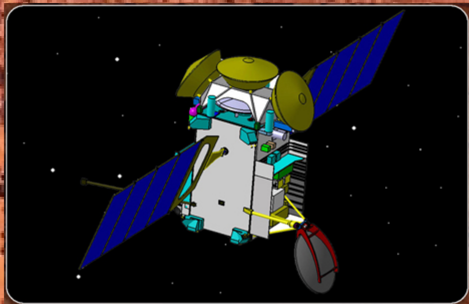

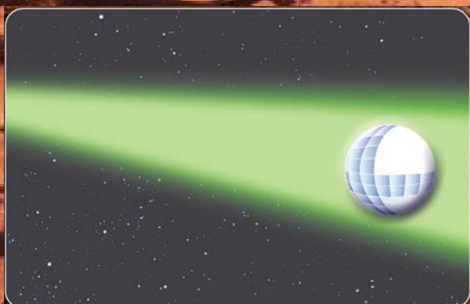

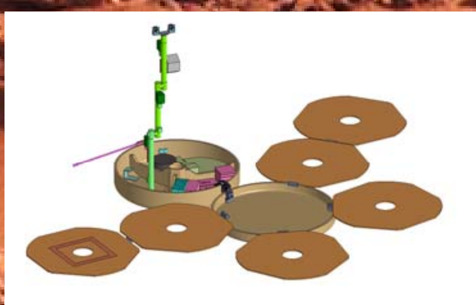

Challenges of Designing the MarsNEXT Network

IPPW-6, Atlanta, June 26th, 2008

Kelly Geelen
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EADS astrium

Outline

- Background
- Mission Synopsis
- Science Objectives and Payload Suite
- Entry, Descent and Landing Sequence
- Lander Configuration
- Lander Design
- Planetary Protection
- Conclusions

