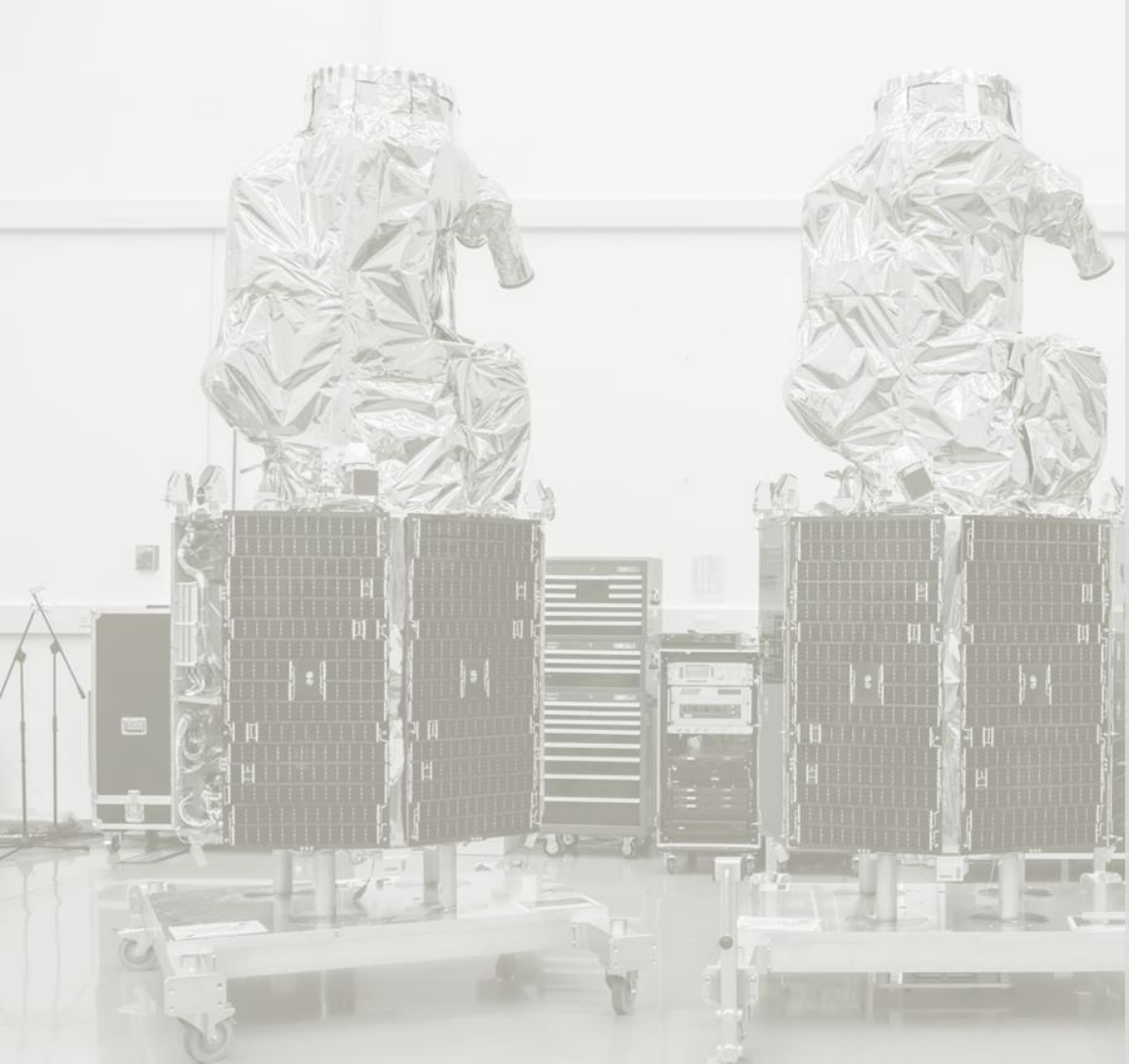


Disruptive technologies and future trends of small satellites

Ben Stern
Surrey Satellite Technology Ltd

ITU Symposium and Workshop on small satellite regulation and communication systems

Santiago de Chile, Chile, 7-9 November 2016

battery as the internal resistance of the cells increased with old age. Fig 2 shows the battery temperature during the same period (Note that the higher the telemetry count, the lower the temperature). The excessive battery temperature accelerated the deterioration of the battery as cell after cell failed (short circuit), and the bus voltage dropped accordingly. Even the gradual cooling of the battery in March-April 1977 did not halt the decay. In June the telemetry indicated a dramatic drop in voltage, and then finally became garbled. Two weeks later the transponder fell silent.

