Moon Exploration
Lunar Polar Sample Return

ESA Thematic information day

BELSPO, 3 July 2012

Introduction

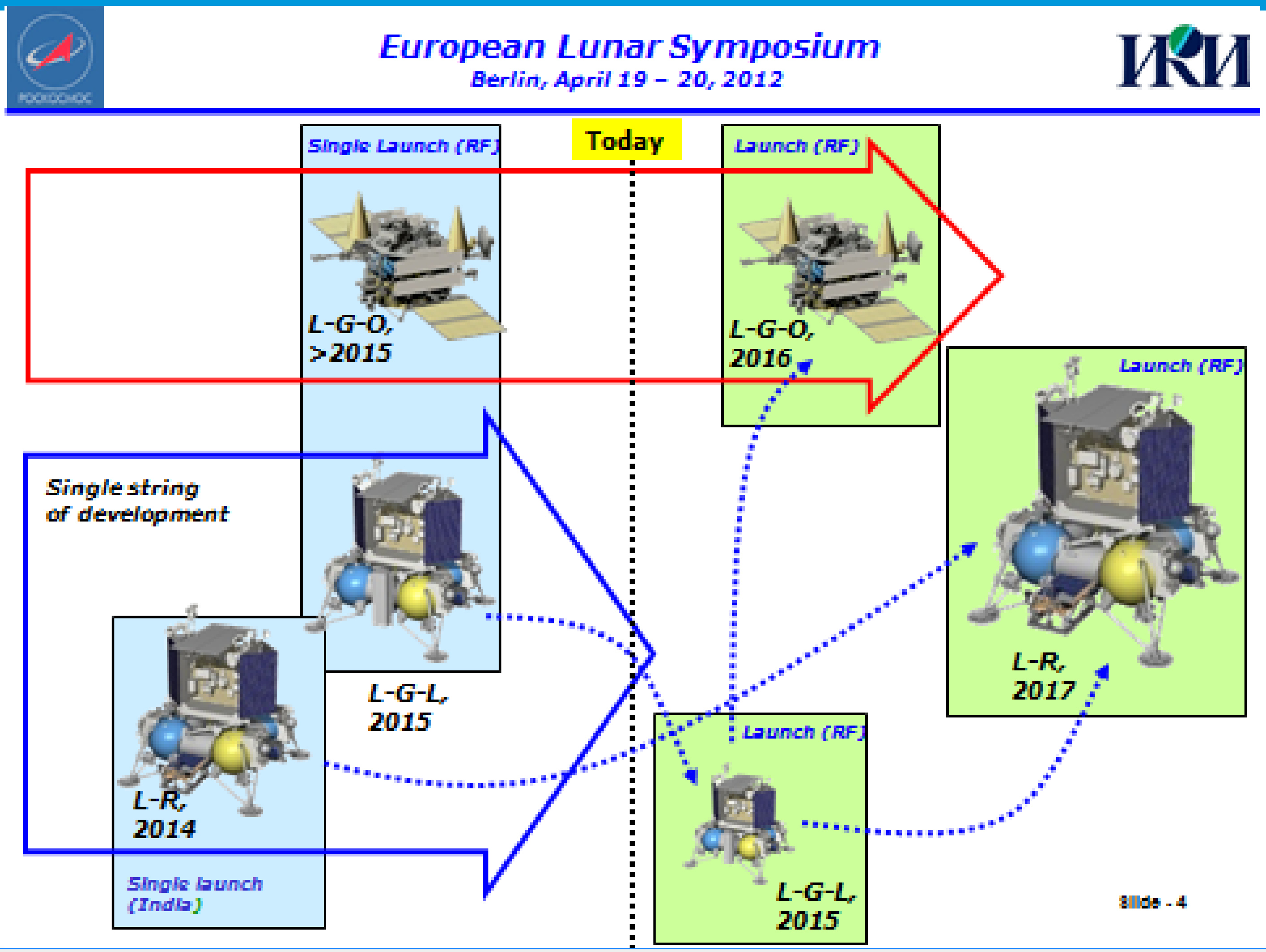
- **Moon Exploration has a very high priority in Roscosmos agenda and builds up on the Luna-Glob and Luna-Resource missions, already approved (but now under review after Phobos –Grunt).**