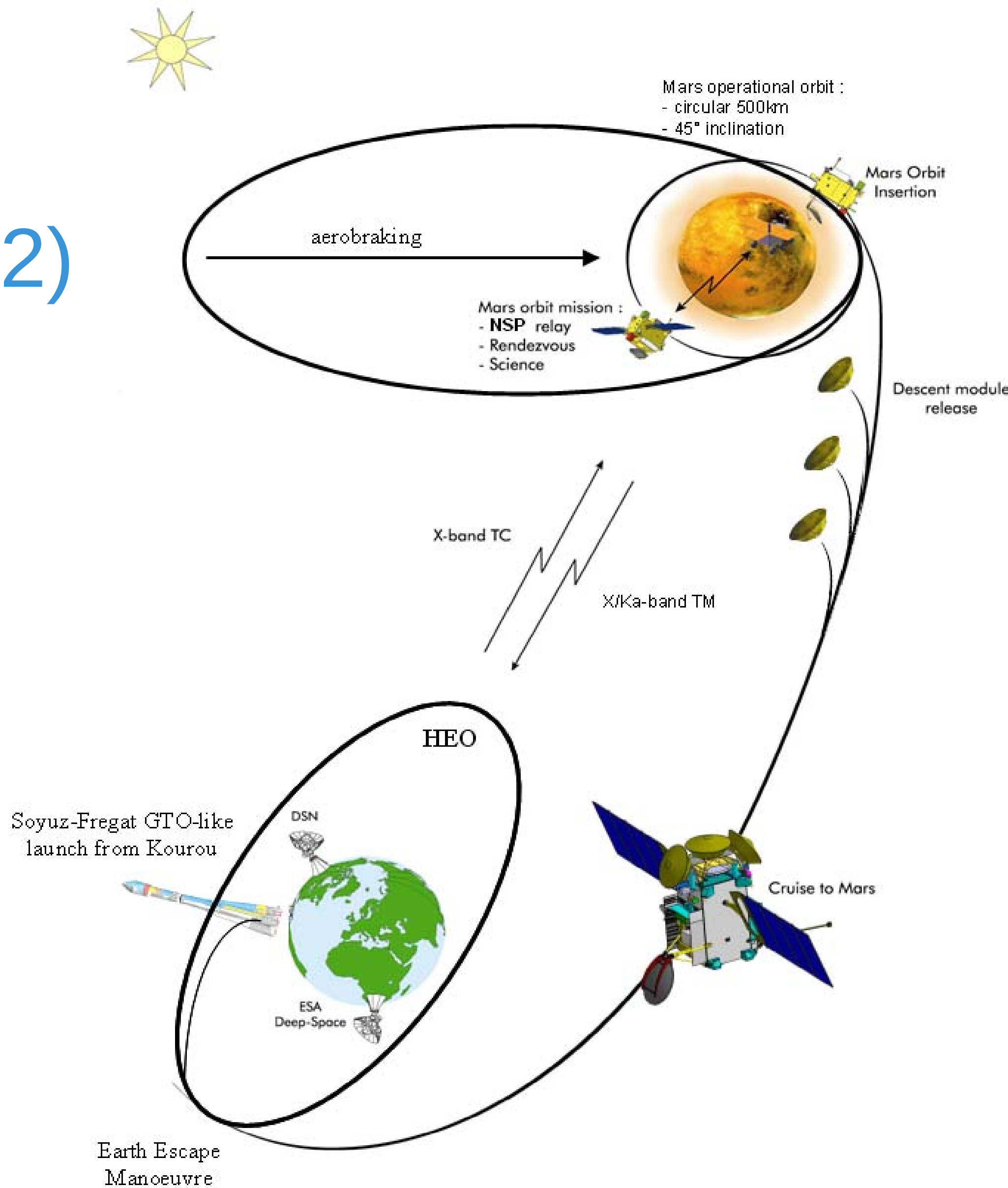
Background

- Mission concept studied by ESA for intermediate mission between the ExoMars mission due for launch in 2013, and the Mars Sample Return mission
- Two mission concepts
  1. Mars mission demonstrating aerobraking, rendezvous and capture in Mars orbit, and delivering a network of surface stations.
  2. Lunar lander mission demonstrating high precision landing with hazard avoidance and focussing on in situ science.
- Study started in February 2008 and due to end in February 2009
- Network Science Probe Study Team Members:
  - EADS Astrium (Kelly Geelen, Lester Waugh),
  - Astrium ST (Philippe Tran, Christophe Balemboy, Francine Bonnefond)
  - Vorticity (Steve Lingard)

esa Vorticity EADS astrium

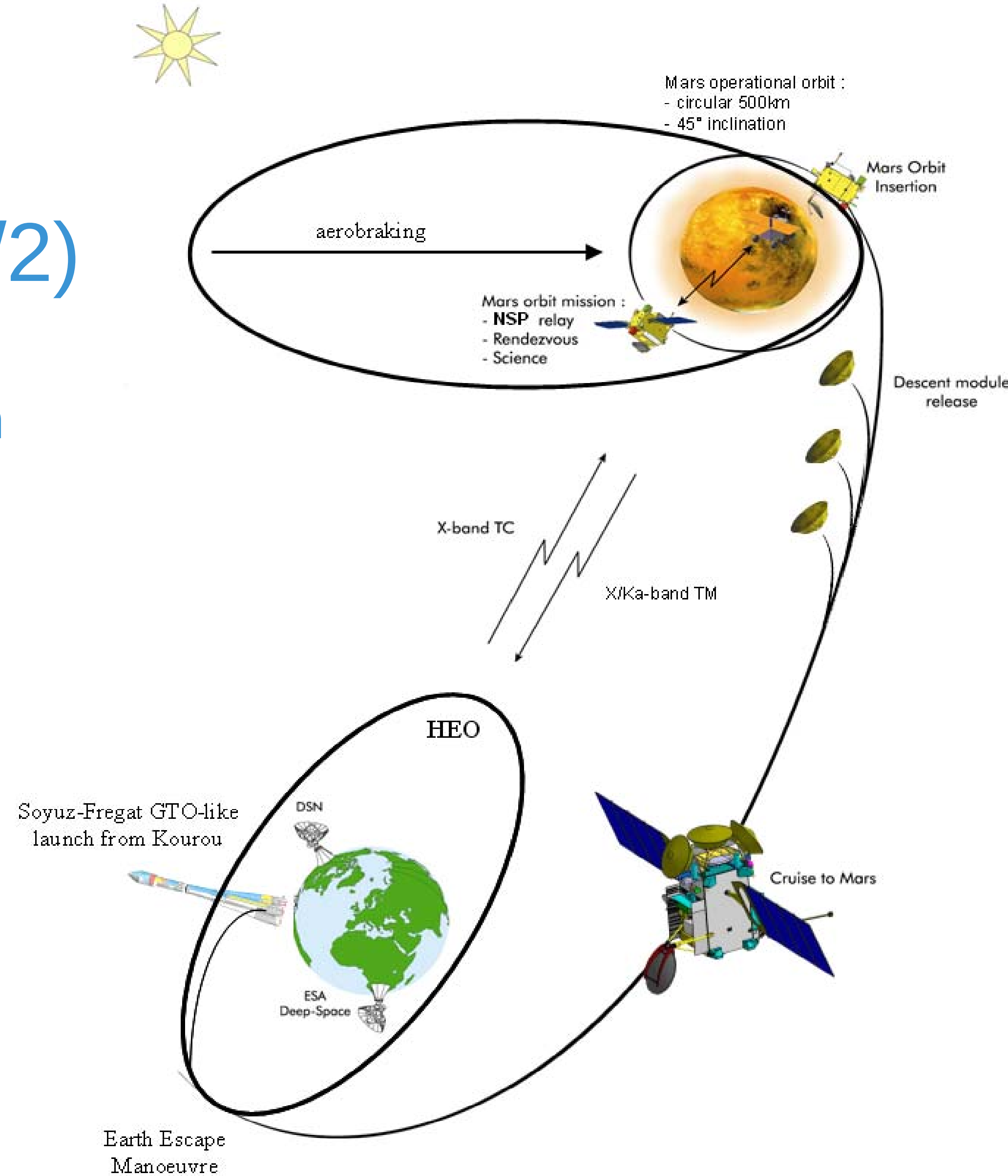
Mission synopsis (1/2)

