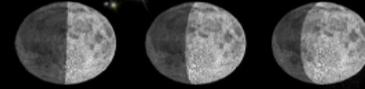




LRO PSWG



NOVEMBER 28 - 30, 2006  
EAST WEST CENTER  
UNIVERSITY OF HAWAII - MANOA  
1777 EAST WEST ROAD  
HONOLULU, HI

# Federal Space Agency Future Missions

Igor Mitrofanov

*Institute for Space Research of Russian Academy of Science*

*and*

*Federal Space Agency of Russia*

# Introductory Remarks

- (1) Even after 30 years of the last Moon landing of Soviet *Luna* sample return mission, the memory of *Moon Race* is still fresh – public does not want another one. We need to suggest new motivations to Russian people for national lunar program.**
  
- (2) New philosophy of Moon exploration – self-consistent national program based both on the heritage of Soviet *Lunas* as well as on the new space technology, and in the content of international cooperation.**
  
- (3) There are three major directions of Moon exploration process in the national space program of Russia:**
  - (a) Human space flights (ISS operations, new space technology for human flights, ground simulations of space environment);**
  
  - (b) Robotic Lunar exploration missions;**
  
  - (c) Participation of robotic missions of other Agencies (i.e. LEND is contributed instrument for LRO).**

## **Introductory Remarks (2)**

**(4) There are four major objectives of Russian Robotic Lunar Exploration Program:**

**(I) To make fundamental studies of the Moon (origin, evolution, internal structure, magnetic anomalies, etc.)**

**(II) To get the necessary science/engineering knowledge for supporting human missions to the Moon (visiting and permanent)**

**(III) To study the processes of lunar resources utilization**

**(IV) To create opportunities for astronomical, Sun and Earth observations**

## Introductory Remarks (3)

(5) There are three technical principles of the proposed Russian Robotic Lunar Exploration Program:

(I) To use *Sojuz-Fregat* launcher

(II) To use the *Phobos-Grunt (Phobos-Soil-Return)* mission, as the baseline prototype, for the first phases of the Program

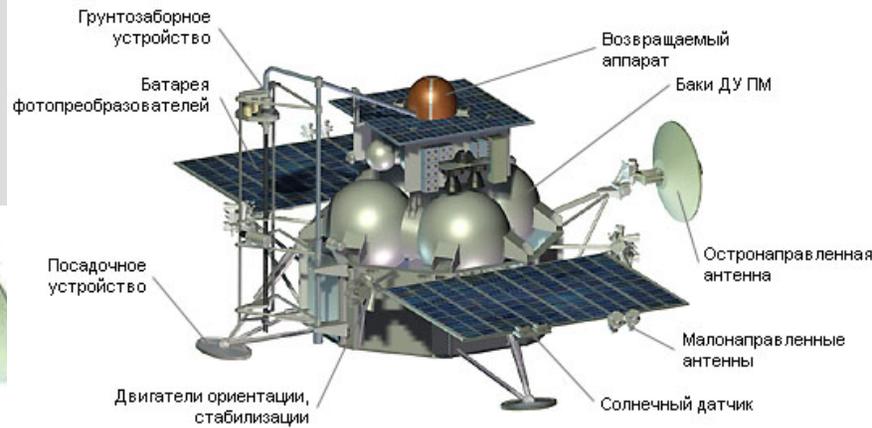
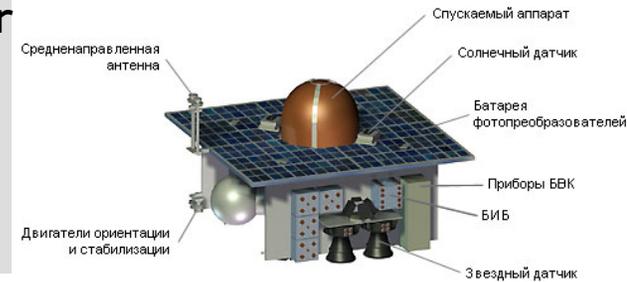
(III) To combine the heritage of Soviet *Luna* landers and *Lunohods* with the development of new technology for surface elements of the Program

# Comment about Phobos Soil Return mission:

There is a new spacecraft of the 4<sup>th</sup> generation for space science and interplanetary missions

The goals are to study Mars (from orbit), Phobos (*in situ*) and to make Phobos soil return

