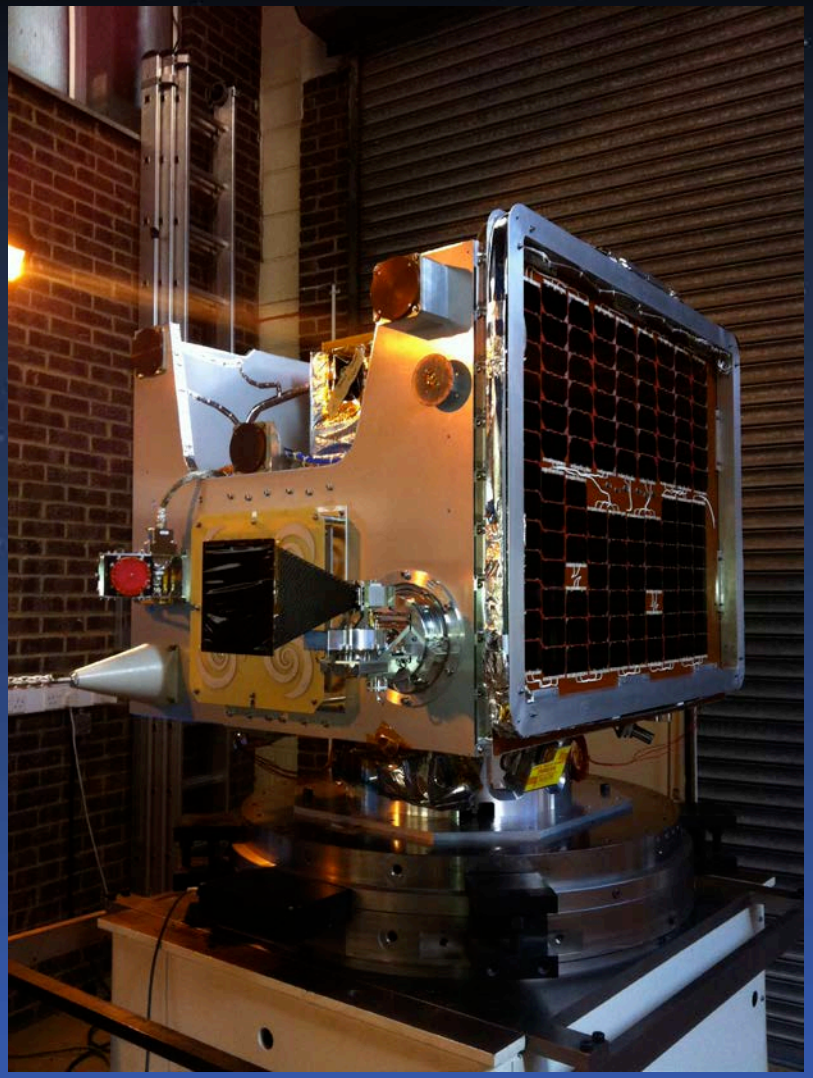
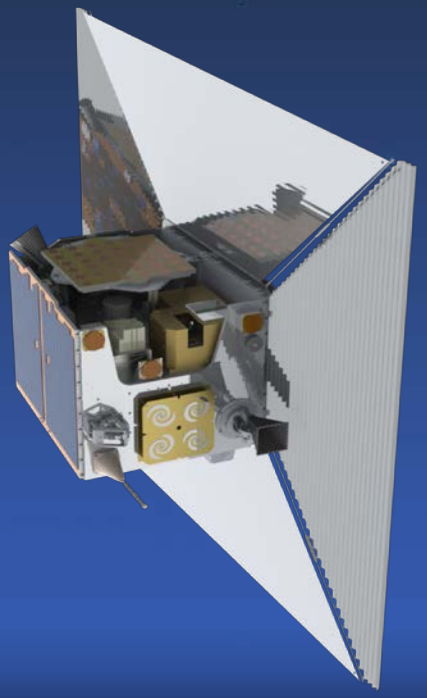
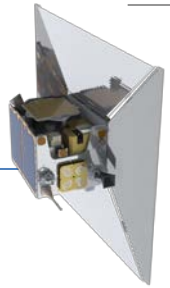
SURREY SATELLITE TECHNOLOGY LTD *Changing the economics of space*