- Launch in 2015, back-up in 2017.
- Injection in GTO of a Single-stage vehicle.
- The vehicle carries 3 Net Science Probes (NSP)
- The NSP are separated on Hyperbolic trajectory
- Insertion of the vehicle on a 4-sol orbit around Mars.
- One Martian year on surface operations, at landing site latitude range between -15º to +30º
  - Survival GDSS



Mission synopsis (2/2)

- The orbiter uses aerobraking to reach its final orbit at 500km of altitude.
  - 6 months for the aerobraking phase.
- A demonstration of Rendezvous and capture is then performed.
- For the rest of the orbiter mission, orbiter is used as relay of NSP, and also for on-board science.
  - Nominal lifetime of 3 (Earth) years in Mars orbit +2 years for extension

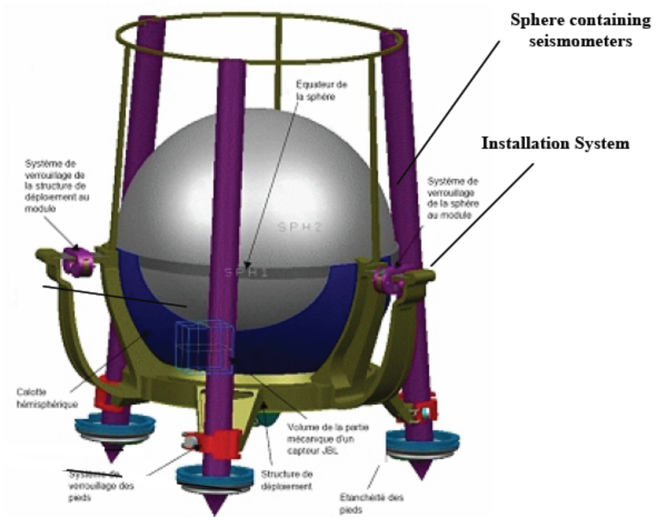


Science Objectives: Network Mission Concept

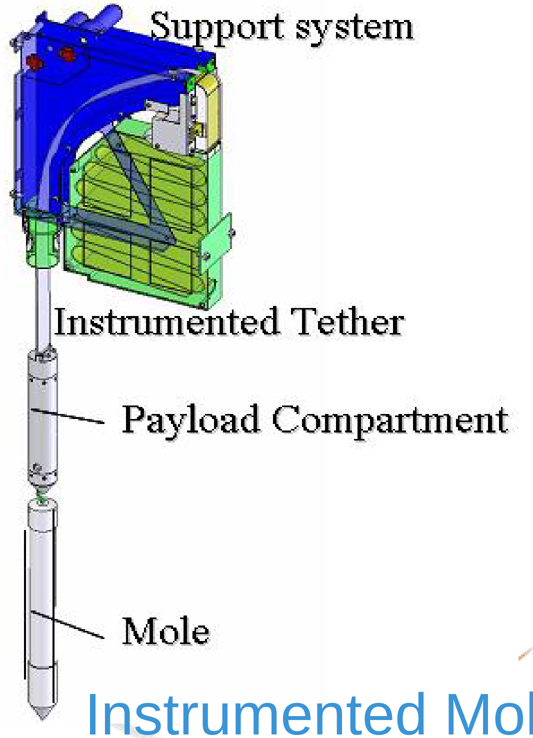
- Determining Internal Structure and Dynamics
- Rotational Dynamics
- Site Geology
- Surface Scattering Properties
- Atmospheric Structure
- Meteorology
- Surface Atmosphere Interactions
- Geochemistry and Mineralogy
- Volatile Studies
- Soil and Rock Magnetism

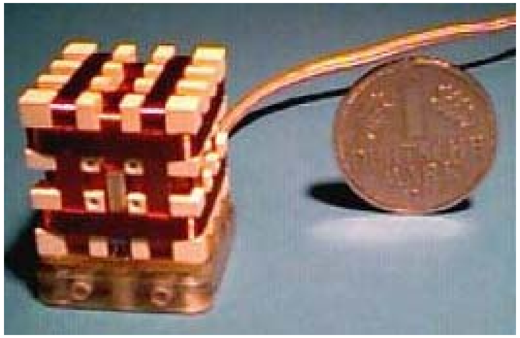
Payload Suite

- Radio-science Ionosphere and Geodesy Experiment (RIGE)
- Atmospheric Electricity Sensor (ARES)
- Meteorological Package (ATMIS)
- Alpha Particle Spectrometer
- Site Imaging System
- Geology/Geochemistry Package