Launch is planned for 2009



Return vehicle

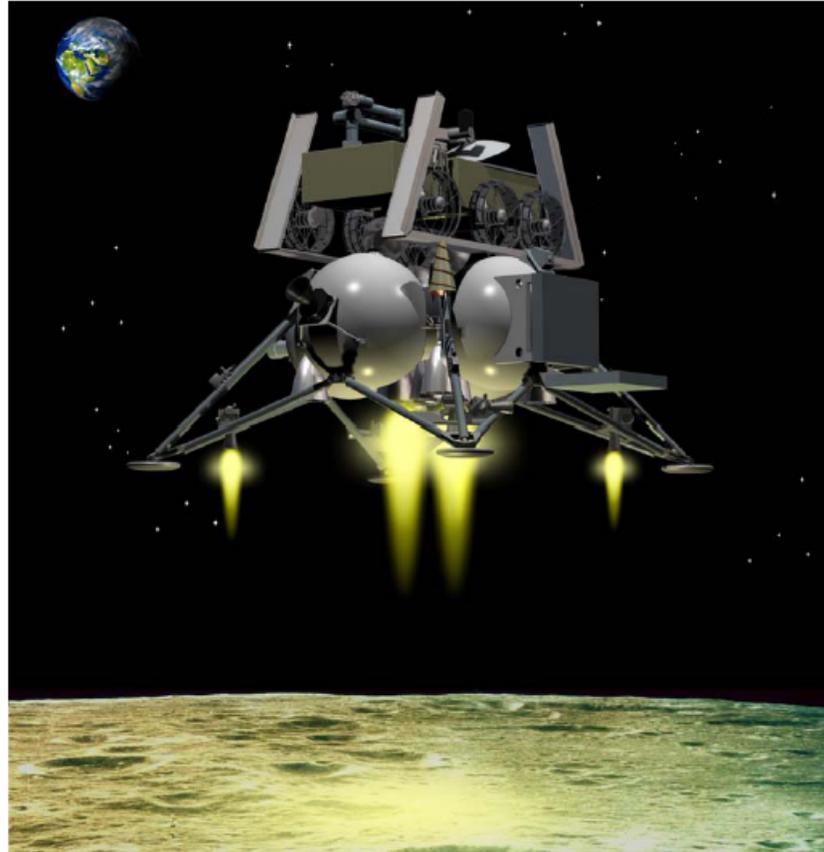
Lander



Cruise configuration



## **ROBOTIC LUNAR EXPLORATION PROGRAM**



G. Polischuk, K. Pichkhadze, A. Luk'yanchikov, V. Dolgopolov et al.



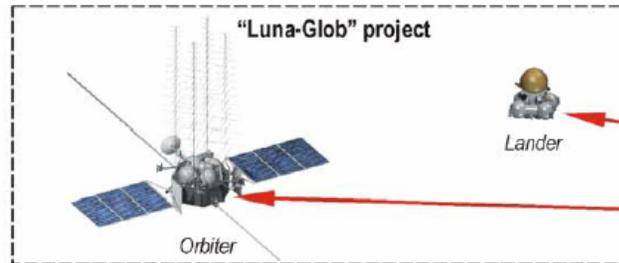
# FEDERAL SPACE AGENCY OF RUSSIAN FEDERATION

## LAVOCHKIN ASSOCIATION



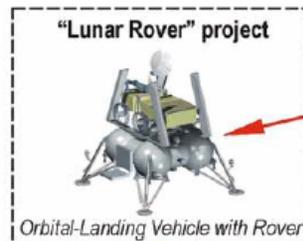
### 1-st phase:

Lunar internal structure exploration and lunar natural resources reconnaissance within the framework of orbital and landing missions



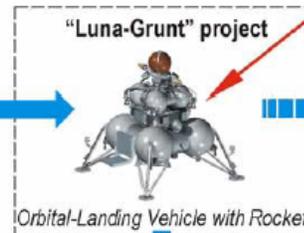
### 2-nd phase:

In-situ researches along the lunar rover movement route, samples collection and analysis



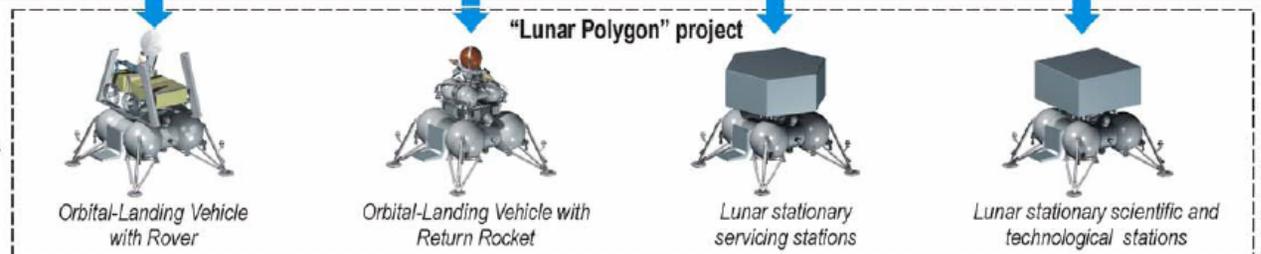
### 3-rd phase:

Lunar samples (collected by rover) return



### 4-th phase:

Creation on the Moon surface of a scientific-research base for development of principal methods for the Moon soil processing, delivery of the received samples and materials to the Earth and also for carrying out of a wide spectrum of scientific researches