- **The Lunar Polar Sample Return (LPSR) mission, planned for launch > 2020, follows up on the same line.**

- **ESA has been invited to participate to the LPSR mission in the frame of a broad cooperation on Exploration, which encompasses Moon, Mars, Jupiter.**

- **For the LPSR a programme of <u>Preparatory Activities</u> is proposed for approval at the coming CM 2012**

Russian Moon Exploration Missions



Lunar Polar Sample Return (LPSR)

- **Main goal is to bring back frozen samples from the Moon polar regions for analysis in Earth laboratories;**

- **Ideally samples can be taken from Moon craters, but very low temperatures not compatible with today's technology for Landing Platform and / or Rover design (even with use of RTGS);**

- **Frozen samples can be obtained from subsurface drilling (1.5 to 2 m) in illuminated areas. Alternatively samples from shadow areas may be considered;**

LPSR Technology Development

The LPSR mission concept is still evolving, main components are:

a. First Lander with high mobility Rover
b. Second Lander with Sample Return Stage

Main technologies needed by the LPSR missions:

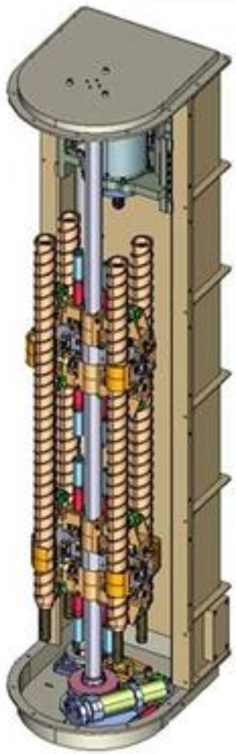
- High Thrust propulsion (a. & b);
- RTGS (a. & b.)
- Drill and Sample handling (a. & b.)
- Precision landing (b.)
- Rover navigation across shadow zones (a. -TBC).

Lunar Resource Lander (2017)

The Luna-Resource Lander is seen as a precursor mission to LPSR:

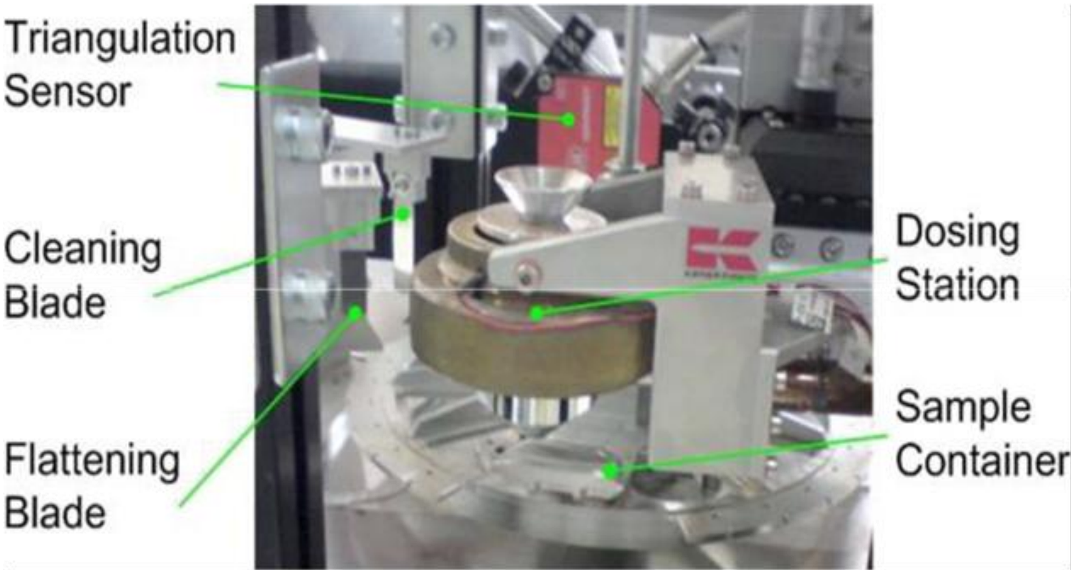
- **Russia's main technology provisions:**
  - **Landing of a Large Platform**
  - **High thrust propulsion**
  - **RTGs**
- **ESA potential contributions:**
  - **Drill to acquire subsurface frozen samples**
  - **Sample handling system to allow in-situ analysis**
  - **Visual Navigation Experiment to validate Precision Landing technology for LPSR (Hazard Detection and Avoidance?).**
- **ESA contribution to payload of instruments.**