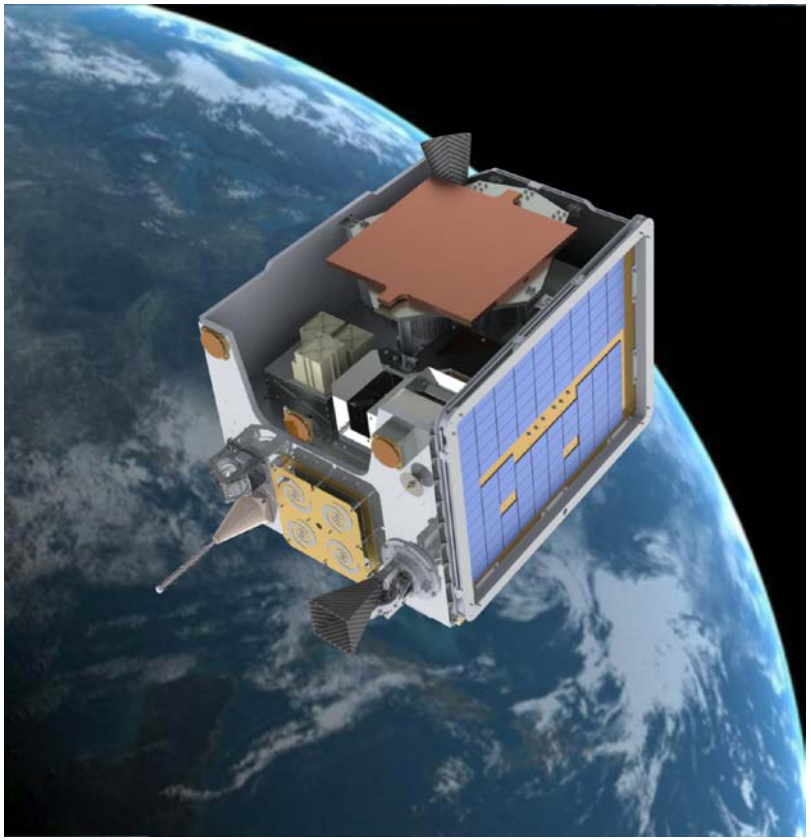
TechDemoSat-1

Victoria O'Donovan

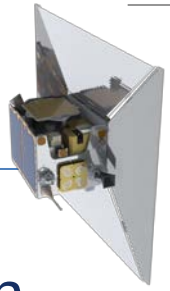




- What and why
- Mission History
- Who's involved
- Mission Requirements
- The Customers
- The Platform
- The Payloads
- SSTL Product Development
- Post Launch
- Where are we now
- TDS -2 …?!

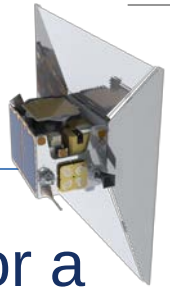


What is TechDemoSat ?

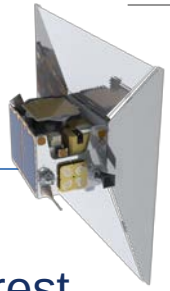


- TechDemoSat stands for “Technology Demonstration satellite”
- A UK Demonstration programme to act as an in-Orbit test bed for the UK’s new technology and research
- Why …..Customers have no sense of adventure !
  - Historically, a major barrier to commercial success in the space industry = Lack of in Orbit flight heritage
  - Leads to a slow take up of new technologies and compromises the marketing potential of UK supplied subsystems.
  - A chance to experiment without customers !
  - A platform that academia can use to collect valuable data for research

How did it start …..



- In late 2008, SSTL concluded that there is a need for a dedicated technology demonstration satellite
- Jan 2009, SEEDA subsequently TSB were engaged
- March 2009 - all members of the UK Space community (Industry and academia) were invited to participate.
- Initial over-subscription of payloads! Addressed by payload providers with multiple submissions selecting their own "favoured payload".