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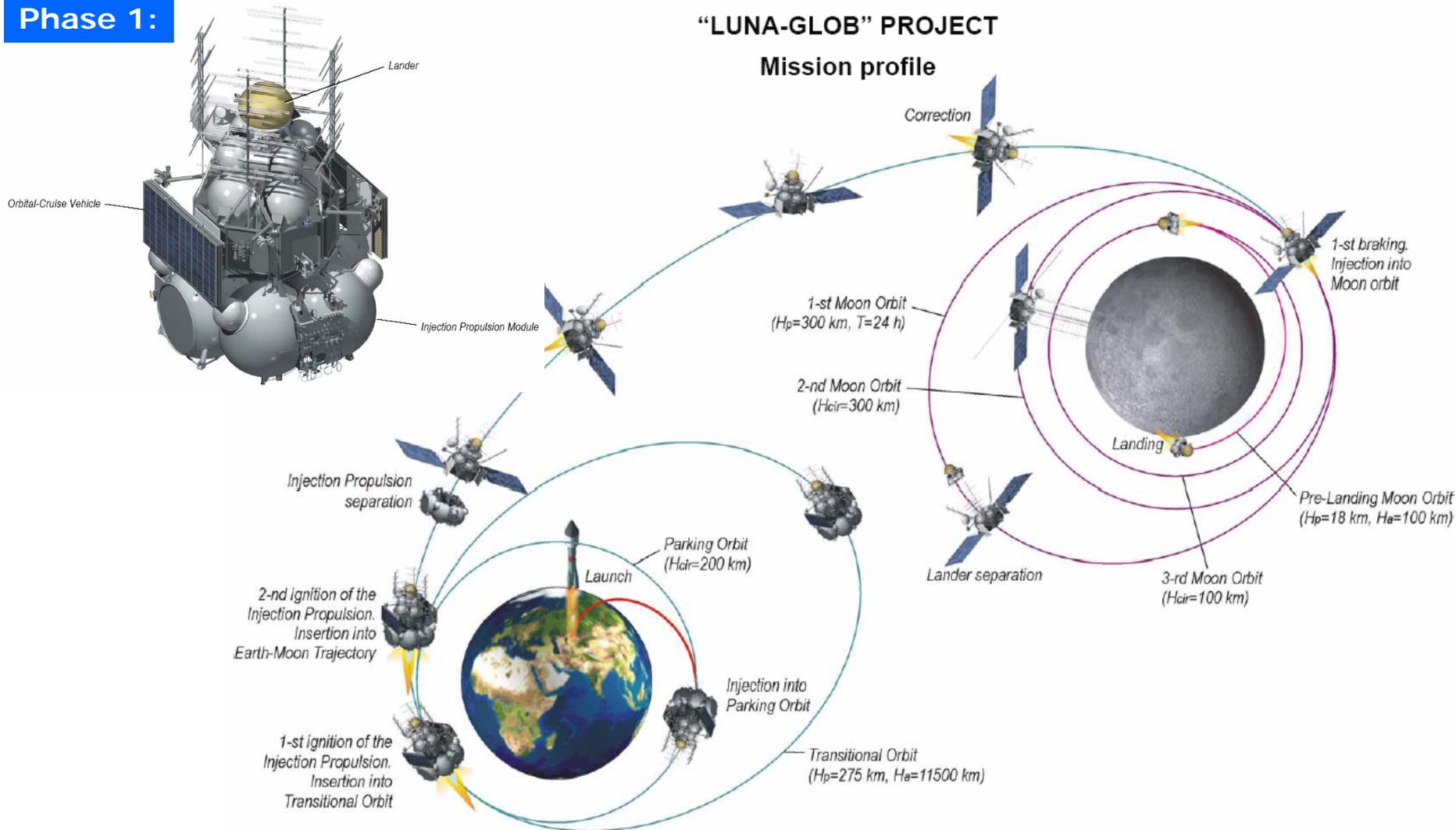
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### Phase 1:

### "LUNA-GLOB" PROJECT

#### Mission profile





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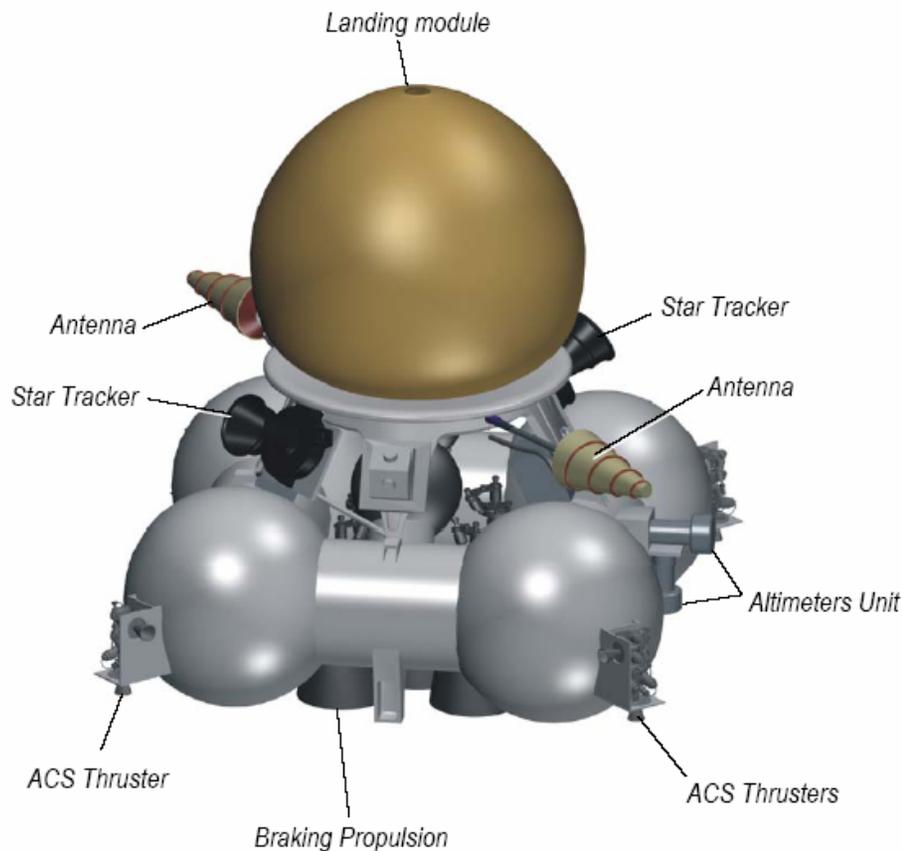
## LAVOCHKIN ASSOCIATION