Weather satellites

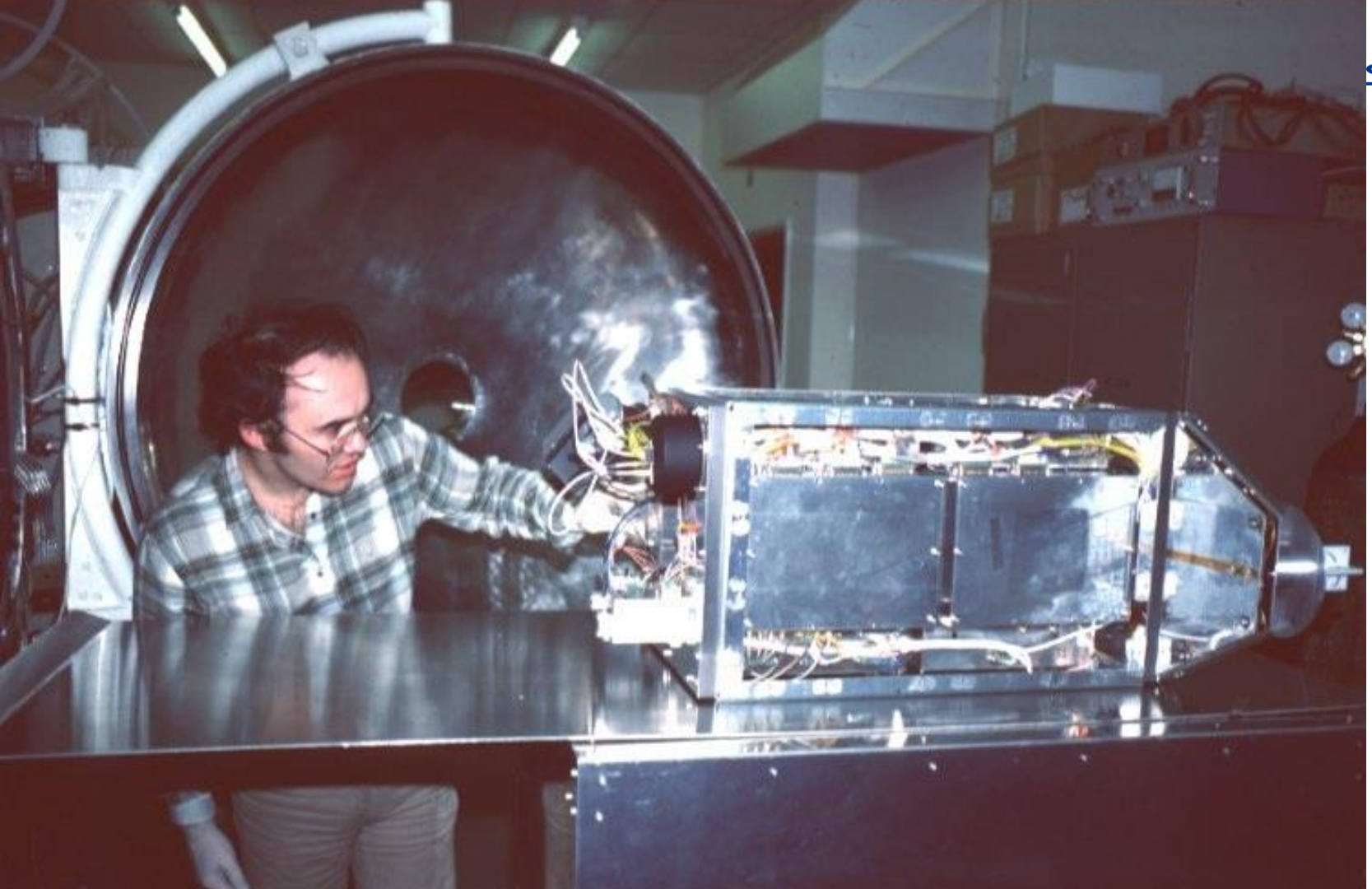
The interval between the demise of Oscar 6 and the launch of Oscar 8 provided a breathing space to update the UoS station and to build up some equipment for the reception of the NOAA-4 and 5 meteorological satellites. Daily cloud-cover pictures were taken until the failure of the NOAA-5 instruments in March 1978. Several spacecraft in the Nimbus and (Russian) Meteor series are also periodically observed.