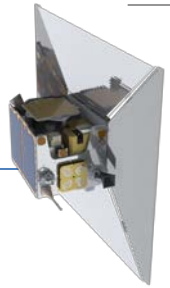


- System engineering study for TechDemoSat includes payload down-selection conducted by VEGA (to avoid any perceived conflicts of interest arising from SSTL) addressing selection criteria which included:-
  - Mass
  - Power
  - Volume
  - Data storage
  - Pointing requirements
  - Technical readiness level
  - Development timescale
  - Funding availability
  - Opportunities for synergistic operation

- June 2010 - grant application to TSB/SEEDA for funding for single-string build of SSTL-150 platform, integration of consortium payloads and full system test.

- October 2010…..Project Kick off

Who's involved ?



TechDemoSat-1

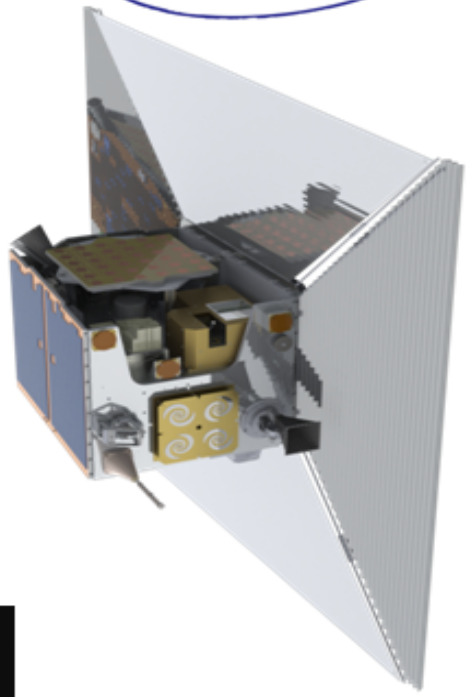
ISIC

SCISYS

Technology Strategy Board
Driving Innovation

SEEDA South East England Development Agency
Working for England's World Class Region

Cranfield University



SSBV

Langton Star Centre

SURREY SPACE CENTRE

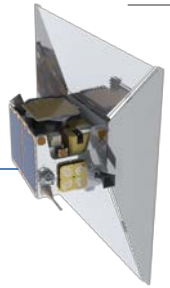
UCL
MULLARD SPACE SCIENCE LABORATORY

RAL Space

University of Oxford

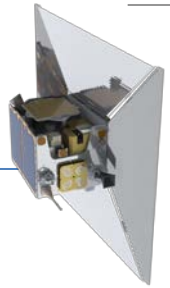
SURREY SATELLITE TECHNOLOGY LTD

To Inspire, Train and Retain



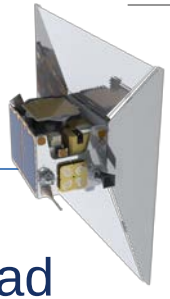
- Inspire
  - A new generation of scientists and engineers
  - CERN@Schools will be using LUCID data (Over 200 schools in the South East)
- Train
  - A number of Universities involved
  - Training students in the transition between Academia and Industry
- Retain
  - Experienced engineers working on exciting new developments

The Customers



- Satellite Platform Funded
  - Technology Strategy Board (TSB) - £3.0M
  - South East England Development Agency (SEEDA) £0.5M
  - Platform at cost to SSTL
  - SSTL absorbing costs of late changes to platform configuration
- SSTL funding our Product Development – over £4.5 M
- All External Payloads funding their own Payloads (Approx £2M in total)
- Payload Providers Management group look after interests of the external Payloads. Representatives from:
  - UKSA
  - TSB
  - TSB Monitoring Officer
  - Independent Industry (Logica and STFC)
  - Independent Academia (University of Leicester)

Mission requirements



#1 The platform shall accommodate the payloads subject to payload specific ICDs to be determined

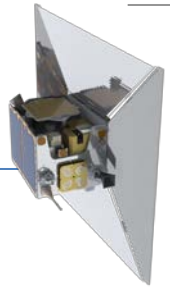
#2 The platform shall be able to operate the payloads in the modes required to complete the agreed payload specific operational tests