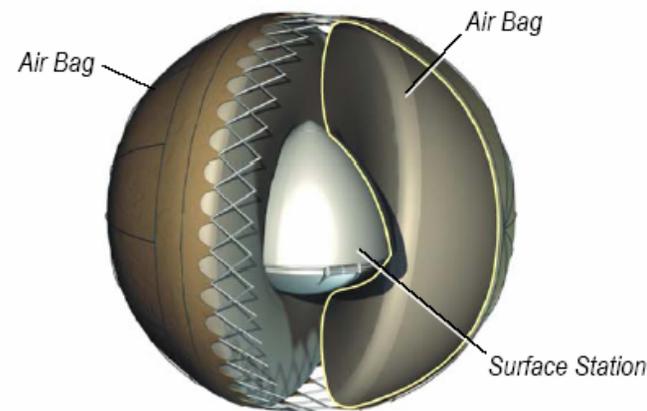
Phase 1:

### "LUNA-GLOB" PROJECT

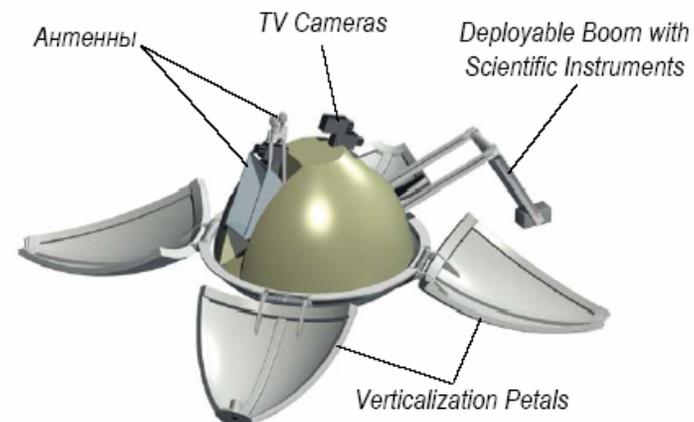
Lander launch configuration



Lander landing configuration



Lander surface configuration





**Phase 1: The Luna Glob mission:**

The mission is in the approved program of Space Exploration of FSA, the launch is scheduled for 2009-2010

There are three segments of the mission:

- orbiter (polar circular orbit 100 km)
- polar lander
- penetrators (TBD)

Science instrumentation for Orbiter (> 120 kg):

- surface remote sensing complex (gamma-rays, neutrons, visual, IR, radio)
- lunar space environment complex (plasma, particles, magnetic field)
- complex for fundamental astrophysics

Science instrumentation for Lander (> 5 kg):