AMSAT Oscar 8

Oscar 8 was launched from the Western Test Range at Lompoc, California, on 5 March at 1754 and was ejected from the second stage of the Thor-Delta launch vehicle at 1919 over Greenland. The 435·1MHz beacon was heard at UoS for a few seconds after ejection and before the spacecraft dropped below the Arctic horizon. On the following orbits, downlink telemetry and doppler

Operators (l to r): G8MLO (Kev), G4EDW (Paul), G3YJO (Martin), G8JFX (Tim) and G4CWH (Colin) on the roof of the university with the antenna mounting in the background. Other operators, not shown, are G8NEF and G8NEH

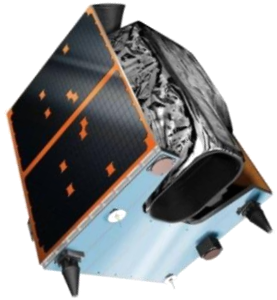
Radio Communication
June 1978



SURREY
SATELLITE TECHNOLOGY LTD

The DMC and RapidEye changed the way people regard small satellites and proved their worth for the EO business.

They created a new, different type of data market.

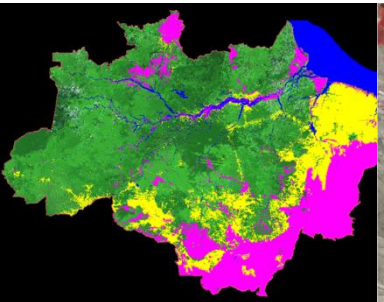


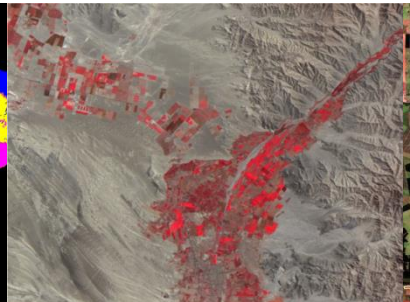
A small satellite “revolution”

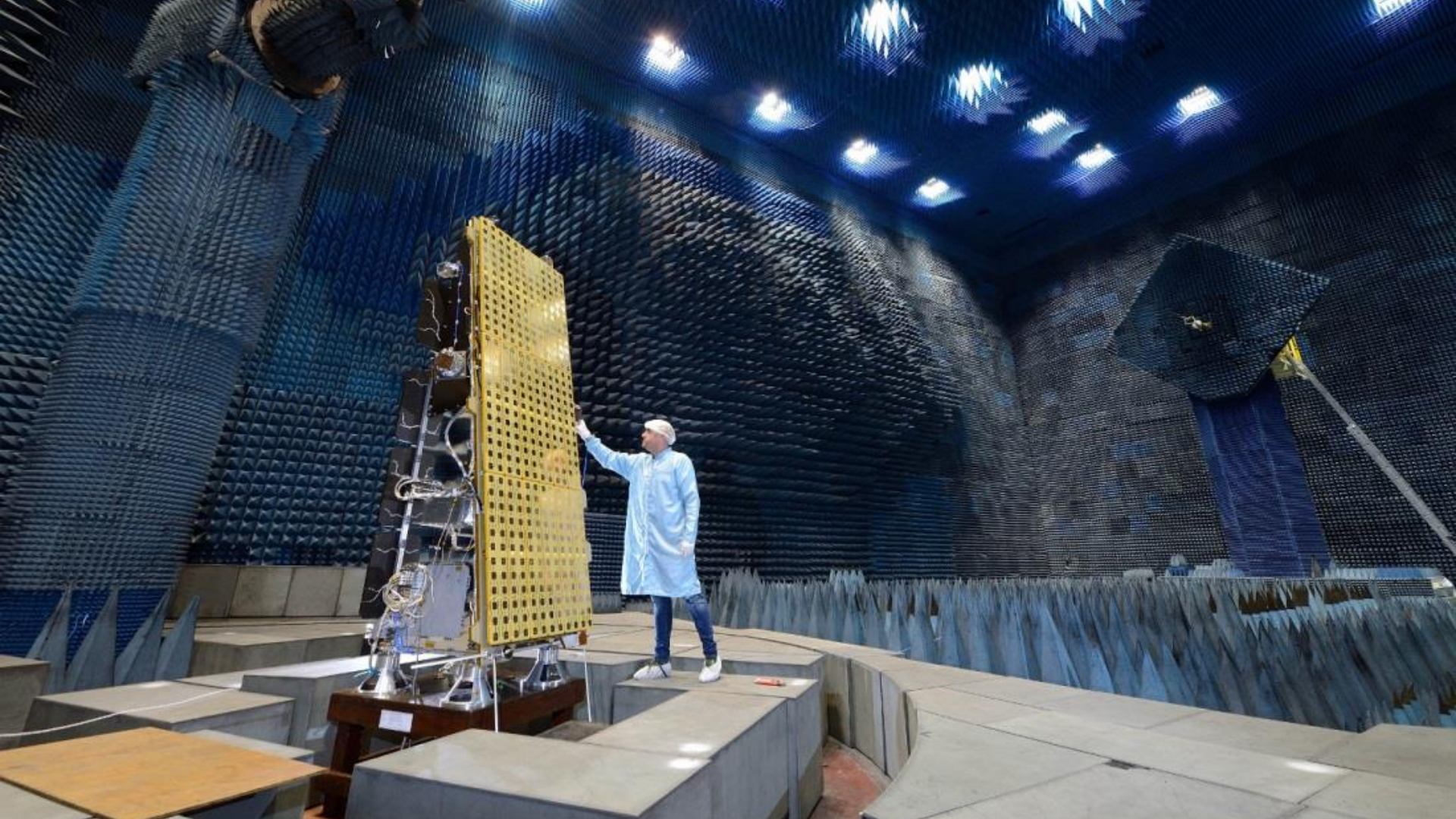
The first wave of small satellites was largely demonstration or communication oriented.

