

# Europa Lander Mission Concept Overview

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Jet Propulsion Laboratory

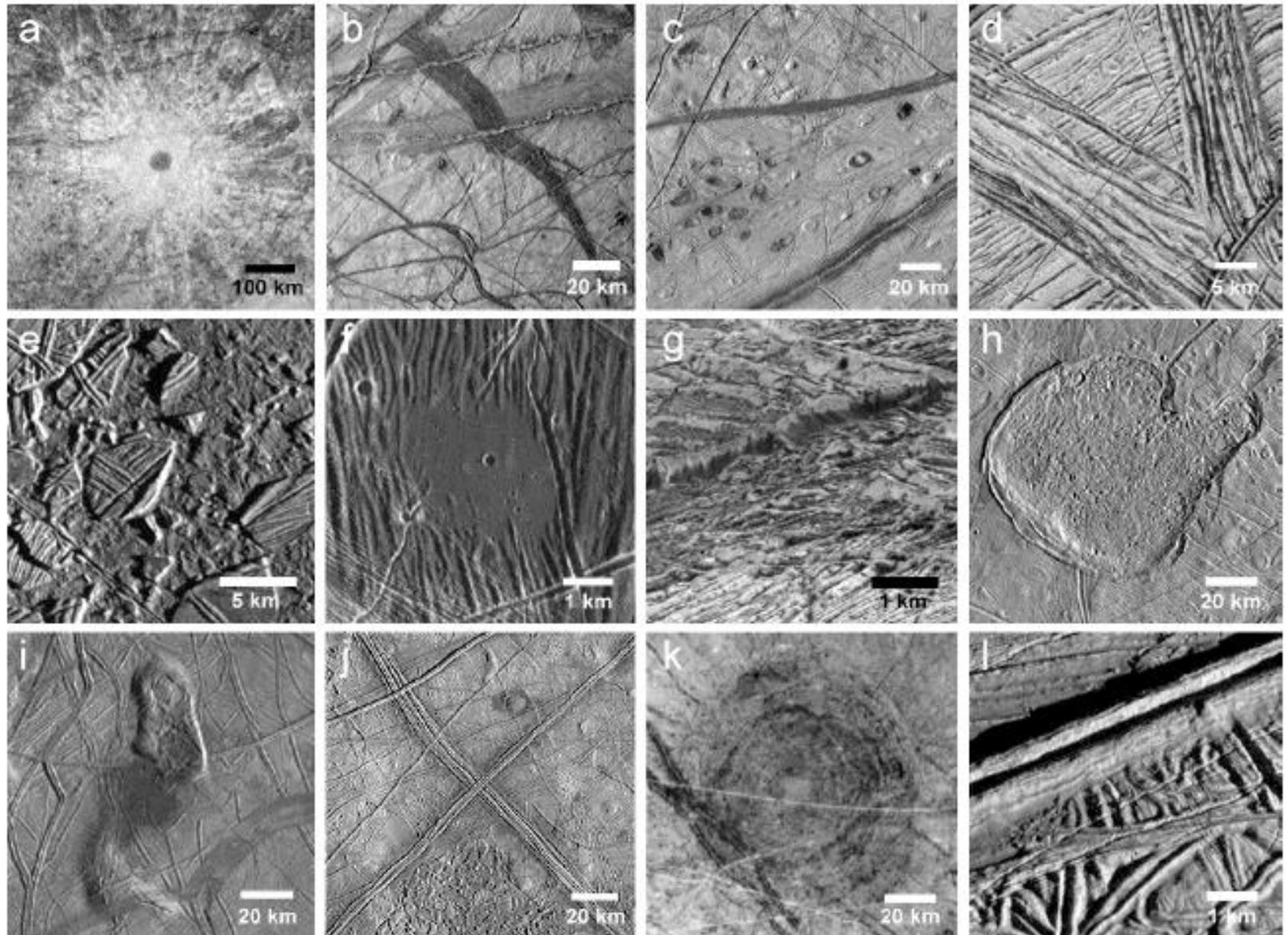
California Institute of Technology, Pasadena CA USA