- gamma-rays and neutrons
- panoramic view
- gas analyzer
- seismometer



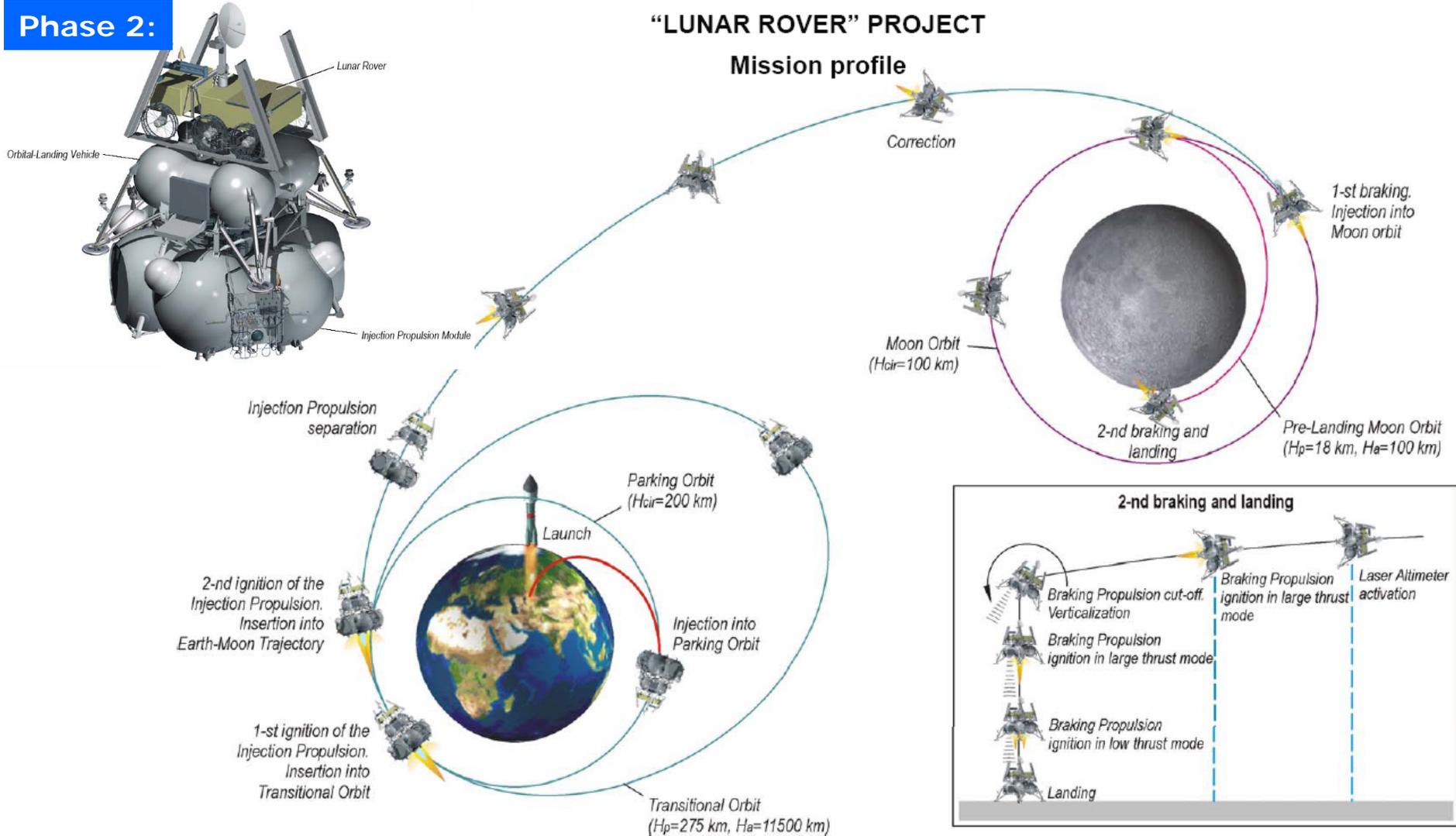
# FEDERAL SPACE AGENCY OF RUSSIAN FEDERATION LAVOCHKIN ASSOCIATION



## Phase 2:

## "LUNAR ROVER" PROJECT

### Mission profile





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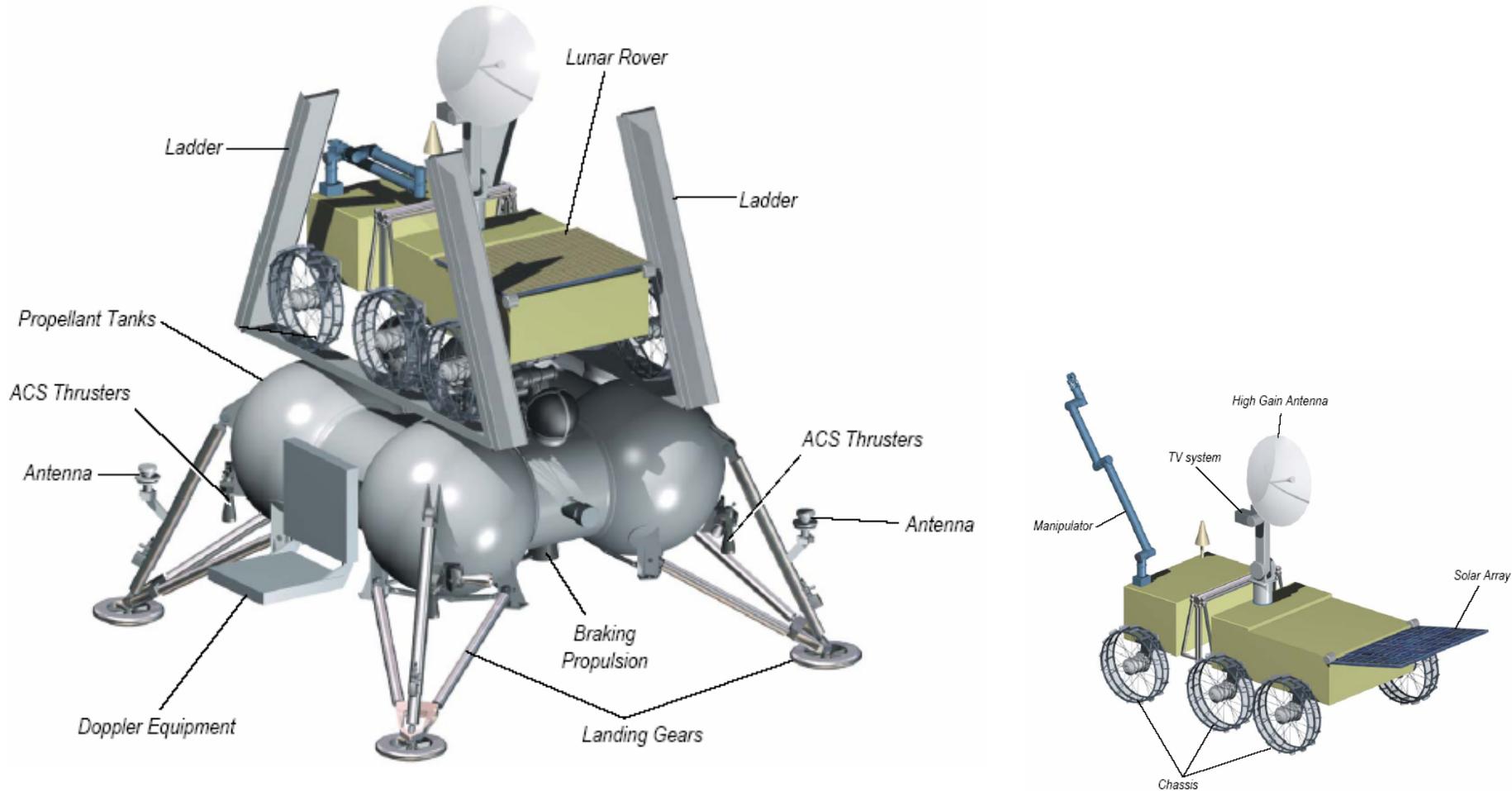
## LAVOCHKIN ASSOCIATION