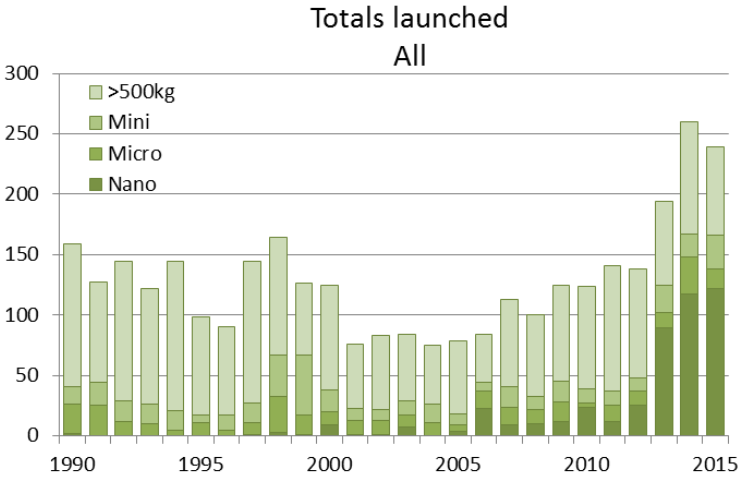
It took until the mid 00’s for a breakthrough in the EO market.

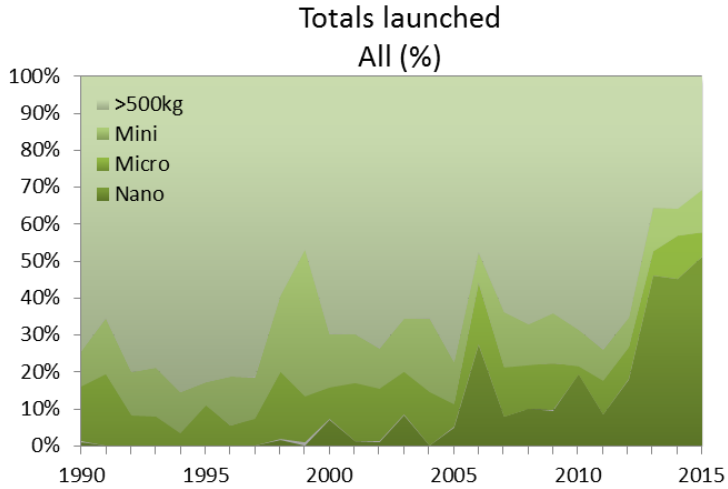
The success of small satellites made the deployment of constellations commercially viable.











