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The MoonNEXT Mission

Bérengère Houdou, James Carpenter
& the ESA MoonNEXT Team
ESA/ESTEC, The Netherlands
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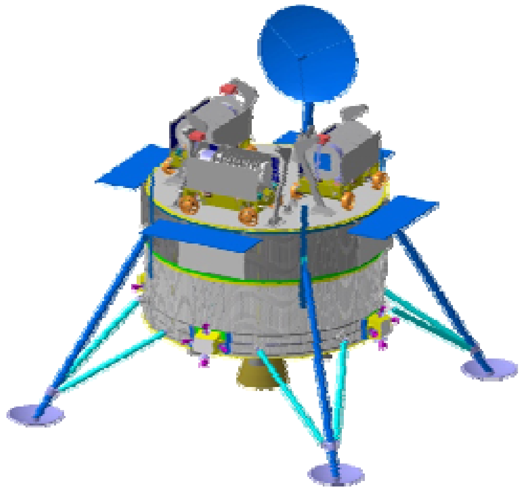
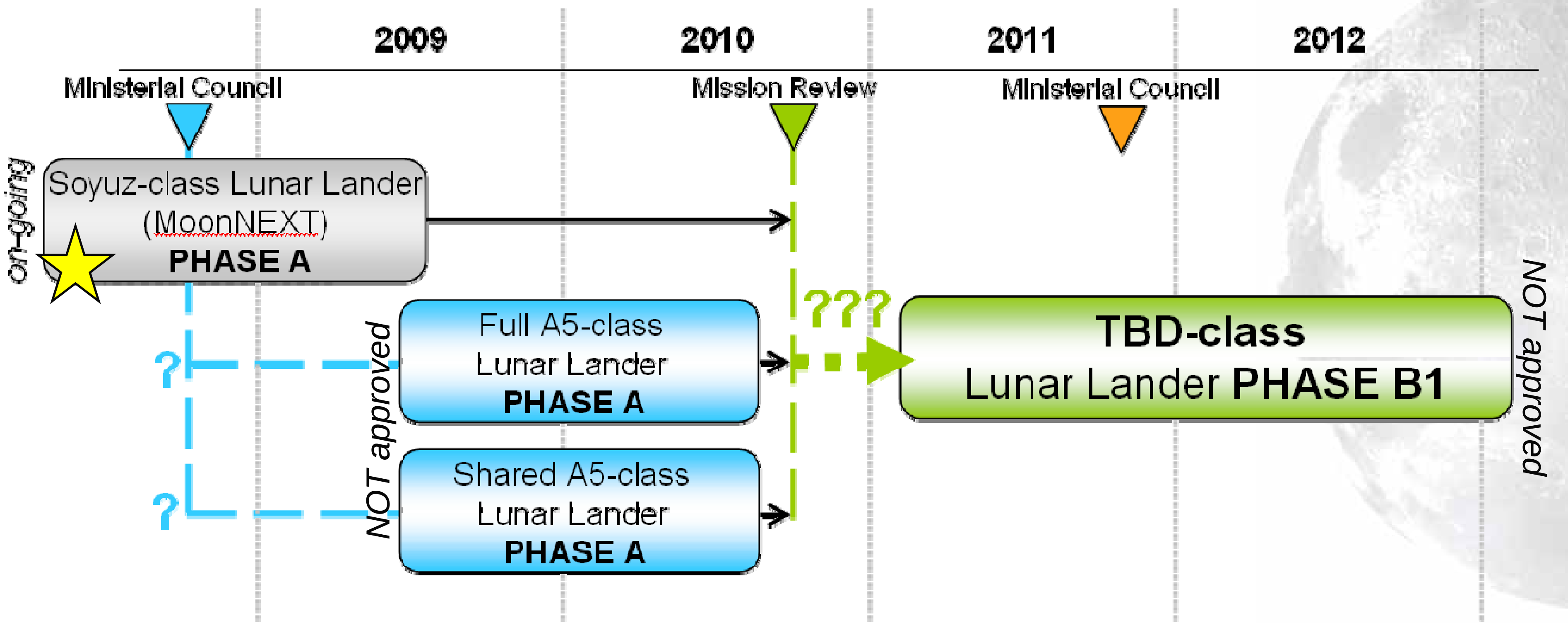
Introduction