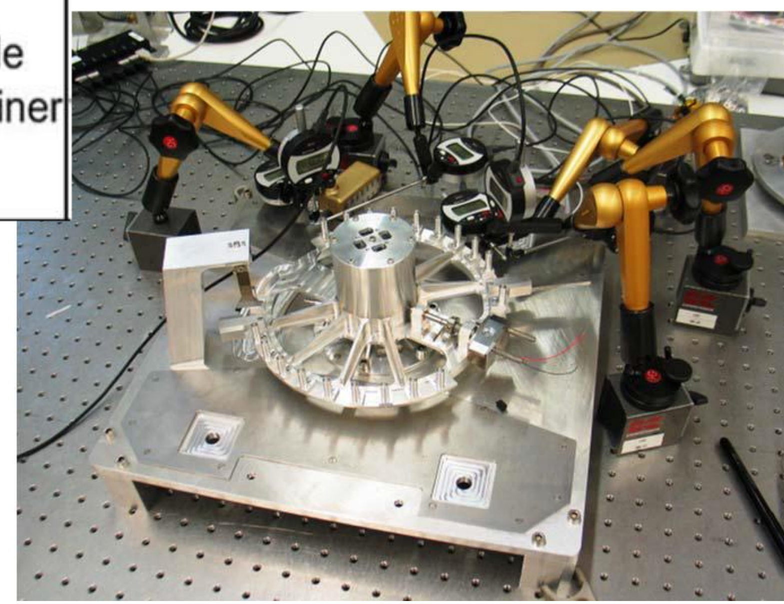
Drill (ExoMars)



Bread Board, Engineering model tested in Laboratory and Mars conditions (adaptation to Moon conditions)

SPDS (ExoMars)





Bread Board tested in ambient and low temperature (-80 C)

Visual Absolute/Relative Terrain Navigation Experiment (VNE)

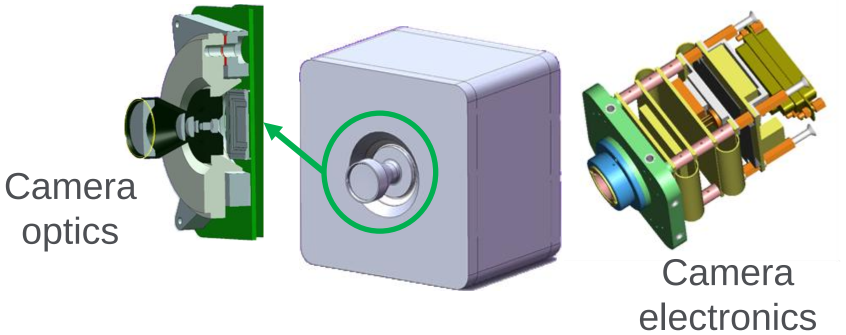
VNE

CAM

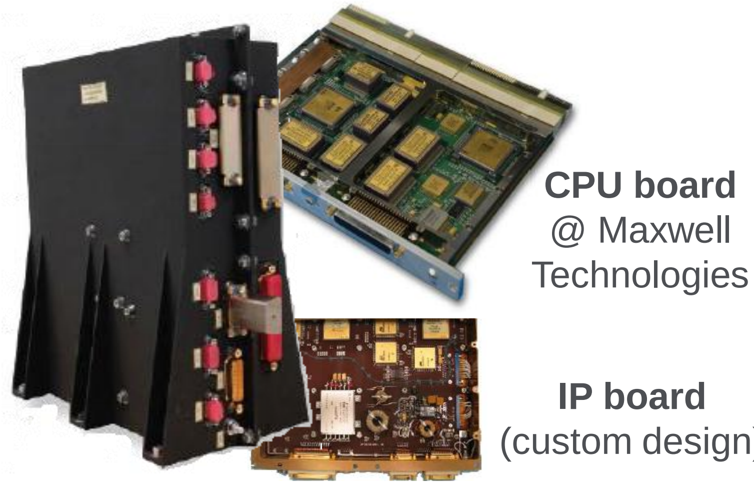
- RadHard CMOS detector: STAR 1000
- Image acquisition rate: 10 Hz (max.)
- Field of view: 50º
- Mass / Power < 0.5 kg / 4.5 W
- Volume: 50x50x50 mm³