14<sup>th</sup> International Planetary Probe Workshop

The Hague, The Netherlands – June 2017



# Galileo Images Show Europa Having Rugged, Unusual Terrain



# EUROPA

CHARGED PARTICLES

SUNLIGHT

IMPACTS

PLUME MATERIALS

SURFACE

PLUME DEPOSITS

CHAOS, LINEAE  
EXTENSIONAL FEATURES

OVERTURNED  
BLOCKS

ICE

ICE FRACTURES  
& VEINS

DIAPIRS

~10 km

OCEAN

OCEAN CURRENTS

~100 km

ROCK  
INTERIOR



ICE BLOCKS



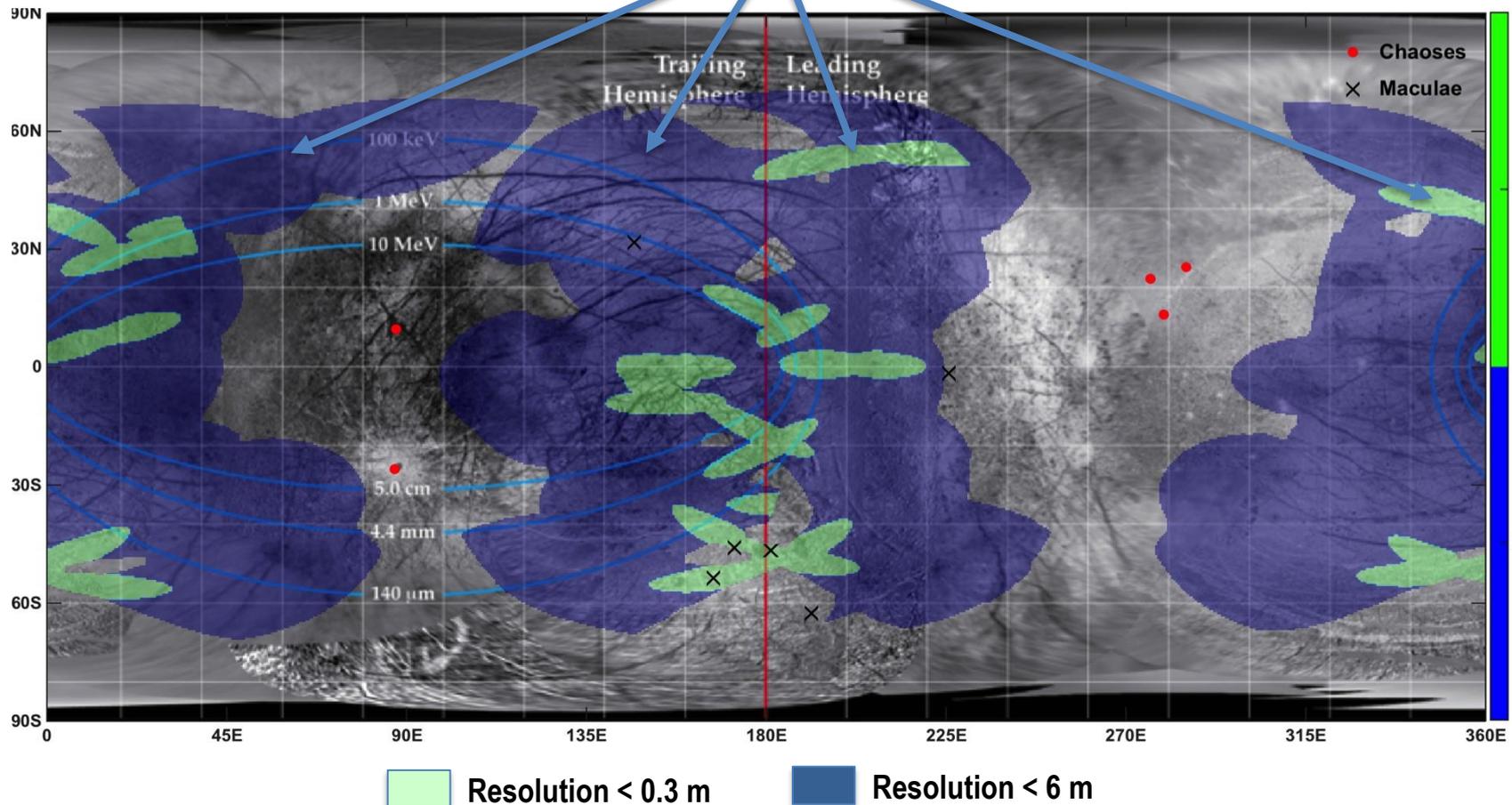
ICE FRACTURES



HYDROTHERMAL VENTS

# Proposed Europa Lander would use Reconnaissance from NASA's Planned Europa Clipper Mission

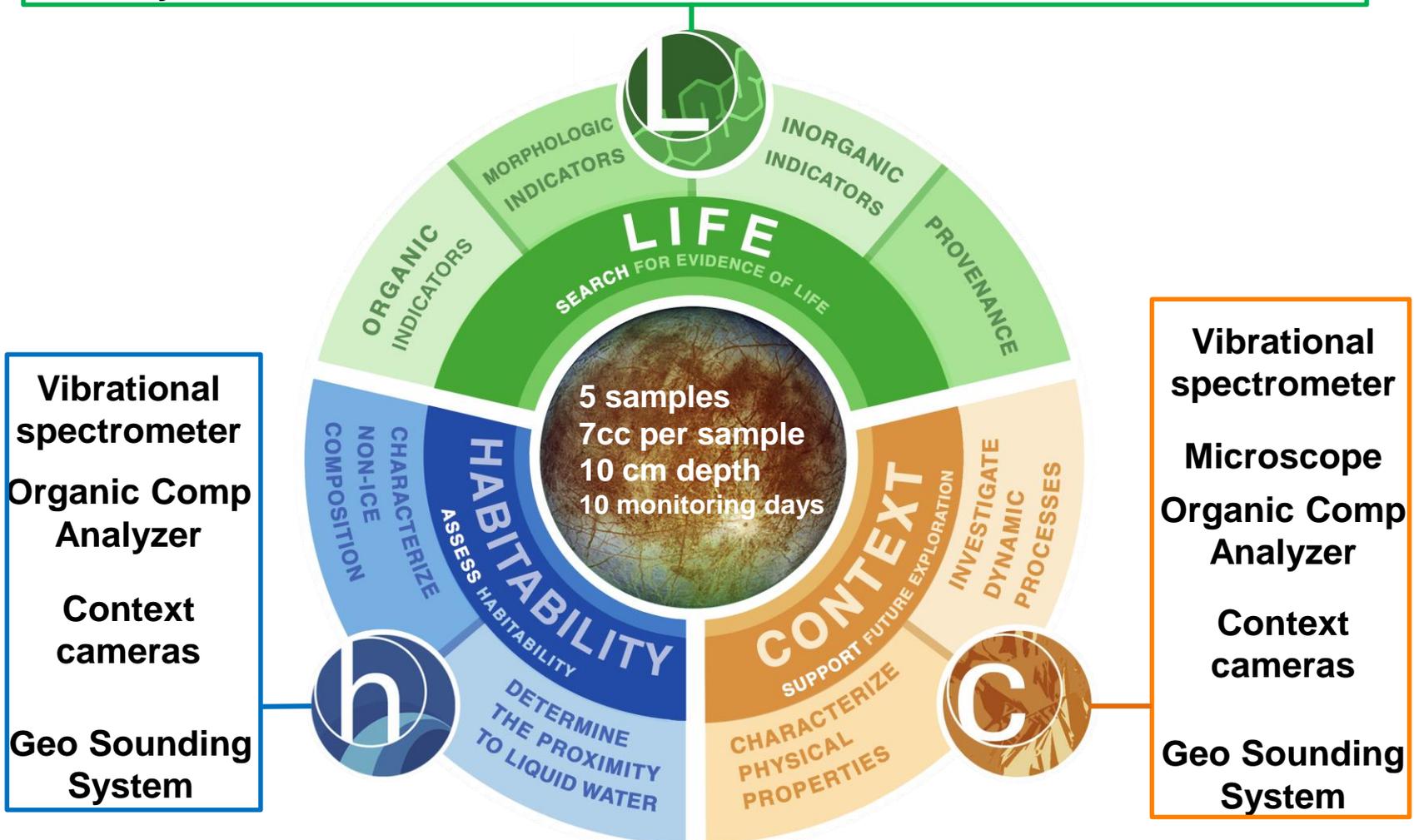
Blue/Green shaded areas represent potential Clipper data with sufficient coverage and resolution for landing site characterization