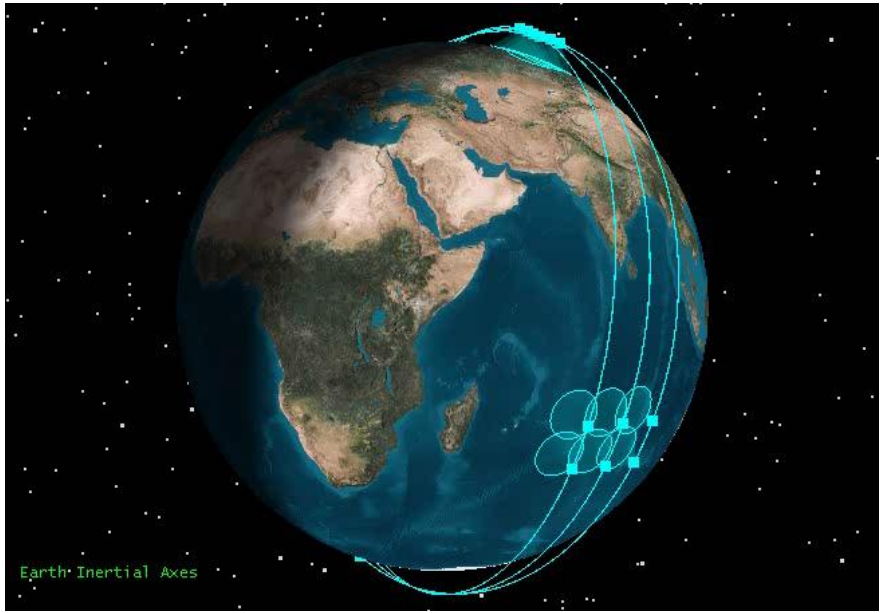
Where is our industry heading?

Small Satellites are an increasing fraction of the launched satellites.

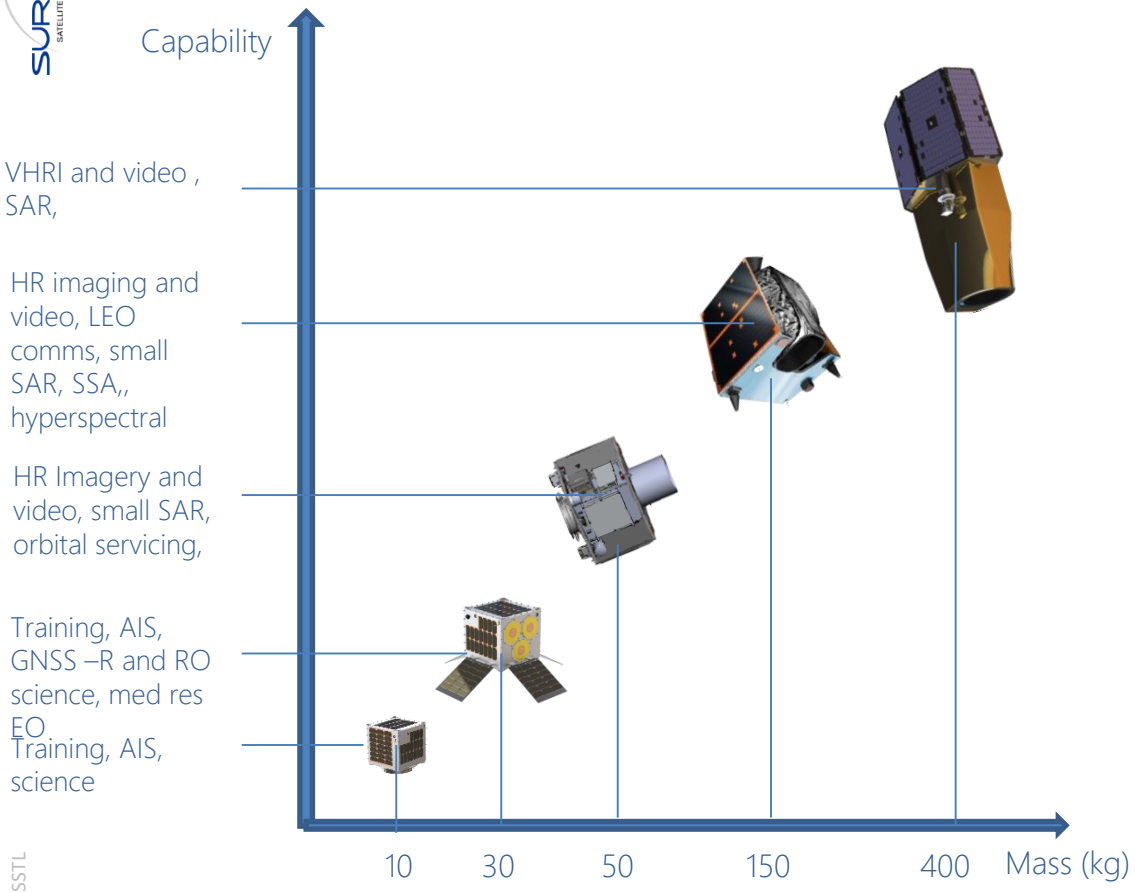
Are small satellites replacing or adding to larger satellites?

