KLEP and KPLO

Korea Aerospace Research Institute
Lunar Exploration Program Office
169-84, Gwahak-ro, Yuseong-gu, Daejeon 34133, Korea

Introduction to Korea Lunar Exploration Program and KPLO Mission

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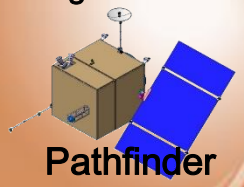
Korea Aerospace Research Institute

KLEP(Korea Lunar Exploration Program) Overview

KARI 한국항공우주연구원 Korea Aerospace Research Institute

1st Phase: Korea Pathfinder Lunar Orbiter Mission

- Technology demonstration for lunar missions
- Lunar sciences
- New technology demonstration (DTN)
- International cooperation
- Use foreign launch service



Pathfinder Lunar Orbiter

2nd Phase: Lunar Orbiter and Lander Mission

- Lunar orbiter, lander mission
- Lunar lander includes a rover
- Use Korean launch vehicle

Lunar Orbiter

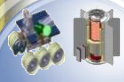
Lunar Lander

Payloads [1st Phase]

- Lunar science payloads
- International payloads
- Space internet (DTN)

Ground Station

- Deep-space antenna
- Tracking and navigation
- Science/Imaging data processing
- TM & TC Operation

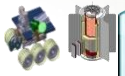


Payloads [2nd Phase]

- Lunar Resources
- Topography
- Space Environment

LV Upper stage

- TLI insertion
- 550kg to TLI



Preliminary Study

- Lunar rover technology
- Energy technology(RTG)
- Launch vehicle upper stage technology
- Lunar landing technology

KPLO(Korea Pathfinder Lunar Orbiter) Mission Overview

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Program Overview

Goal	Enhancement of the lunar exploration technology and science research
Orbit	Polar orbit 100km
Mass	550kg
Mission lifetime	1 year
Target Launch date	End of 2018