Seismometer





Magnetometer

Optical Depth Sensor

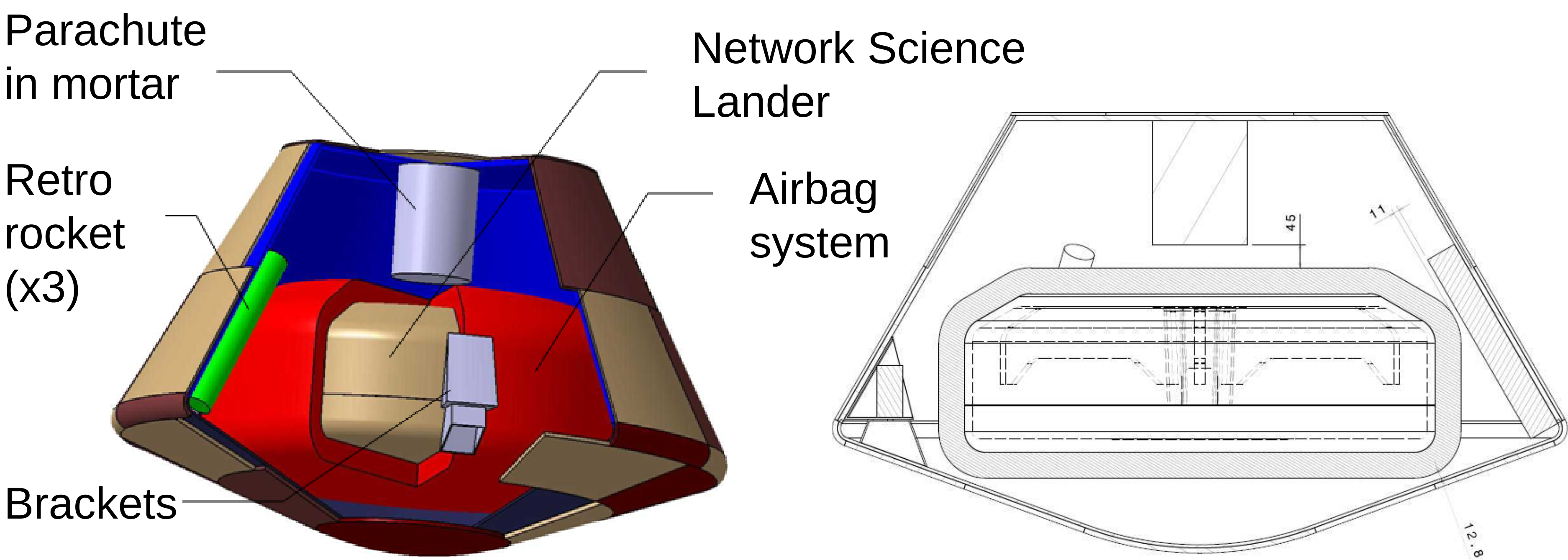
Instrumented Mole

EDL Sequence

- Coast
- 1. Entry:
  - Based on on-board sensors and software the parachute mortar is activated at appropriate Mach number
- 2. Descent:
  - parachute opens,
  - the Front Shield is jettisoned (3)
  - Lander with airbags system is lowered along a bridle (4).
  - Airbags are inflated (5).
  - Retrorockets are ignited (6).
  - Bridle is cut ; the Back Cover drifts away from the Lander (7);
- Landing:
  - Lander protected by its airbags bounces several times (9) (10).
  - Airbags system is separated from the lander;
- Surface operations begin.

Vorticity EADS astrium

Network Science Probe Configuration



- MPF-MER-like aeroshape
- Main diameter 1422 mm
- Airbag gas generator in central hole in lander
- Antenna on back cover or use of RF transparent window