Phase 2:

### “LUNAR ROVER” PROJECT

#### Spacecraft landing configuration



## ROBOTIC LUNAR EXPLORATION PROGRAM





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## LAVOCHKIN ASSOCIATION

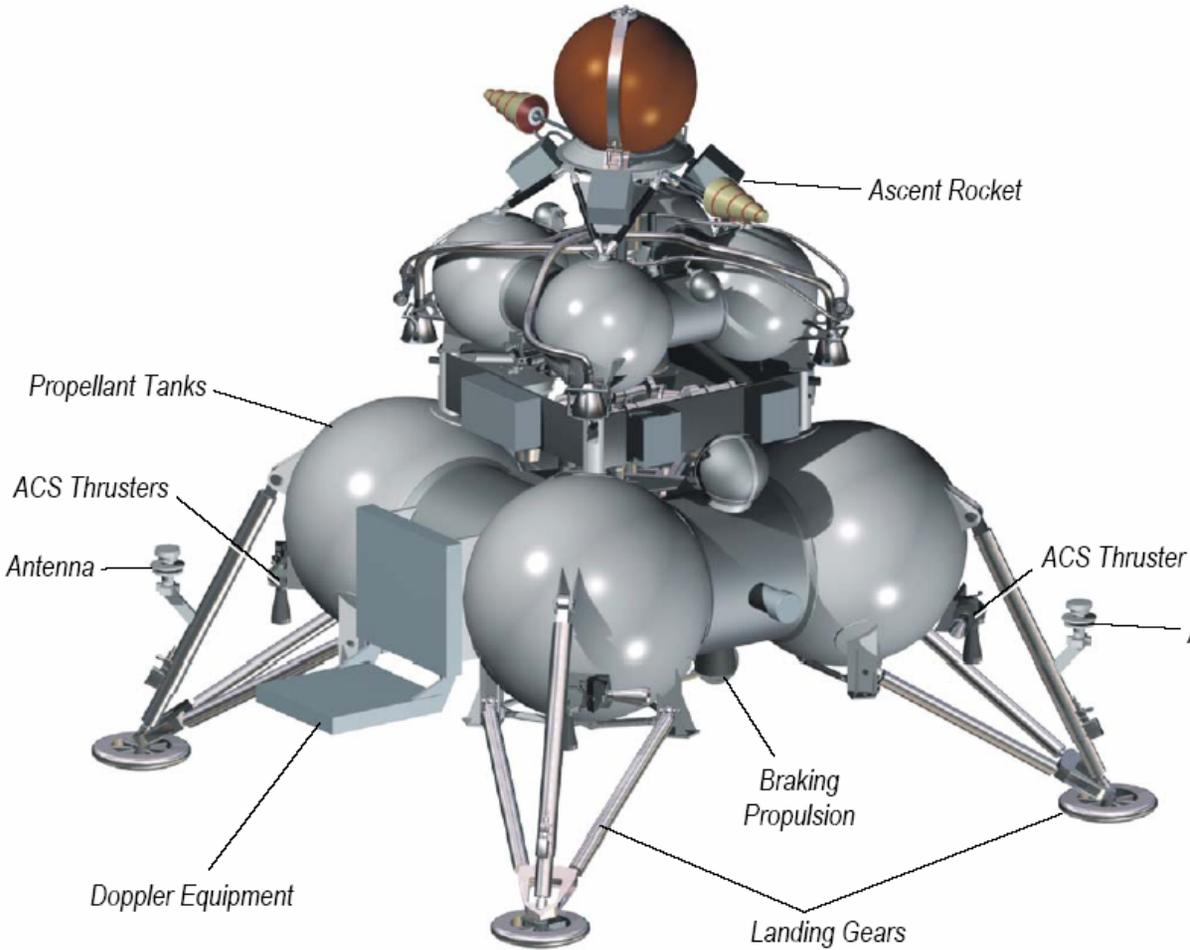
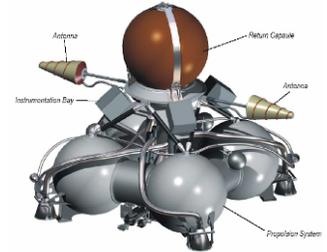