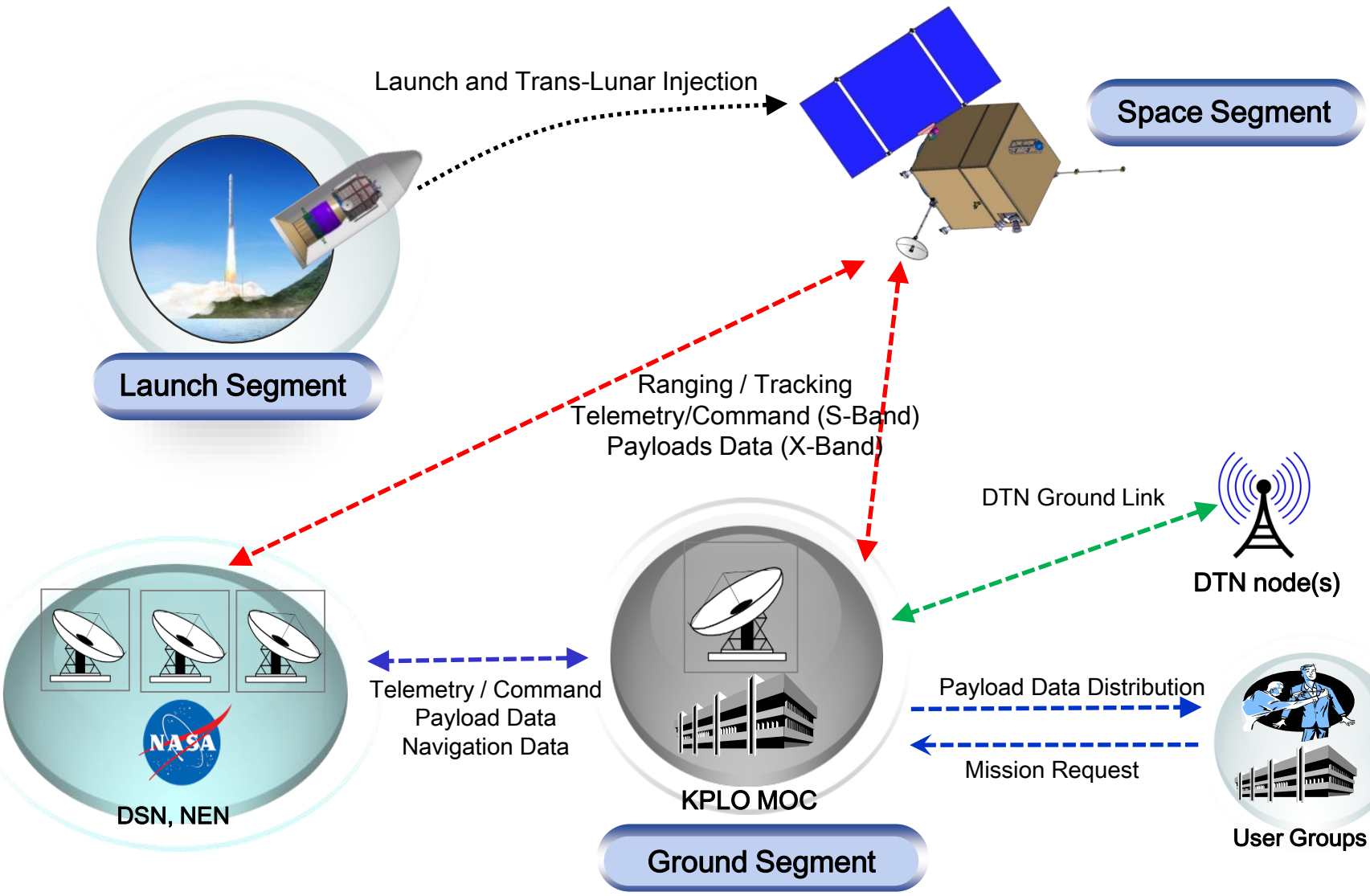
Main Contents

- System and Bus development
- Building a Ground-station for deep space mission
- Scientific instruments (Domestic/International)
- Space internet demonstration

