Mission ORCA: Orbit Refinement for Collision Avoidance

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The Space Debris Tracking Problem

- Risk of Kessler syndrome
- Current means of detection not accurate enough
- Collision warnings often ignored

ORCA’s goals

- Improve orbit determination accuracy for resident space objects (RSOs)
- Improve reliability of collision warnings
- Focus on affordability

Mission requirements

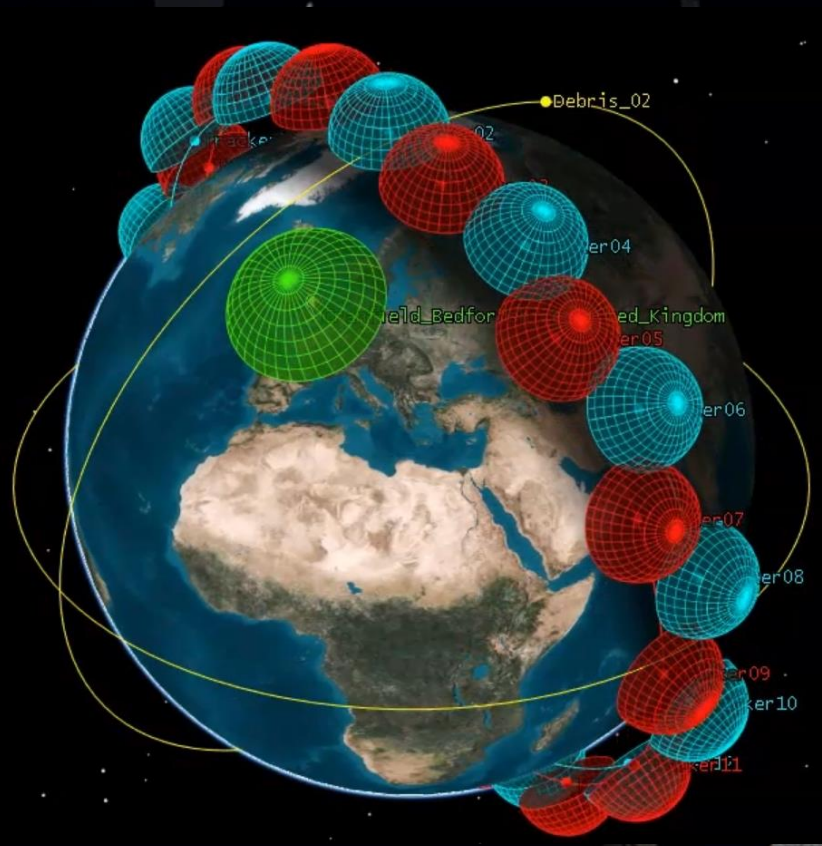
- Shall detect RSOs as small as 300 cm^3
- Global coverage of the 800km to 1400km band
- Users shall receive state vector of objects within 6 hours of potential collision
- Platform shall make use of COTS components to reduce cost
- Mission duration shall be at least 5 years

Users of service

- Primary Users: Satellite operators
  - Many satellites in the region and growing
  - Potential use of the region by megaconstellations
- Secondary users: Archive
  - Recorded state vector data stored for analysis
  - Academics and analysts

Mission Concept

- Constellation of 12U CubeSats
- 28 operational + 4 active spares
- Two orbital planes
  - Dawn-dusk Sun-synchronous orbit
  - Altitude: 750 km
  - RAANs: 52 and 59.5 deg
- Custom payload + COTS components



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Payload Design

- Two-mirror Ritchey-Chrétien Cassegrain deployable telescope
- Imperx C4020 CMOS 8P sensor
- 1000 km range for ⌀5cm RSO

Detection strategy

- Uses Earth albedo
- Reorient S/C
- Take pictures
- Eliminate stellar background
- Compare position
- Locate

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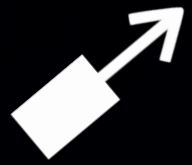

- Less than 4 arcseconds pointing accuracy
- 0.1º attitude control

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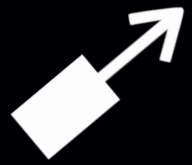