Phase 3:

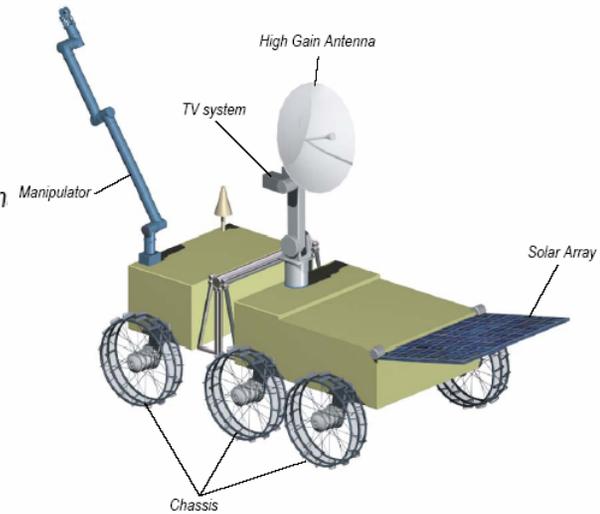
### “LUNA-GRUNT” PROJECT

#### Spacecraft landing configuration

“LUNA-GRUNT” PROJECT  
Ascent/ Return Rocket



Lunar Rover





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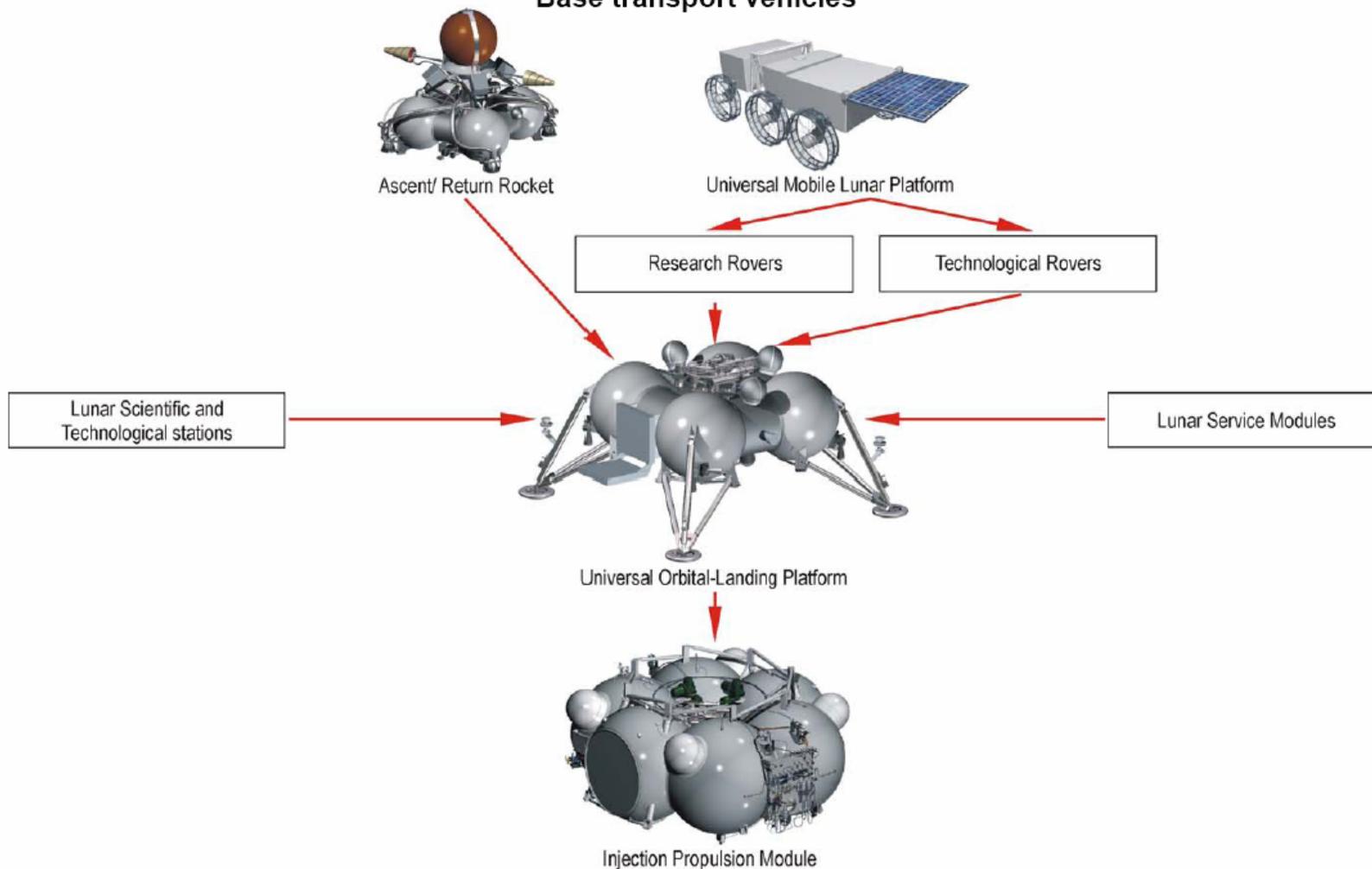
## LAVOCHKIN ASSOCIATION