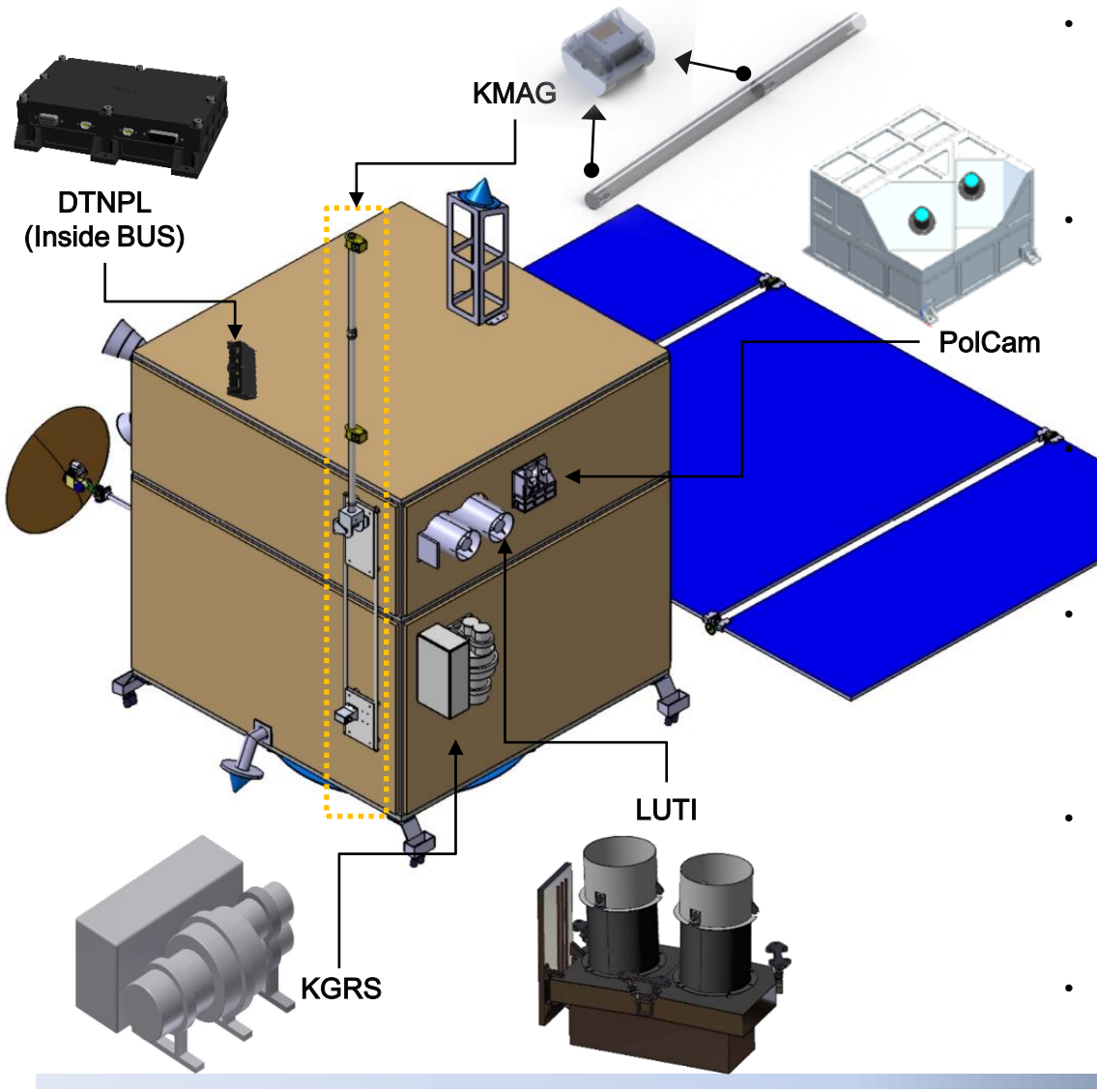
KPLO Mission Objectives

1. Developing indigenous lunar exploration technologies
   - Developing lunar exploration technologies (orbiter bus, lunar orbit insertion, operation, tracking, communication, navigation)
   - Building DSN Ground-station
2. Scientific investigation
   - Lunar topography
   - Scientific investigation on lunar environment and resources
3. Realizing space new technologies
   - Demonstration Space internet

Top Level System Architecture

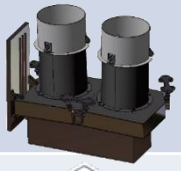
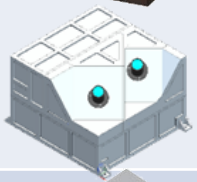
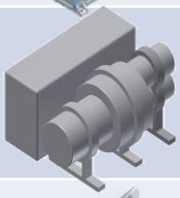
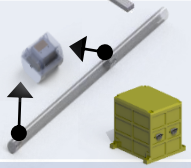


KPLO Instruments Summary



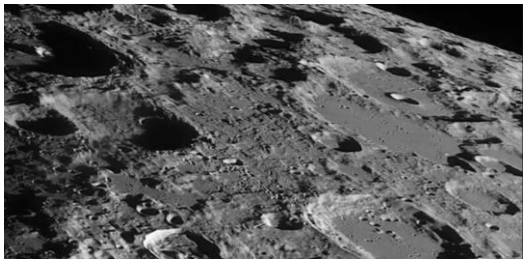
- **Lunar Terrain Imager (LUTI)** – LUTI will take images of probable landing sites for the 2nd stage lunar exploration mission and special target sites of the lunar surfaces with a high spatial resolution (<5m)
- **Wide-Angle Polarimetric Camera (PolCam)** – PolCam will acquire the polarimetric images of the entire lunar surface except for the polar regions with medium spatial resolution in order to investigate the detailed characteristics of lunar regolith.
- **KPLO Magnetometer (KMAG)** – KMAG will measure the magnetic strength of the lunar environment (up to ~100km above the lunar surface) with ultra-sensitive magnetic sensors.
- **KPLO Gamma Ray Spectrometer (KGRS)** – KGRS will investigate the characteristics of lunar resources including rare elements, minerals, etc., and map the spatial distribution of the elements.
- **Disruption Tolerant Network experiment payload (DTNPL)** – DTNPL will take space communication experiment based on disruption tolerant network technology.
- **NASA Provided Instrument(s)** will be selected through NASA/AO process.