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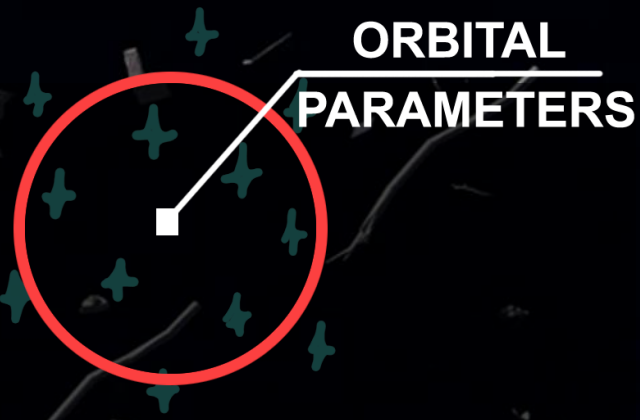

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Raw data from CMOS camera – 268 MB per object

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On-board Data Handling – 13 MB

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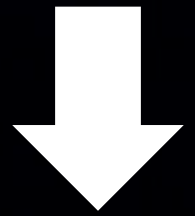
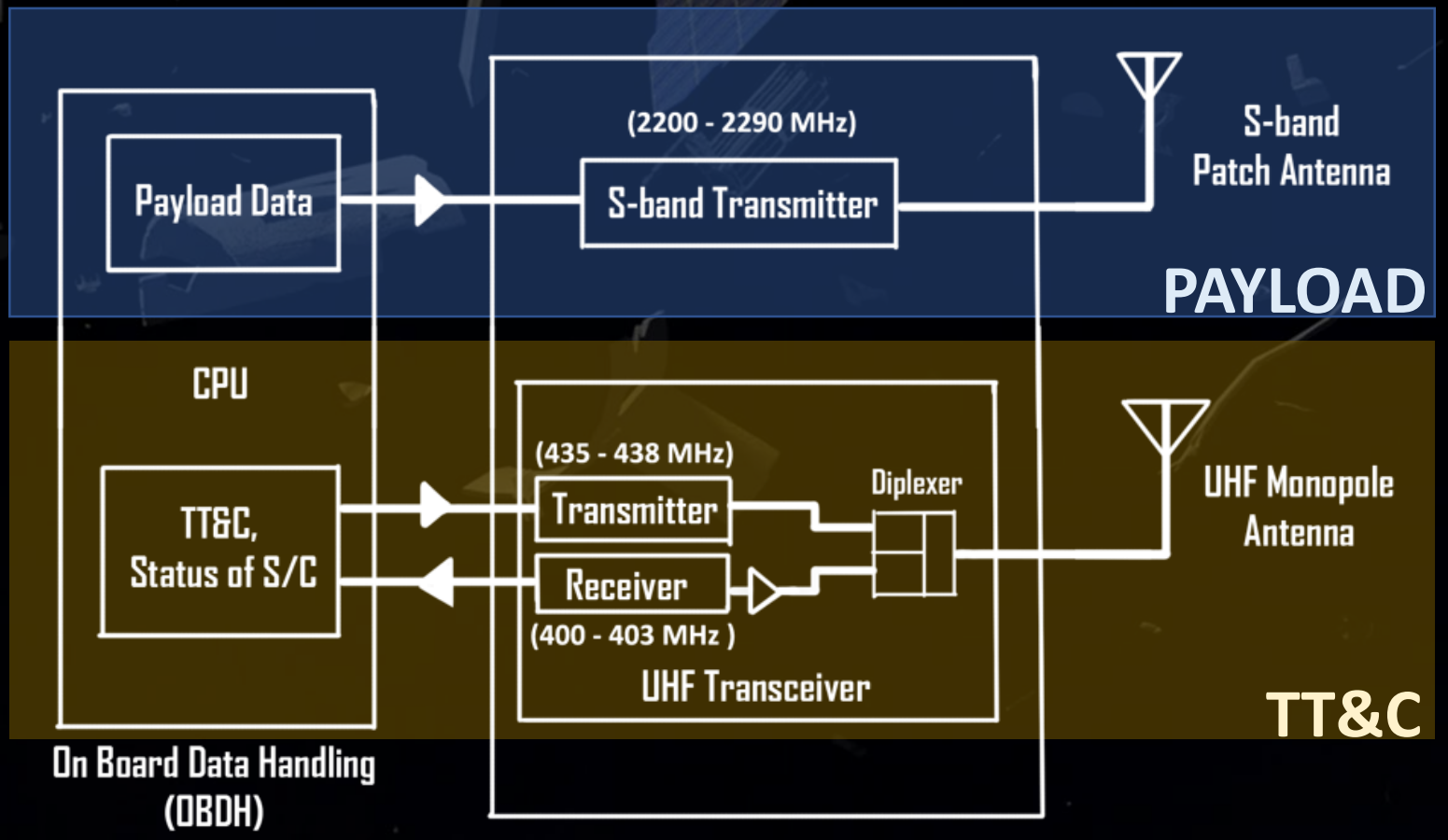