- Potential long-term term perspective for European participation into international Human Lunar Exploration: high capacity cargo lander, using a full Ariane 5
- Different approaches to meet this goal are currently being considered by ESA:



MoonNEXT Phase A Industrial Teams

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3 Consortia, for a study duration of 12 months

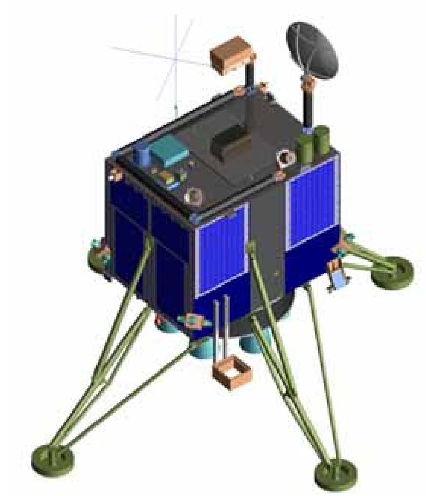
Interim Review
July 2008

2008				**2009**	
1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter

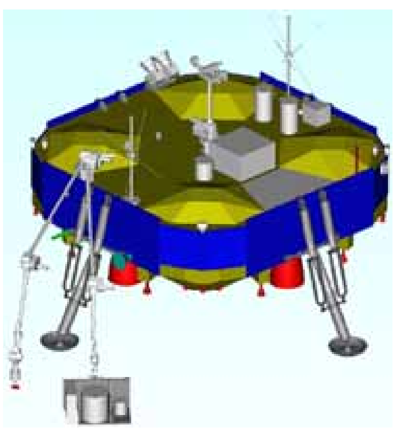
PHASE A: *Part 1* — **PHASE A:** *Part 2*

Astrium Space Transportation

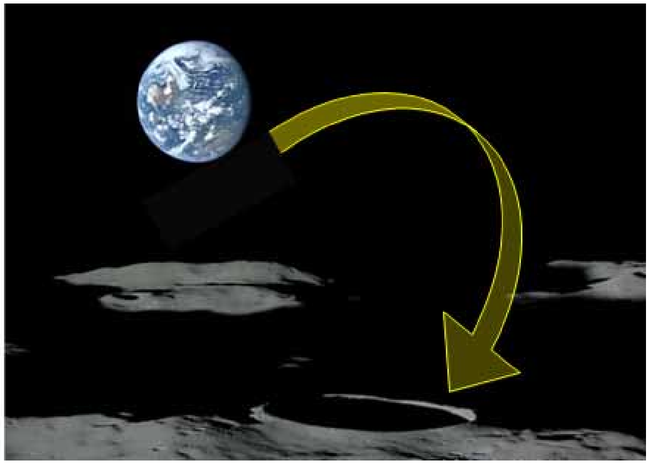
OHB System



Thales Alenia Space



MoonNEXT Objectives



- MoonNEXT **technological** objective:

  1. Autonomous soft precision landing

  2. With hazard avoidance

at the lunar South Pole

- MoonNEXT **payload** objectives:

  1. Exploration-enabling science (e.g. environmental monitoring) and technology demonstration (e.g. life sciences)

  2. Lunar science (e.g. geophysics)

  with the possible deployment and operations of a rover (if mission mass budget allows)

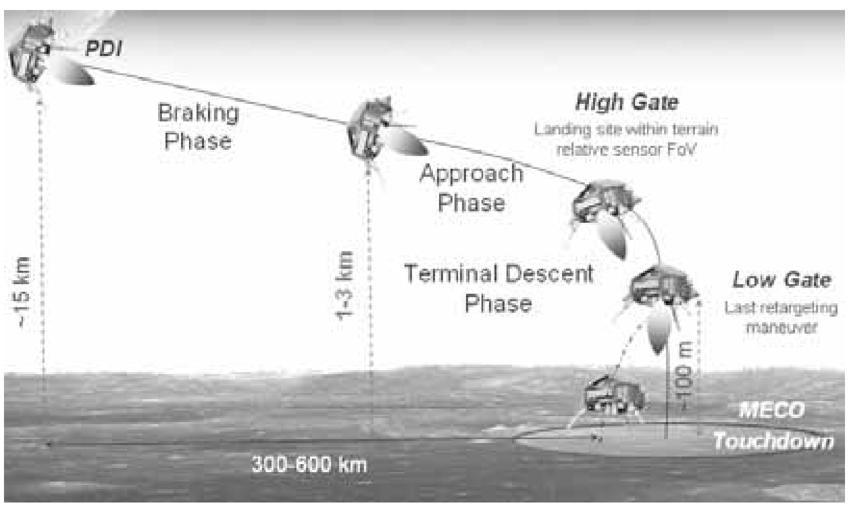
- MoonNEXT studied configurations (Soyuz-based):