And are we providing what the users need?

The age of the constellation



Total number of satellites	Number of orbital planes	Lat 20° revisits	Lat 50° revisits
12	3	0-2 per day	2-3 per day
24	3	3-5 per day	4-6 per day
36	3	Daily	Daily
36	4	2 per day	Daily
72	3	>1 per day	>1 per day
135	3	1-2 per day	1-3 per day
163	9	Multiple per day	Multiple per day



What to offer

At the end of the day users need a certain performance (including a certain price). We can (and should) challenge the requirements, but it is their business.

Our technology biases and beliefs should not get in the way of the best solution.

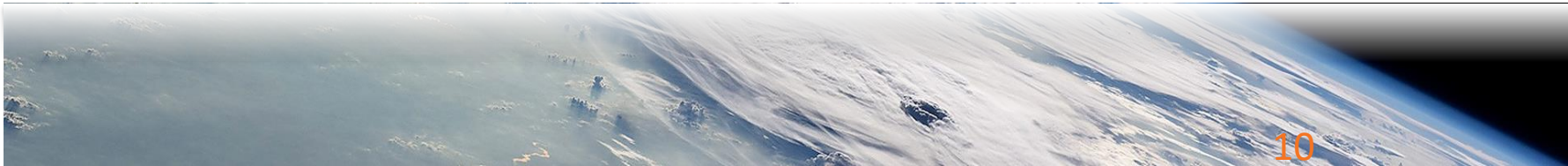
UrtheCast

- 2010: Founded effectively as a “spin-out” of MDA
- A disruptive vision to democratise Earth observation data by building the world’s most advanced, space-based “big-data” geospatial collection, processing, and information management system
- 2013: Established two fully operational sensor suites on the ISS – the Theia instrument producing medium resolution optical imagery, and the Iris instrument producing ultra high definition videos
- 2015: Acquired Deimos Imaging which also includes the acquisition of the standalone Deimos-1 medium resolution satellite and Deimos-2 high resolution satellite
- 2015: Announced plans of the OptiSAR Constellation – the world’s first commercial SAR and Optical satellite constellation in partnership with SSTL

Brisbane, Queensland, Australia Captured by the Theia Instrument on the ISS. © 2015 UrtheCast

Mission Overview

- Known as the OptiSAR Constellation, the mission will comprise of 8 Optical and 8 SAR satellites
- Each pair of satellites will consist of a dual-mode, high resolution Optical satellite (video and pushbroom) and a dual-band high resolution SAR satellite (X-band and L-band) flying in tandem
- The Constellation will provide an unmatched space-imaging capability, including high collection capacity, Optical and SAR data fusion, weather-independent high resolution imaging using the SAR, target revisit, and imaging latency
- By flying the satellites in tightly-paired SAR and Optical tandem formations, the constellation is expected to offer a number of innovative capabilities, including on-board real-time processing, cross-cueing between the satellites, and cloud avoidance in the trailing Optical satellites
- Creates new opportunities for both businesses and government with an altogether new and responsive way to addressing applications