Phase 4:

### “LUNAR POLYGON” PROJECT

#### Base transport vehicles





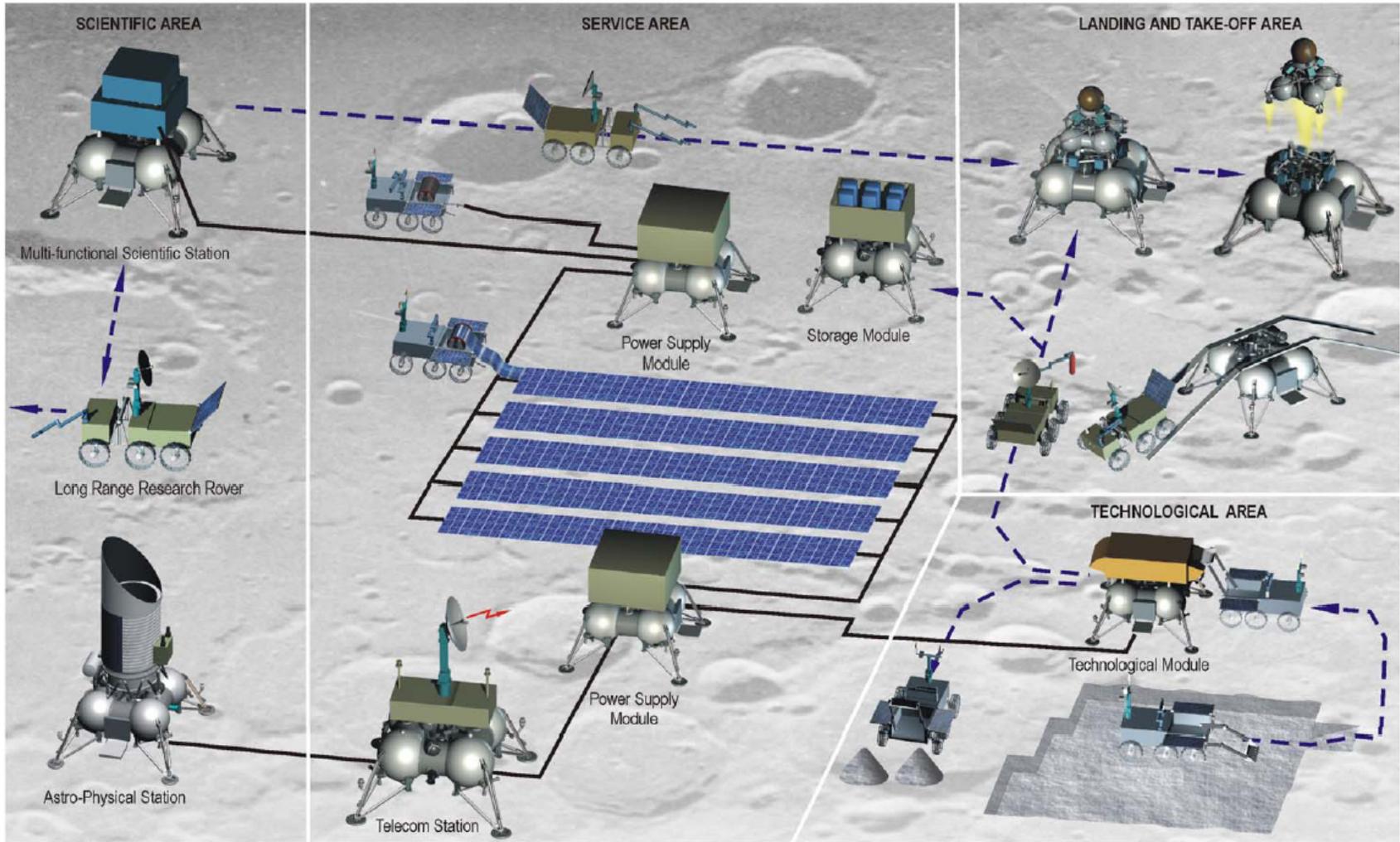
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Phase 4:

### “LUNAR POLYGON” PROJECT



## ROBOTIC LUNAR EXPLORATION PROGRAM

## Concluding Remarks

- (1) The Russian Robotic Lunar Exploration Program is in the discussion stage now, but the very first mission “Luna Glob” of the phase 1 of this Program is already in the approved part of the FSA Space Program. Expected launch date is 2009-2010.
- (2) Detailed concepts of the next missions for “Lunar Rover”, “Lunar Grunt” and “Lunar Polygon” will be determined when the first phase of the Program will be accomplished. The next decade is the time frame for these phases 2-4.
- (3) However, three major cornerstones are quite well determined for the Program:
  - medium-class launchers (*Sojuz-Fregat*) will be used,
  - interplanetary vehicles with similar subsystems (*Phobos-Soil-Return*) will be used,
  - new surface elements will be developed, based on the existing heritage of old time *Lunas* and *Lunohods*.