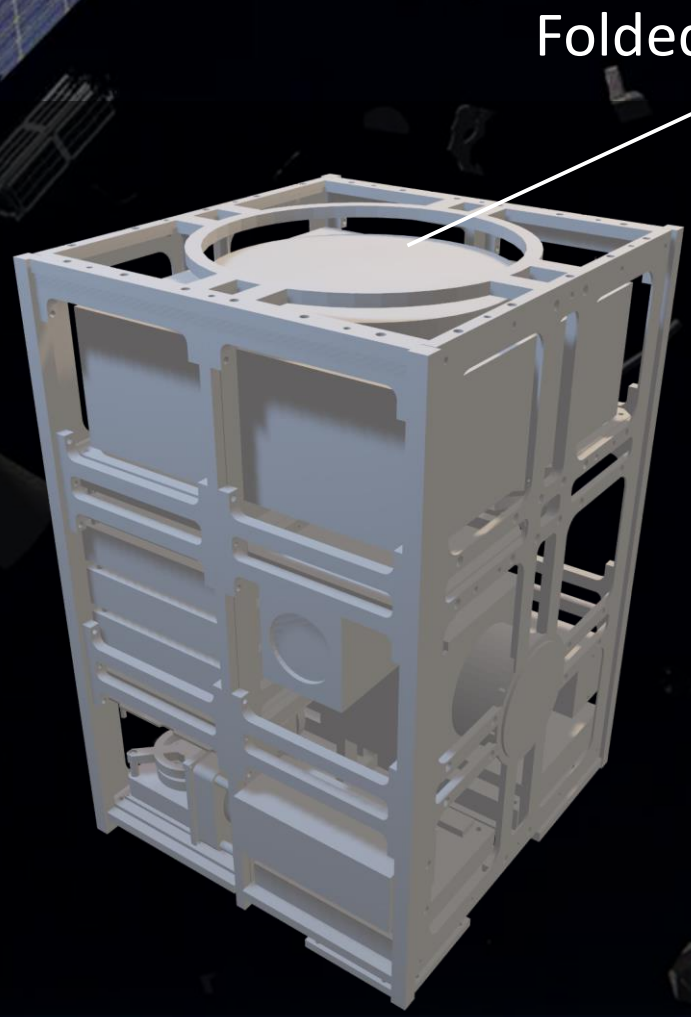
Transmit to ground (S-band)

Data transmission



Supporting subsystems

- COTS CubeSat components
- Complete design study
- Mass/link/cost/power budgets
- More info on paper