UrtheCast's OptiSAR™ Constellation

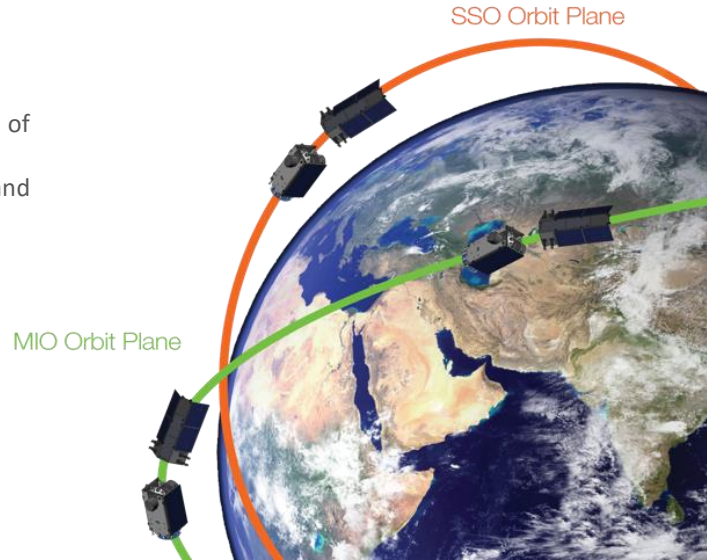
16 standalone satellites

Unmatched in terms of sensor diversity, fused data potential, high collection capacity, low latency, revisit over critical regions (mid-latitudes)

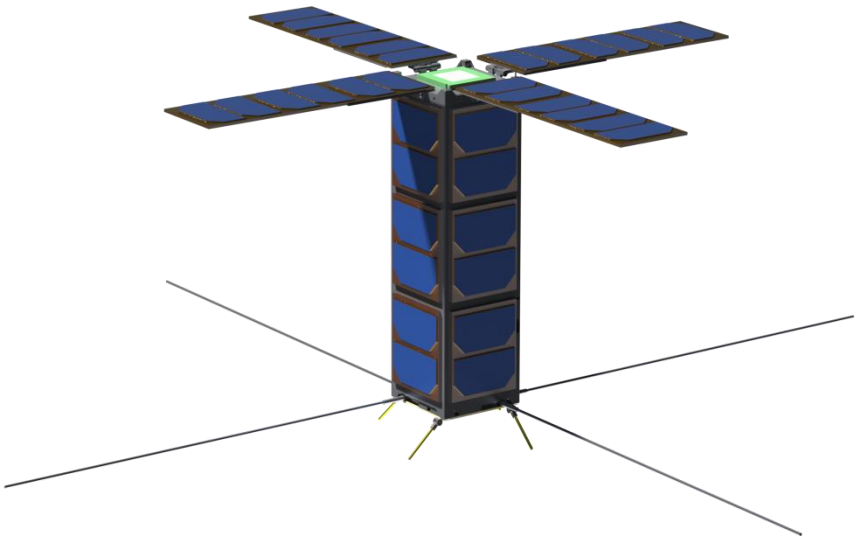
Fully integrated SAR and Optical constellation	World's first
More than daily average revisit anywhere in the world and up to 18x per day at mid latitudes	World's best
Simultaneous dual-band SAR imaging (quad-pole L-band and X-band) at 1 m resolution class	World's first
Simultaneous dual-mode Optical (video and pushbroom) at 0.5 m GSD class	World's first
Ultra HD video from space (Full Motion Video)	World's first
Unique operational modes (cross cueing, cloud avoidance, use of SAR antenna for comms)	World's first
Unique proprietary and patented cloud-based processing, distribution and visualisation system	World's most advanced

Constellation Design

- 8 Optical and 8 SAR satellites at an altitude of 450 km split across two orbital planes: a sunsynchronous plane and a medium inclined plane
- The combination of planes enables optimum revisits in the mid-latitude regions to be achieved, while providing global coverage that extends to the poles
- The satellites are equally distributed in each plane with the Optical trailing the SAR by a few minutes to enable cross-cueing operations
- The entire formation of the constellation combined with the unique concept of operations enables a fusion of datasets with very low latency, creating and addressing a range of applications in a new and responsive way



VESTA



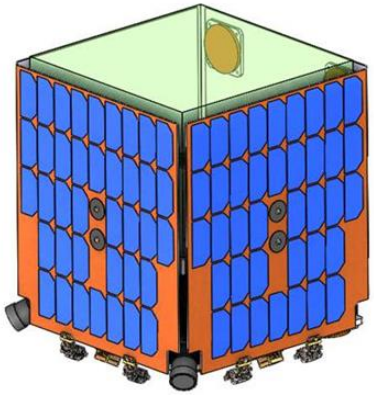
VESTA satellite platform, a technology demonstration mission that will test a new two-way VHF Data Exchange System (VDES) payload for the exactEarth advanced maritime satellite constellation.