#3 Platform shall be designed to be operational for the full mission life of 3 years (3 years includes LEOP and commissioning)

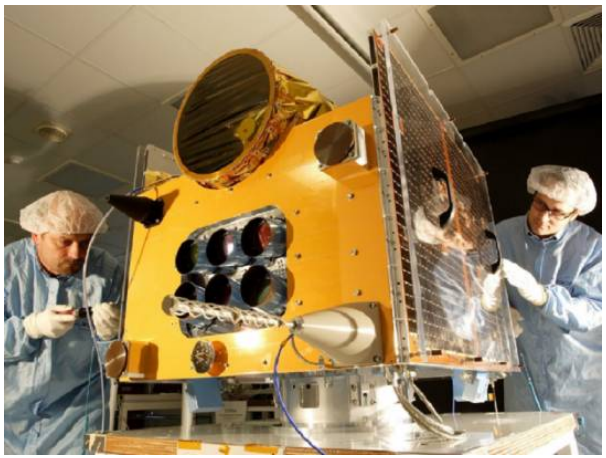
#4 Platform FRR (Flight Readiness Review) should be completed 18 months after project KO

#5 Platform shall have heritage and have fully qualified avionics for the primary string

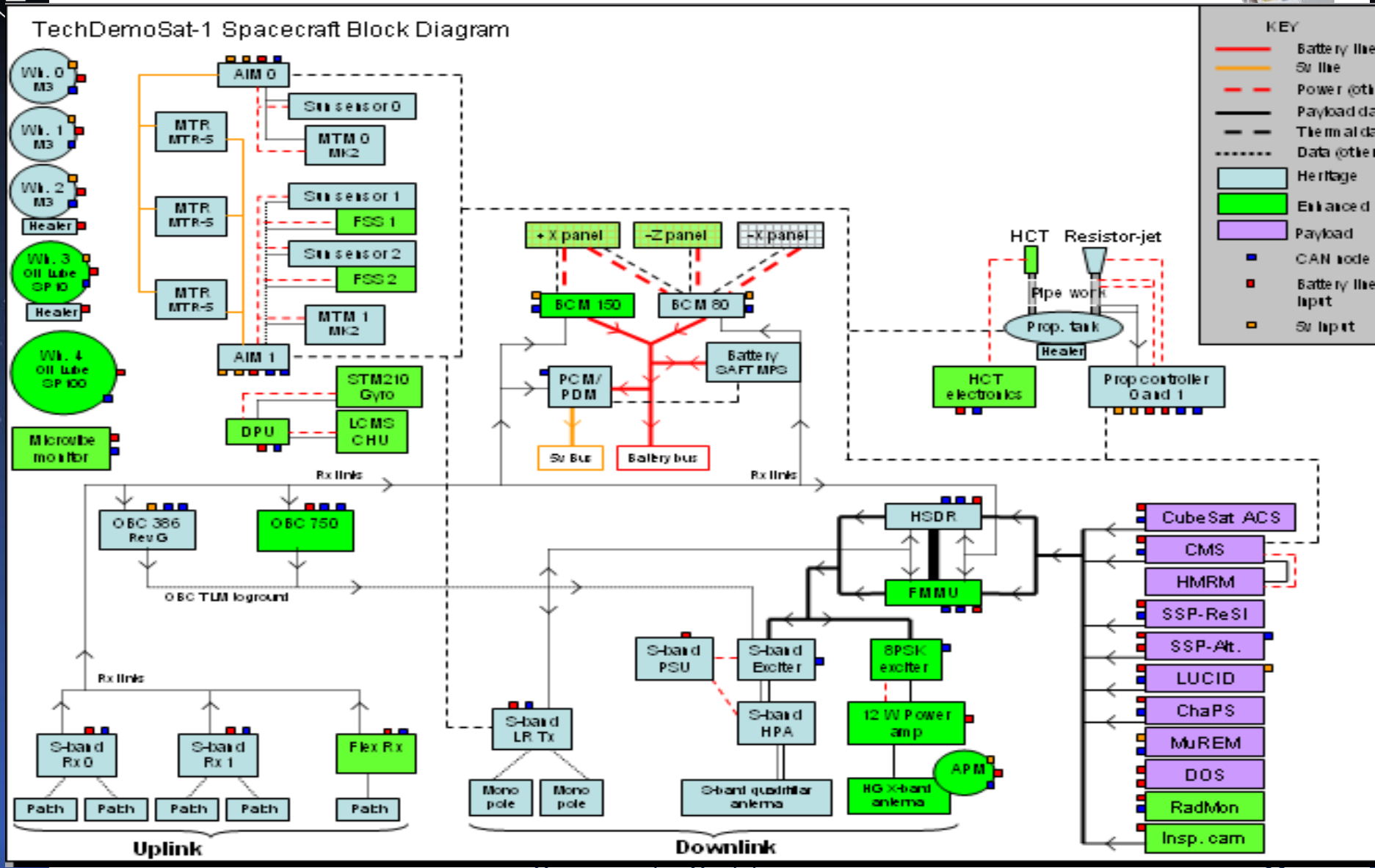
The Platform



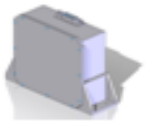
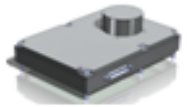
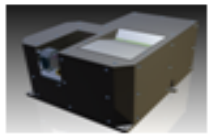
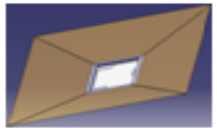
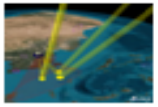
- Quick and low cost – SSTL building platform at cost price
- Changes to bus as a result of changes to Payload configuration absorbed by SSTL
- SSTL-150 platform based on RapidEye
- Mission sold as single string avionics
- SSTL using Redundant string for Product development