  1. Lander-only (baseline, detailed design)

  2. Lander + Rover (feasibility study)

MoonNEXT Mission Sequence

- Launch with Soyuz 2.1-b from Kourou in the timeframe 2015-2018
- Earth-to-Moon transfer (a few days)
- Low circular Lunar orbit
- Soft precision landing (200 m, tbc) with hazard avoidance at the South Pole (favourable illumination conditions)



- Coast phase
- Braking phase
- Approach phase:
  - hazard mapping and safe site identification
  - retargeting, steering to the selected safe site
- Terminal descent and touchdown on legs

→ Fully autonomous (~1h30)

- Deployment of the surface payload
- 1-year operations, with direct communication to Earth (no orbiter assumed)

MoonNEXT
Main Design Features

- Main mission architecture trade-offs:
  - transfer orbit: LTO / HEO / GTO
  - staging (separated in LLO before landing) or no

- Landed mass: between 650 kg and 800 kg
- Payload capability: a few 10s of kg

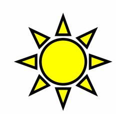
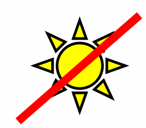
- Main mass drivers: propulsion and structure subsystems

- Complex propulsion subsystem but no new engine development

Main engines:
500N EAM
in continuous mode

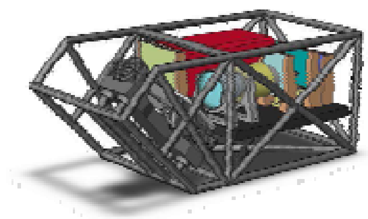
Assist engines:
220N ATV thruster,
in pulse-mode

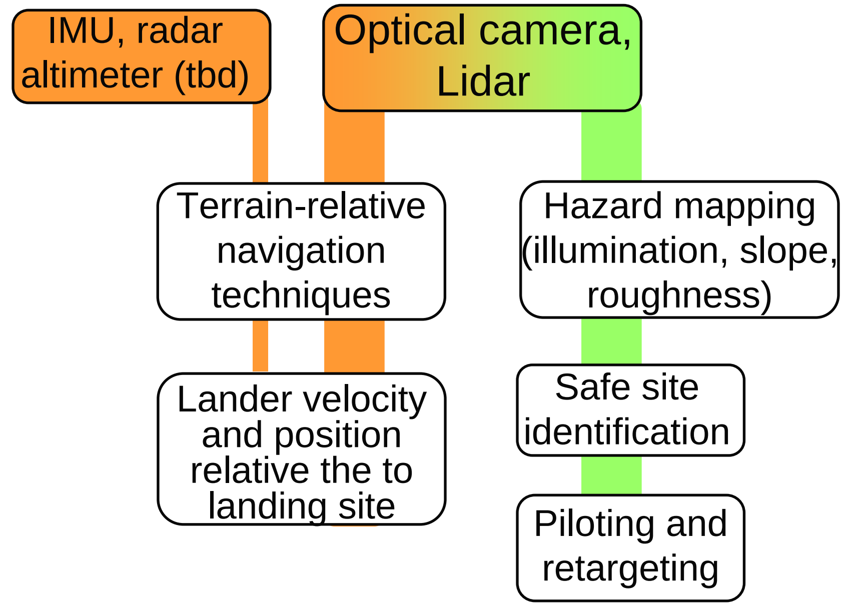
- Thermal control: RHUs
- Power: batteries (no RTG), size driven by payload operations during darkness
- Touchdown: 4 deployable legs with crushable