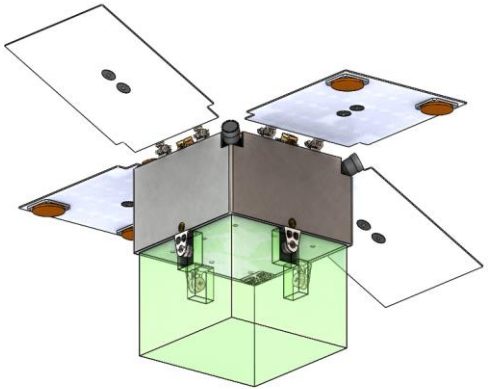
The contract was signed as part of an MOU between Honeywell Aerospace and the UK Space Agency.

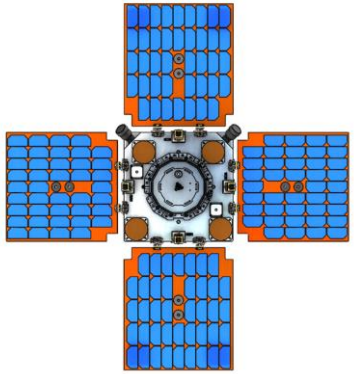
Honeywell

UK SPACE AGENCY

A platform designed to offer microsatellite performance for cubesat budget







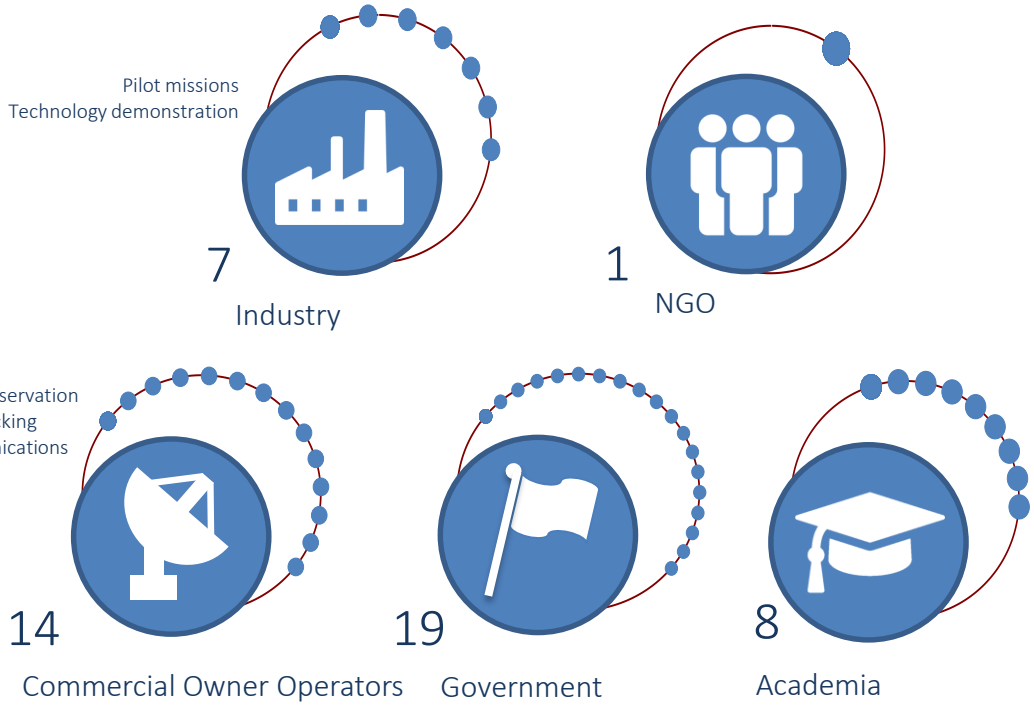
SSTL-12

Aimed at filling the gap between cubesat and microsatellite

Scalable in performance and price with a range of power, storage, TT&C, propulsion.

27U form factor with a lifetime of >5 years and a payload capacity of <25kg

Experience with different customers



Quality

SSTL have experience with a range of customers with different needs and different budgets.

Maintaining high quality for low cost is crucial to the success of small satellites