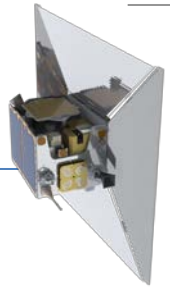
The System

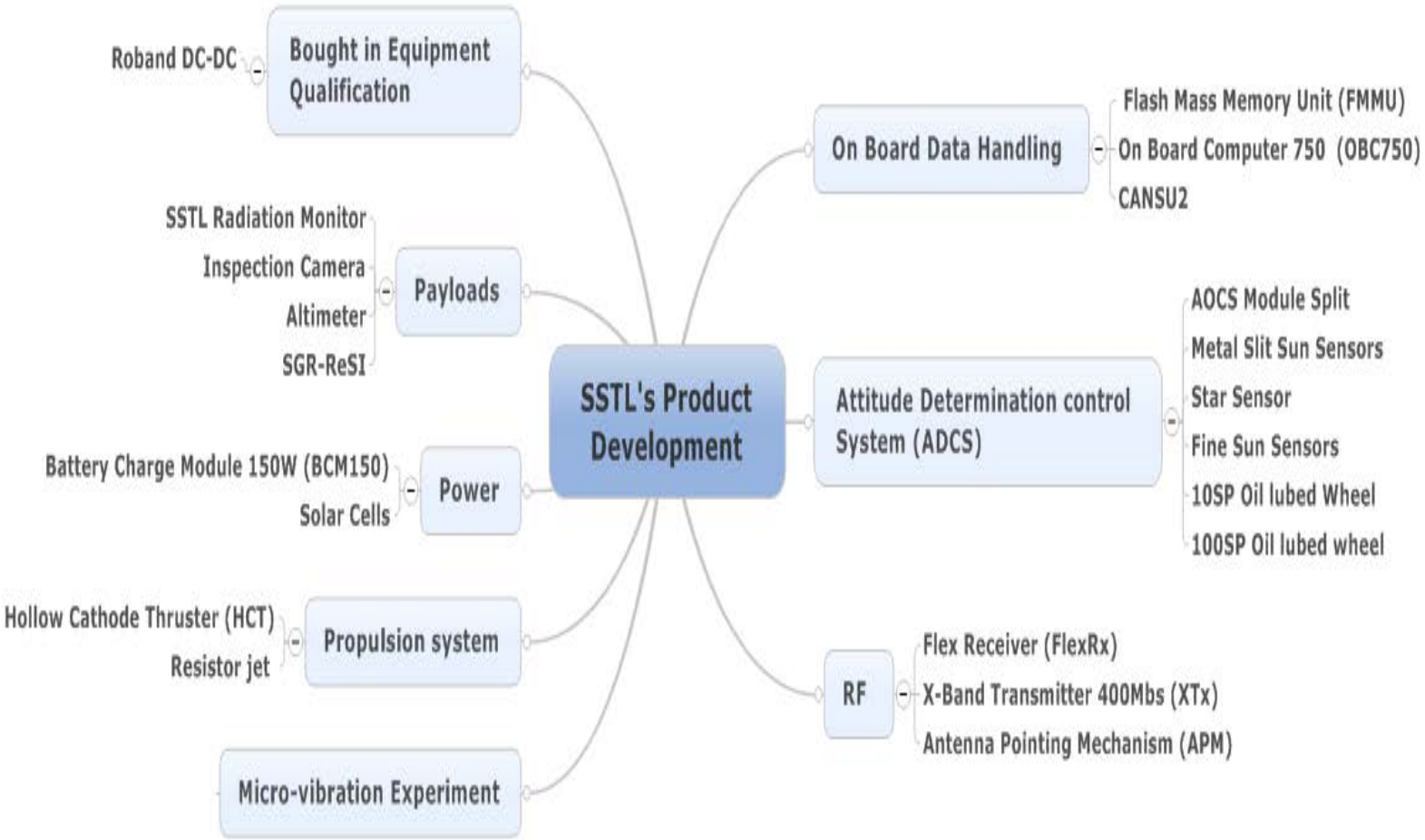

TechDemoSat-1 Spacecraft Block Diagram
KEY
Battery line
5v line
Power (oth
Payload da
Thermal da
Data (other
Heritage
Enhanced
Payload
CAN node
Battery line input
5v input
Wh. 0 M3
Wh. 1 M3
Wh. 2 M3
Heater
Wh. 3 Oil tube SP 10
Heater
Wh. 4 Oil tube SP 100
Microvibe monitor
AIM 0
Str sensor 0
MTM 0 MK2
MTR MTR-5
MTR MTR-5
MTR MTR-5
Str sensor 1
FSS 1
Str sensor 2
FSS 2
MTM 1 MK2
AIM 1
STM210 Gyro
DPU
LCMS CHU
+X panel
-Z panel
-X panel
BCM 150
BCM 80
Battery SAFT MPS
PCM/ PDM
5v Bus
Battery bus
HCT
Resistor-jet
Pipe work
Prop. tank
Heater
HCT electronics
Prop controller 0 and 1
Rx links
Rx links
OBC 386 Rev G
OBC 750
OBC TLM loground
HSDR
FMMU
CubeSat ACS
CMS
HMRM
SSP-ReSI
SSP-Alt.
LUCID
ChaPS
MuREM
DOS
RadMon
Insp. cam
Rx links
S-band Rx 0
S-band Rx 1
Flex Rx
Path
Path
Path
Path
Path
Uplink
S-band LR Tx
Mono pole
Mono pole
S-band PSU
S-band Exciter
8PSK exciter
S-band HPA
12 W Power amp
APM
S-band quadrifilar antenna
HG X-band antenna
Downlink