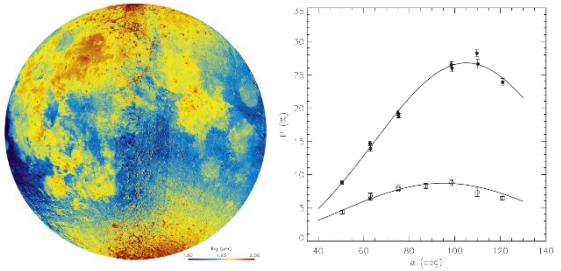
Korean Domestic Instruments

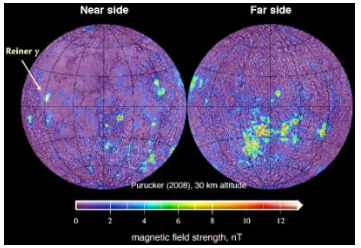
Instrument	Measurement	Exploration Benefit	Science Benefit
LUTI (KARI+) 	<5m resol images of selected regions of lunar surface	Future landing site for the next lunar mission	Geology, Topology of the lunar surface
PolCam (KASI+) 	First polarimetric map of near-/far-side of the moon	Effect of lunar soil on electro-mechanical parts of landing module	Characteristics of lunar regolith, Space weathering process
KGRS (KIGAM+) 	Map of major elements (Mg, Ni, Cr, Ca, Al, Ti, Fe, Si, O, U, He-3, Water)	Better knowledge of space environments; Radiation environment for manned mission	Distribution of lunar resources; Water/mineral contents
KMAG (KHU+) 	3D map of lunar magnetism, magnetic information of lunar swirls	Better knowledge of space environments	Origin of the Moon, Lunar magnetic evolution
DTNPL (ETRI+) 	Technical demonstration payload for experimental testing of Disruption Tolerant Network technology in space	Effective communications in delay / disruptive condition in deep space exploration	N/A

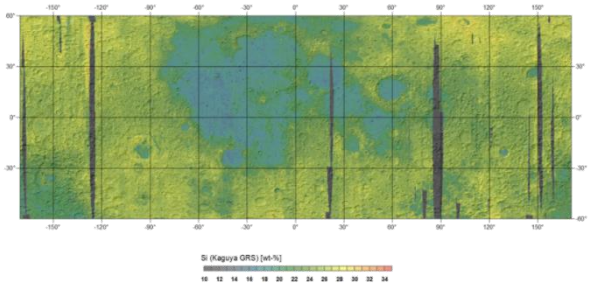
Instrument-Directed Science Goals

- LUTI
  - Obtain high-resolution images of future landing sites (2nd stage Korean Lunar Exploration Mission)
  - Target observation of interesting places on the Moon
- PolCam
  - Polarimetric imaging survey of the entire lunar surface except for the pole regions at various phase angles (0°~120°) and spectral bands (320, 430, 650nm)
  - Investigate the characteristics of lunar regolith and Ti contents (varying latitude, longitude, mare & high-lands)
- KMAG
  - Investigate the origin of the crustal magnetism of the Moon (Impact/Dynamo, etc.)
  - Characteristics of the lunar magnetic anomalies
- KGRS
  - Map the distribution of major elements on the lunar surface and the beneath of the surface (up to 50cm)
  - Geological and geochemical activities of the Moon
  - Obtain radiation map of lunar environment









Ground Segment

Goal

- Establish Korea DSN Antenna(26~34m) compatible with Worldwide DSN in Korea
- Implement an Operational Ground Station for TC/TM & Science Data Processing

Payload Data Processing

- Multi-Payloads Data Storage & Pre-Processing
- Science & Image Data Processing & Management
- Payloads Data Calibration & Validation

Simulator

- Orbiter/Lander Simulation

DSN

- Multi-band Large Antenna Design
- Ranging for Moon & Deep Space
- Protocol Design compatible with NASA DSN/ESA ESTRACK
- Modulation/Demodulation & Coding for Deep Space

Spacecraft Control

- CCSDS
- Telemetry Data Real-time Processing
- Telecommand Generation & Processing

Mission Planning

- Mission Req. Collection & Scheduling
- Mission Conflict Detection & Re-Scheduling
- Orbiter/Lander Timeline Generation & Distribution

Flight Dynamics & Navigation

- Tracking Data Processing
- Orbit Determination & Prediction
- Orbit Maneuver(TLI , MCC & LOI)
- Sensor Calibration

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Thank you