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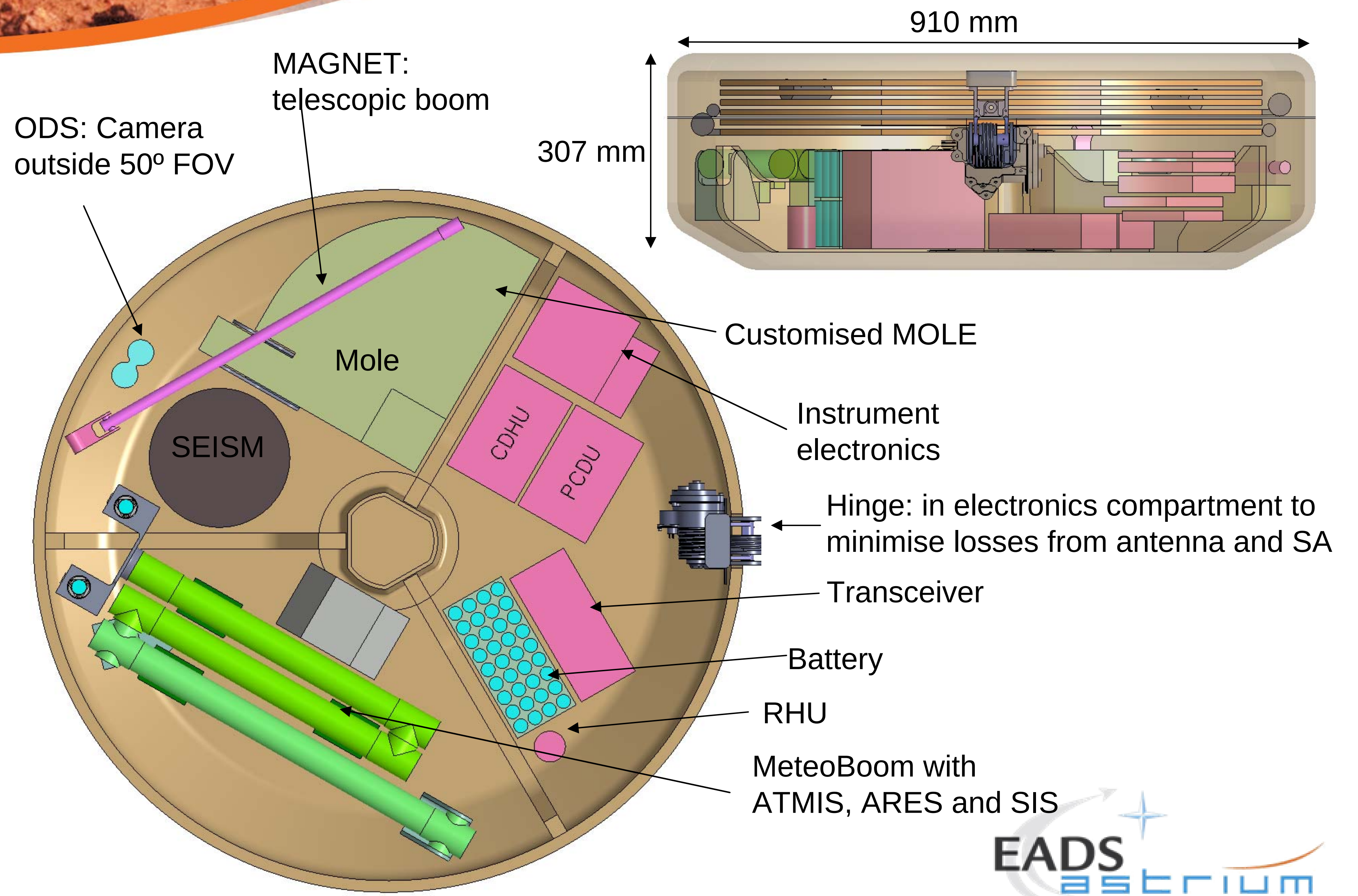