The External Payloads

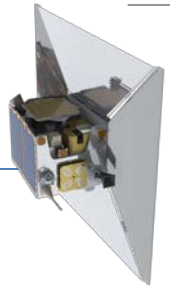
Payload	Supplier	Description	Illustration
MuREM	University of Surrey (Surrey Space Centre)	The Micro (μ) Radiation Environment Monitor (MuREM) is a miniature radiation environment and effects monitoring payload.	
ChaPS	Mullard Space Science Laboratory (MSSL)	The Charged Particle Spectrometer (ChaPS) is designed to measure electron and ion populations in the orbit of the host spacecraft.	
LUCID	Langton Star Centre	The Langton Ultimate Cosmic ray Intensity Detector (LUCID) allows characterisation of the energy, type, intensity and directionality of high energy particles.	
CMS	University of Oxford / RAL	The Compact Modular Sounder (CMS) is a set of compatible optical, detector, cooling and electronic sub-systems which can be used to implement miniature infrared remote sensing spectrometers or radiometers.	
HMRM	Rutherford Appleton Laboratory	The Highly Miniaturised Radiation Monitor (HMRM) is a an ultra-compact, low power radiation monitor developed for re-use on future ESA missions.	
CubeSAT ACS	Satellite Services Ltd	The CubeSAT ACS payload is a complete 3-axes attitude determination and control subsystem for Cubesats.	
DOS	Cranfield University	The De-Orbit Sail (DOS) is intended to demonstrate a novel means for de-orbiting a satellite at the end of its mission lifetime through deploying a sail to increase aerodynamic drag.	
Sea State Payload	Surrey Satellite Technology Limited (SSTL)	Passively monitors ocean roughness via detecting reflected GPS signals and provides orbit determination via dual-band GPS (SGR-RESI).	

SSTL's Product Development

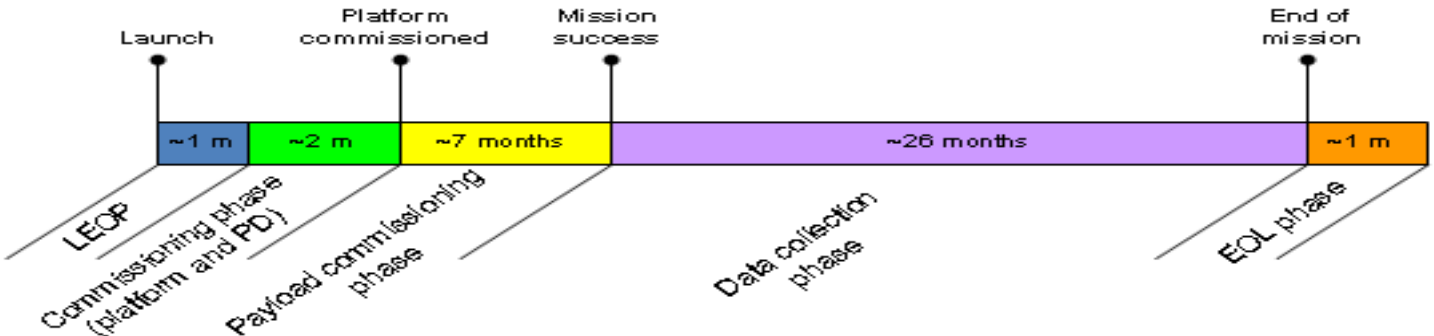




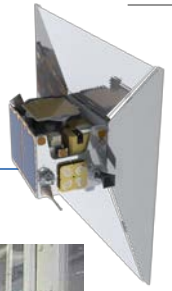
Post Launch



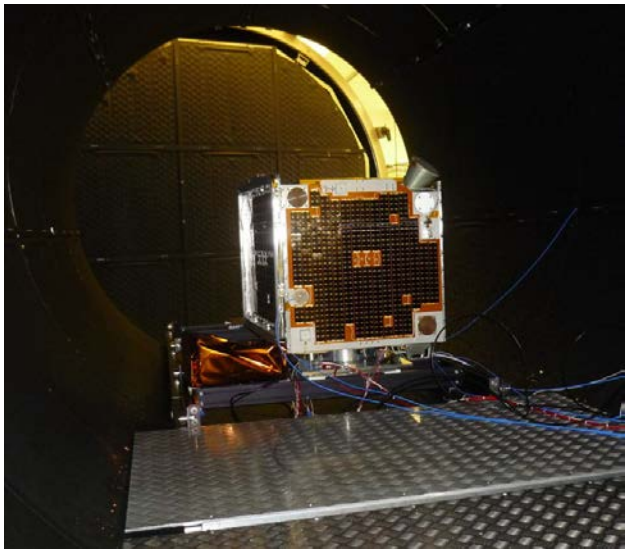
- 3 year Mission
- SSTL have donated use of Ground stations to support TDS free of charge for Mission duration
- TDS-1 will be the first Satellite commissioned from Harwell
  - Mission Operations Centre (MOC) will be located at Harwell –operation of Payloads & MPS
  - Spacecraft Operations Centre (SOC) will be at SSTL, Guildford
- Payloads Operated in an 8 day cycle – 2 days are for SSTL PD
- MPS written and developed by SciSys with SSTL



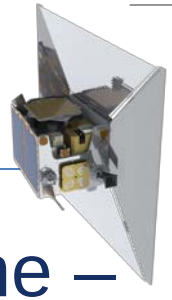
So where are we now..?