		
		No travel
	Limited P/L operations	Limited P/L operations No travel

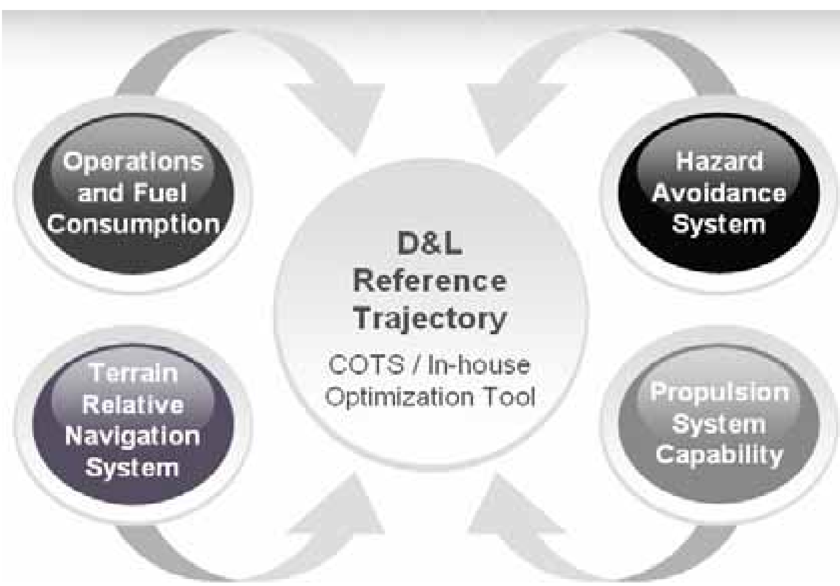
Soft Precision Landing with Hazard Avoidance

- Achieved by augmenting lander GNC system with new-generation sensors and algorithms
- Significant technology development effort on-going in Europe





- Key design drivers and constraints:



- To meet the 200m precision requirement: use of a specific terrain-relative navigation technique based on matching real-time images with reference maps stored onboard

Core Payload Objectives

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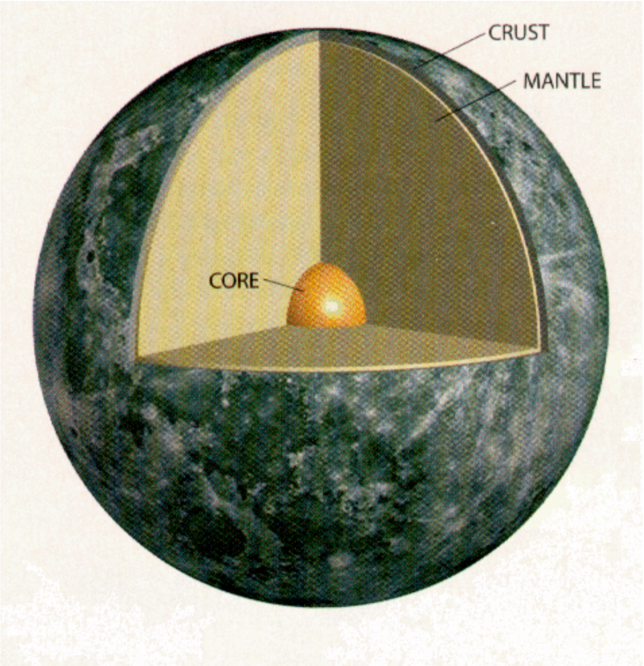
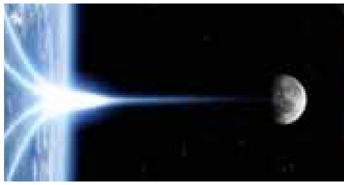
Preparation for Human Exploration:

- Demonstrate technologies for future human exploration
- Characterise potential hazards and challenges (e.g. dust, radiation, impacts)
- Characterise a potential human outpost location

Lunar Geophysics:

- Internal structure and composition
- Formation history and evolution
- Compatible with the International Lunar Network