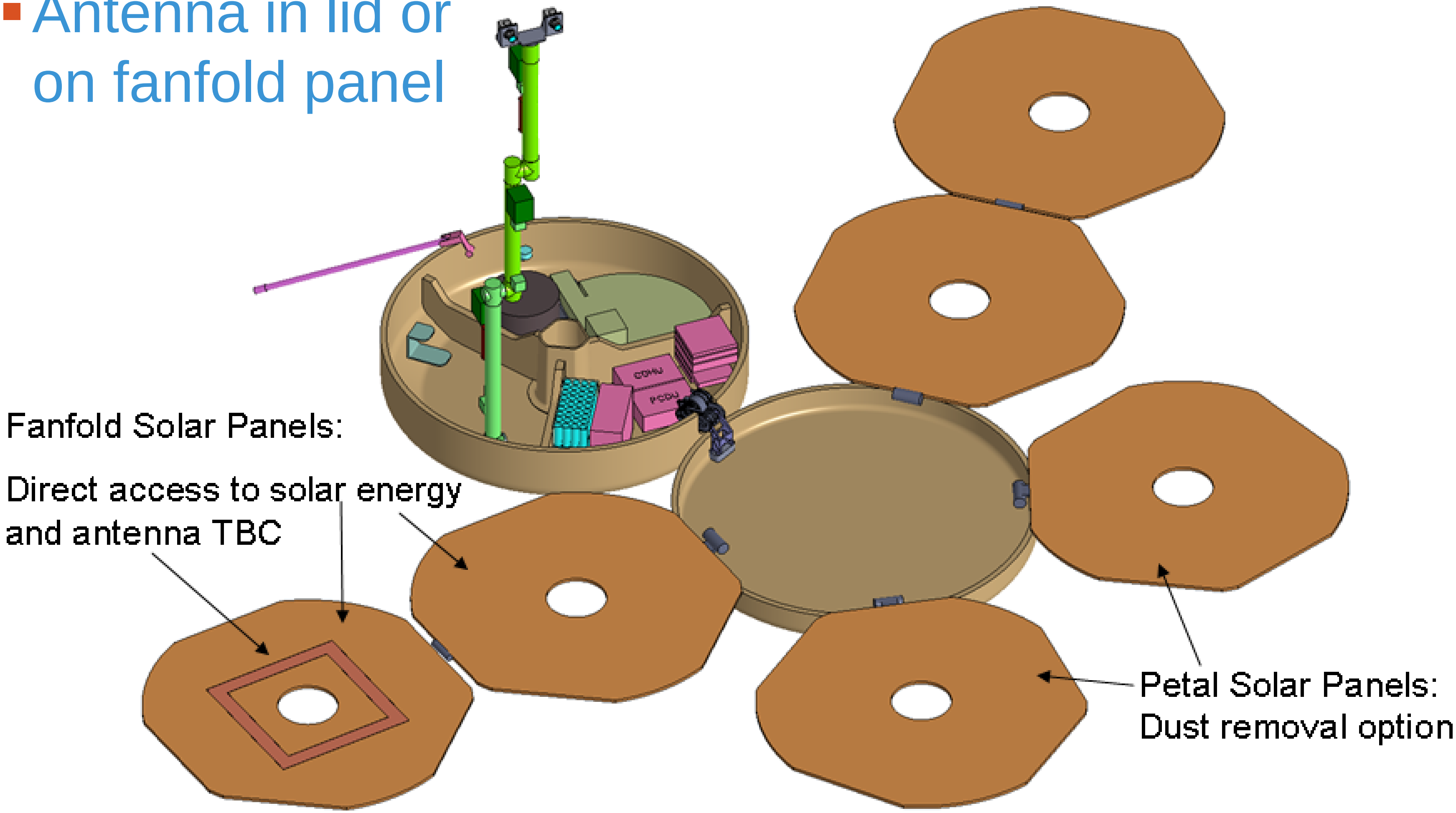
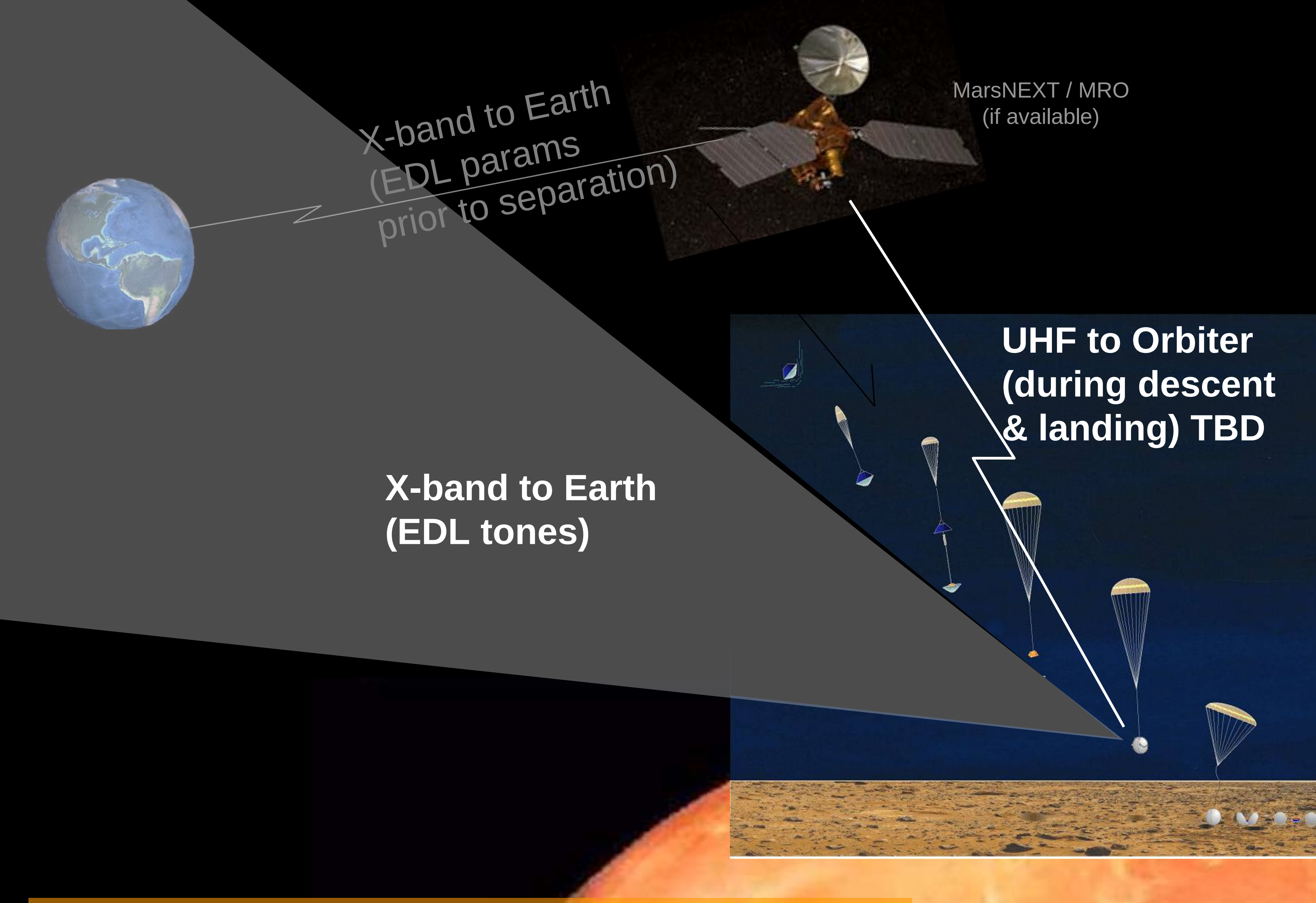
Lander Configuration