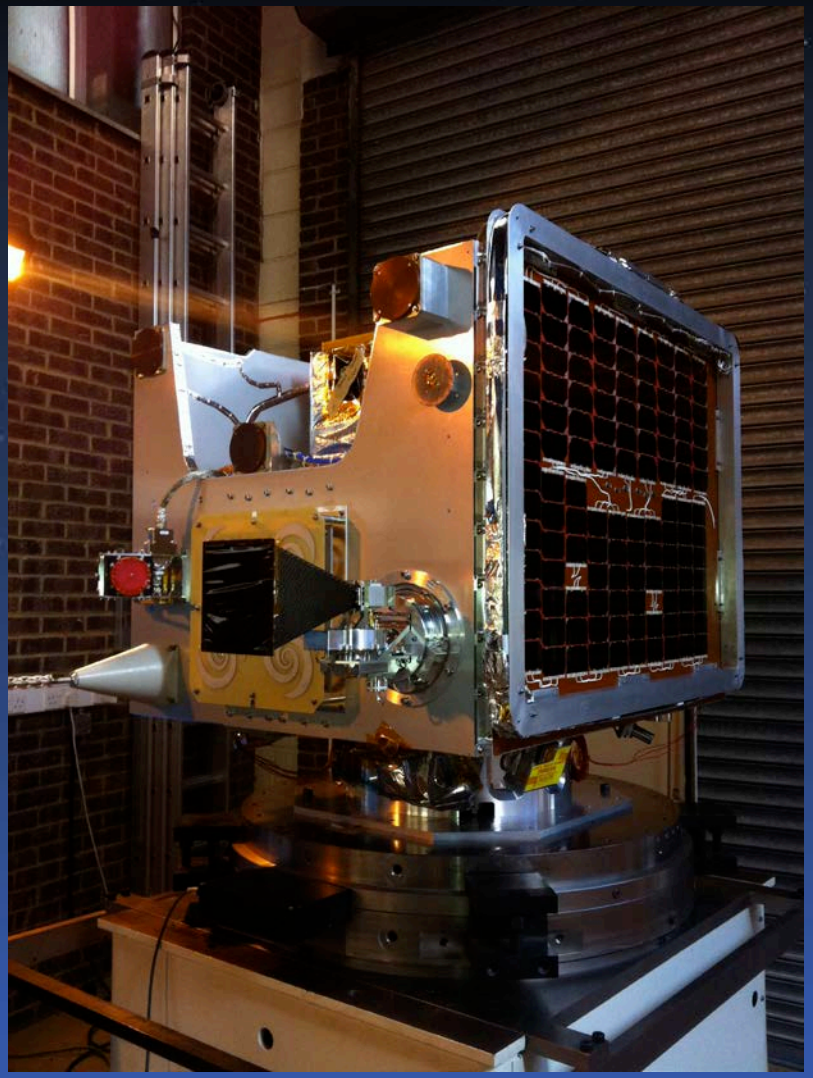
- Satellite Has completed:
  - AIT
  - Vibration testing
  - Moment of Inertia
  - TVAC
- Currently at SSTL boxing up for EMC testing
- System End to End Testing (SEET) Dec
- Completion of testing in Jan with FRR
- Launch Agency have requested TDS by 10th Feb 2013
- Launch date Q1/Q2 2013



The future …!!



- Interest to make TDS into a rolling programme – CATSat-1?
- Much interest in UK press
- Dissemination and Exploitation of TDS-1 data
- Make these missions into known opportunities that people can baseline



Thank you

-Questions ?-