VNU:

- Image processing and navigation filter
- IP board:
- CPU board: 3xIBM 750FX PowerPC™ processors, 1800 MIPS, 512 kB of On-Chip L2 cache, 256 MB of SDRAM
- SpaceWire I/F
- Mass / Power < 4.5 kg / 25 W
- Volume: 300x300x200 mm³ (TBC)



CAM conceptual design @ OIP Sensor



VNU mechanical configuration (GAIA VPU as example)

LPSR Programme Proposal

Conceived initially as mainly engineering and design activity the LPSR Programme Proposal has evolved to include a substantial hardware contribution:

LPSR initial preparation:

- ESA-Roscosmos to perform a joint assessment of the proposed mission concept and define a possible share of responsibilities;
- Phase A industrial studies to address in detail the feasibility and cost associated with the proposed European contributions.

For the Luna-Resource Lander (2017), provide (EQM & FMs):

- Drill and SPDS adapted from ExoMars
- Visual Navigation Experiment from the Lunar Lander.

- **Back-Up slides**

Missions Technology Development

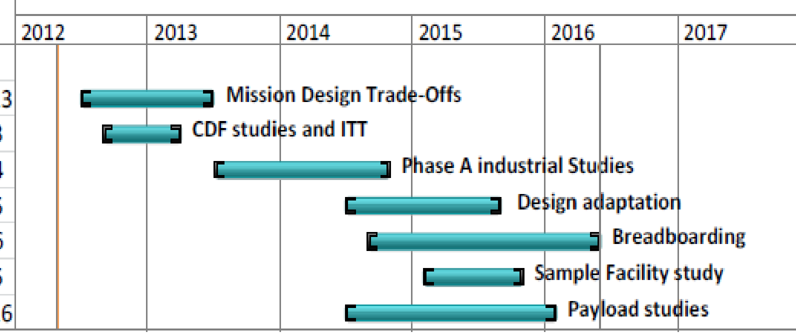
	Mission	Launch	Propulsion High Thrust	Rover High Mobility	Drill (2m)	Precision Landing
1.	Luna-Glob Lander	2015	(Medium)			
2.	Luna-Glob Orbiter	2016	(Add surface telecom capability)			
3.	Luna-Resource Lander	2017	X	(Small)	X	Visual Nav. Experiment
4.	Lunar Lander (ESA)	2018				X
5.	LPSR 1 Lander / Return Stage	2020	X		X	
6.	LPSR 2 Lander / Large Rover	2020+	X	x	X	X

Technology Development Rationale

- **Missions 1-4 develop and demonstrate the technologies needed by the LPSR missions 5-6:**
  - **High Thrust propulsion;**
  - **Drill and Sample handling**
  - **Precision landing**
  - **Rover with advanced navigation across shadow zones (TBC).**
- **The overall scenario provides for synergy and reduced risk (to be assessed: Return Stage design heritage goes back to the 70s)**

ESA Activity Planning

ID		Task Mode	Task Name	Duration	Start	Finish
1						
2			Mission Design Trade-Offs	262 days	Sun 01/07/12	Mon 01/07/13
3			CDF studies and ITT	153 days	Sat 01/09/12	Tue 02/04/13
4			Phase A industrial Studies	345 days	Sat 06/07/13	Thu 30/10/14
5			Design adaptation	306 days	Tue 01/07/14	Tue 01/09/15
6			Breadboarding	459 days	Mon 01/09/14	Thu 02/06/16
7			Sample Facility study	197 days	Sun 01/02/15	Sun 01/11/15
8			Payload studies	415 days	Tue 01/07/14	Mon 01/02/16



LPSR WG Milestones

ESA – Roscosmos joint WG aiming to:

- **Preliminary findings report and detailed planning: July 2012**
- **Mission concept baseline definition: September 2012**
- **Joint CDF study (at ESTEC): October – November 2012**
- **Discussion and agreed scope of the ESA Phase A industrial studies: 1 Q 2013 (pending outcome of CM 2012)**

Detailed planning to be further discussed at the joint meetings ESA / Roscossmos / IKI 10 & 11 May in Lausanne.

Drill (ExoMars)