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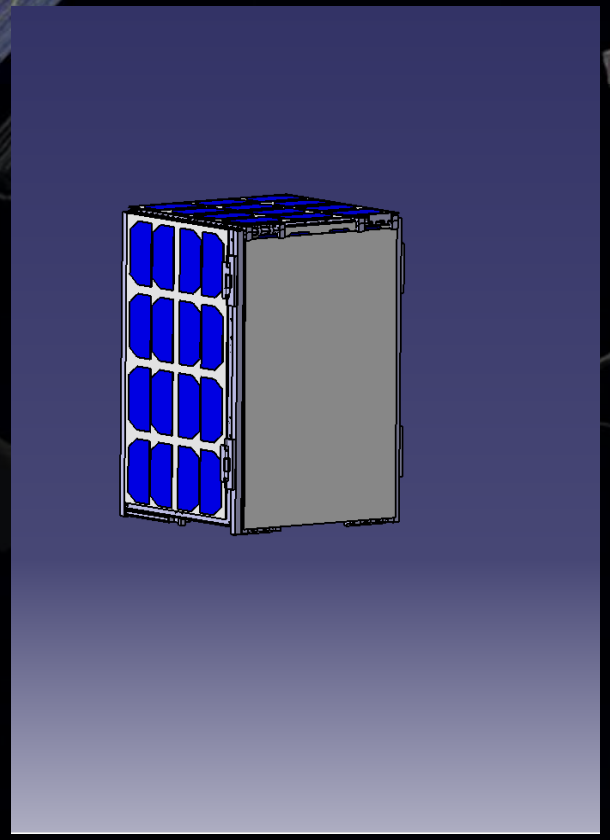
Supporting subsystems

- Total mass: 18.73 kg
- 0.26 m² of Solar Panels
- 35 W generated EOL
  - (14 W peak consumption)



Launch

- Two Firefly Alpha launchers
- Two Small Launch Orbital Maneuvering Vehicles (SL-OMV) in each launcher
- Eight CubeSats in each SL-OMV – 16 CubeSats per launch
- SL-OMVs deploy CubeSats to their final orbit

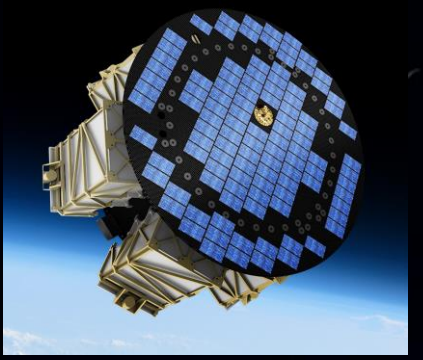


Image: SL-OMV (Moog)

Disposal

- Compliance with IADC 25 year deorbit requirement
- Roll-Out DeOrbit sails + backup
- Automatic deorbit if satellite reliability < 90%

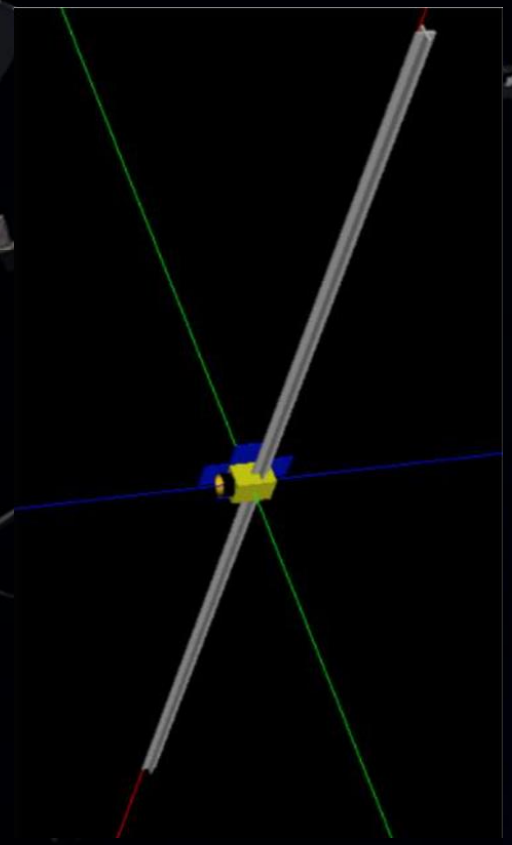


Image: CubeSat with Sails deployed

Cost

- Hardware (1 CubeSat): 194.000 GBP
- Setting into orbit the whole constellation: 33.6M GBP
- Desired anual income: 13.25M GBP

Conclusions

- Well-defined mission concept for location of RSOs
- Low-cost solution with extensive use of COTS components
- Enables easier tackling of the space debris problem

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Thank you for your attention

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