Core Payload Instruments on Lander

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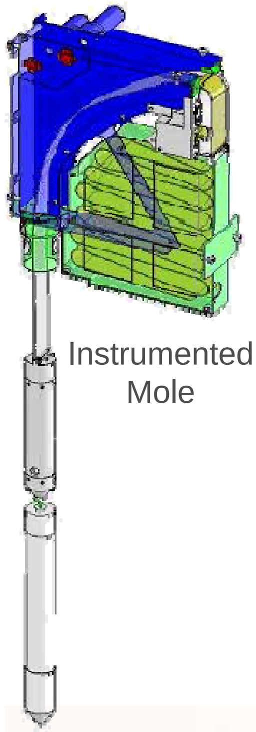
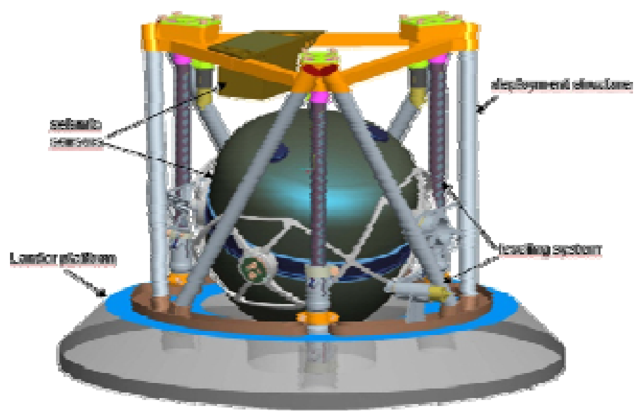


Instrumented Mole

- Landing site characterisation
- Internal structure of the Moon
- Lunar radiation environment
- Lunar meteoroid environment
- Lunar dust
- Technology demonstration in preparation of human exploration

Strawman Instruments	Topics Addressed
Site Imaging System	Landing site characterisation (blue)
Instrumented Mole	Landing site characterisation (blue), Internal structure of the Moon (orange)
Lunar Radiation Monitor	Lunar radiation environment (red)
Lunar Dust Camera	Lunar dust (purple), Lunar meteoroid environment (yellow)
Seismometer	Lunar meteoroid environment (yellow), Internal structure of the Moon (orange)
Langmuir Probe	Lunar dust (purple)
Magnetometer	Internal structure of the Moon (orange)
Laser Reflector	Internal structure of the Moon (orange)
First Extraterrestrial Man Made Ecosystem	Technology demonstration in preparation of human exploration (cyan)
Reversible Solid Oxide Fuel Cell	Technology demonstration in preparation of human exploration (cyan)

ExoMars PanCam from which the Site Imaging System is derived

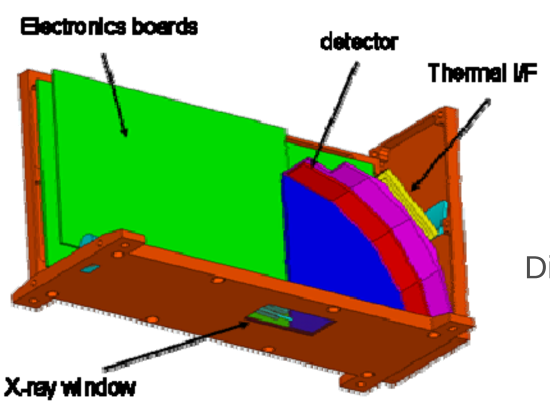


Seismometer

Complementary Instruments on Lander

- (cyan) In-situ resource characterisation
- (red) Elemental composition
- (black) Mineralogy
- (yellow) Volatiles
- (pink) K-Ar dating
- (grey) Micrometeoroid environment
- (purple) Radio astronomy preparation
- (white) Geochemistry package support

Strawman Instruments	Topics Addressed
X-ray Diffractometer	(cyan) (red) (black) (pink)
Gas Analysis Package	(cyan) (yellow) (pink)
Sample Preparation and Distribution System	(white)
Lunar Radio Environment	(purple)
IR Spectrometer	(cyan) (black)
Lunar Meteoroid Environment	(grey)
Remote Raman-LIBS	(cyan) (black) (red)



X-ray Diffractometer

Beagle 2 Gas Analysis Package

Conclusions

- MoonNEXT (Soyuz-based) offers a unique opportunity by combining cutting-edge landing technology, preparation for human exploration and ILN-compatible science

- The detailed design of the **Lander-only** configuration has just started and is planned to be completed mid-2009

- **In discussion** for approval at the coming ESA Ministerial Council (end Nov.): Phase A studies of A5-class Lunar Landers

- Final decision on class of lander foreseen end-2010 **(To Be Confirmed)**