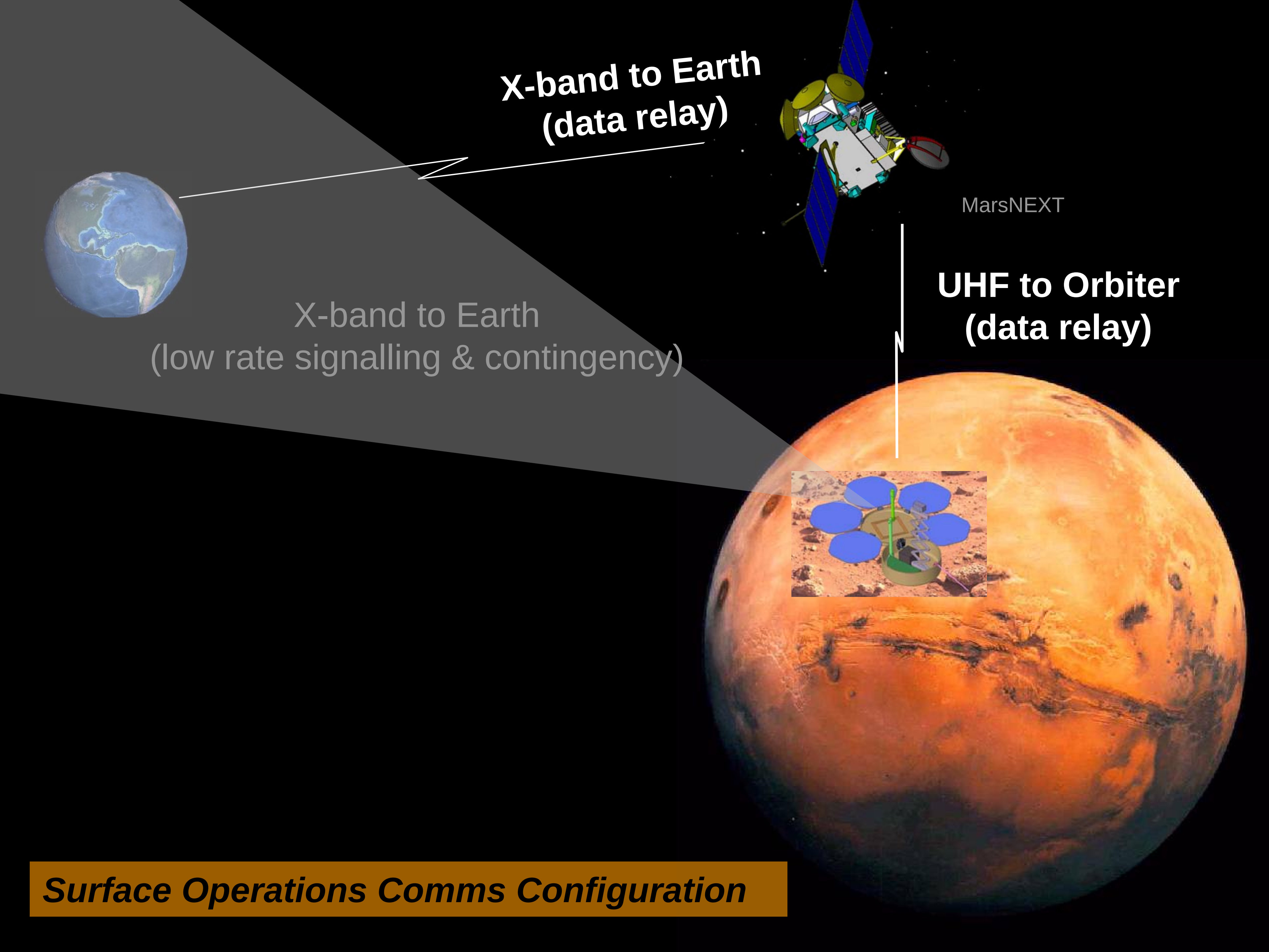
Configuration: Deployed

- Antenna in lid or on fanfold panel



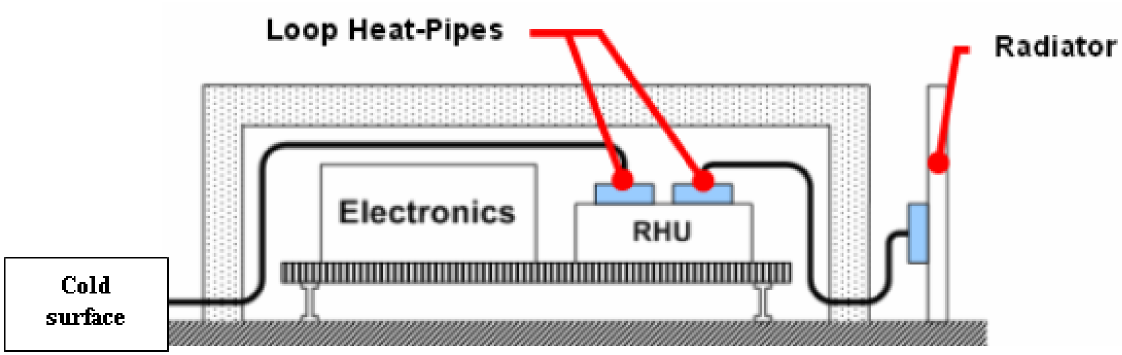


Entry Descent & Landing Comms Configuration


X-band to Earth
(data relay)
MarsNEXT
UHF to Orbiter
(data relay)
X-band to Earth
(low rate signalling & contingency)
Surface Operations Comms Configuration

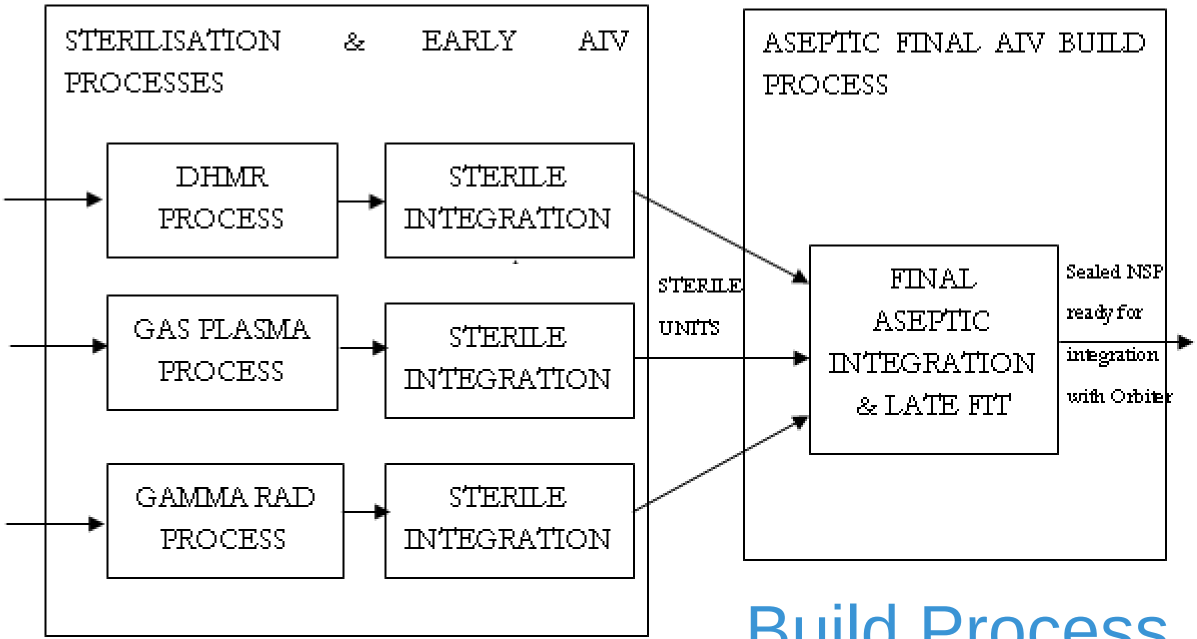
Thermal Architecture

- Survival heating provided by RHU's
  - Reliable background, non-deteriorating, self sustaining heat source
  - Sized to keep Probe 'alive' (survival) in absence of solar/electrical power
  - Minimised RHU thermal output eases cruise heat dumping
- Insulated Electronics Box (with gas gap)
- Additional battery insulation
- RHU heat split between battery and other internal electronics
- Goldised external finish to minimise losses & maximise solar gain
- Thermal switch required to protect battery from overheating



Planetary Protection

- The Network Science Probe is classified as Planetary Protection Category IVa.
  - *IVa is for landed systems without life-detection experiments and with no intention to access a Mars special region.*



Build Process

Conclusions

- Three Network Science Probes feasible with payload mass of ~8 kg.
- The total mass of the three probes including margins is estimated to be 365kg
- Some instruments need to be adjusted to limit the lander volume
- The landing latitude should be constrained to -15º to +30º
- Low power modes, hibernation and a survival mode needed to limit the power system mass.
- Nominal data relay via MarsNEXT orbiter although limited opportunities during the aerobraking phase. X-band direct-to-Earth used for contingency.
- Heritage and lessons learned from Beagle2 used for the NSP design.
- Thermal architecture is based on an RHU (robust concept).

- The mission concept will be studied further under the current contract and proposed to the ESA Ministerial Council at the end of 2008.

Questions?

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