Pre-Decisional Information — For Planning and Discussion Purposes Only

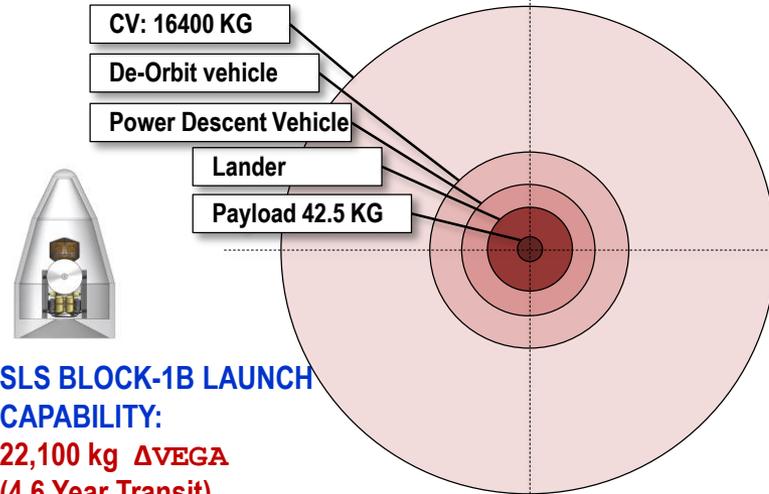
# A Connected Set of Goals & Objectives

Organic Comp Analyzer    Microscope    Vibrational spectrometer    Context cameras



# Europa Lander Concept - Four Significant Driving Challenges

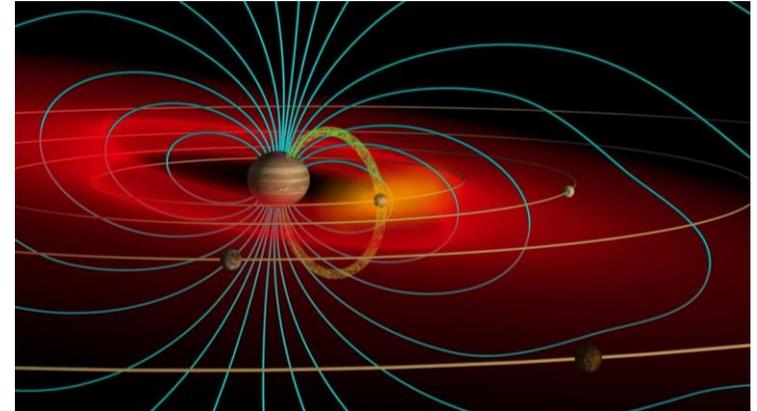
## 1 - Launch Mass:



SLS BLOCK-1B LAUNCH CAPABILITY:

22,100 kg  $\Delta$ VEGA  
(4.6 Year Transit)

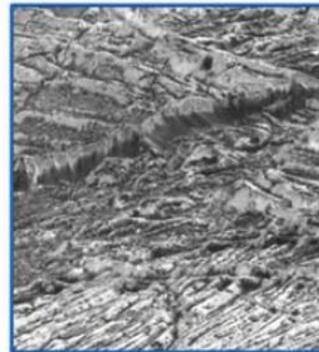
## 3 - Jovian Radiation Environment:



- Drives short surface mission duration ~ 30 day Relay Orbiter
- Vaults provide a 150 krad environment

## 2 - Surface Topography & Properties:

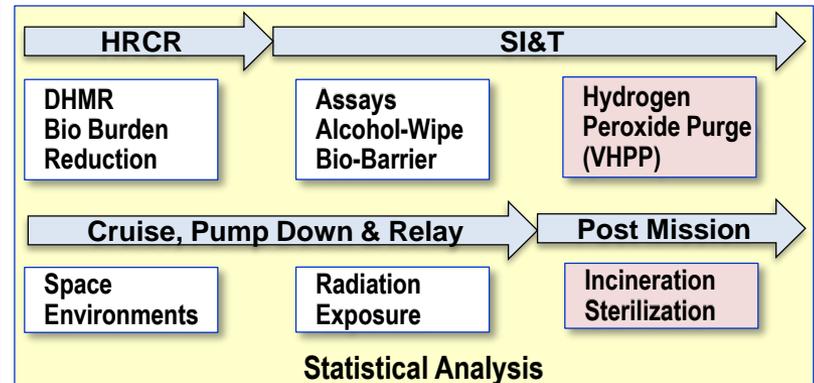
- Clipper Reconnaissance
- Soft Landing
- Pin Point Landing with TRN
- Hazard Detection & Avoidance
- Adaptive Stabilizers AKA Cricket
- Site Simulation – Phase A/B
- Site Selection – Phase C/D/E
- Site Certification – Phase E



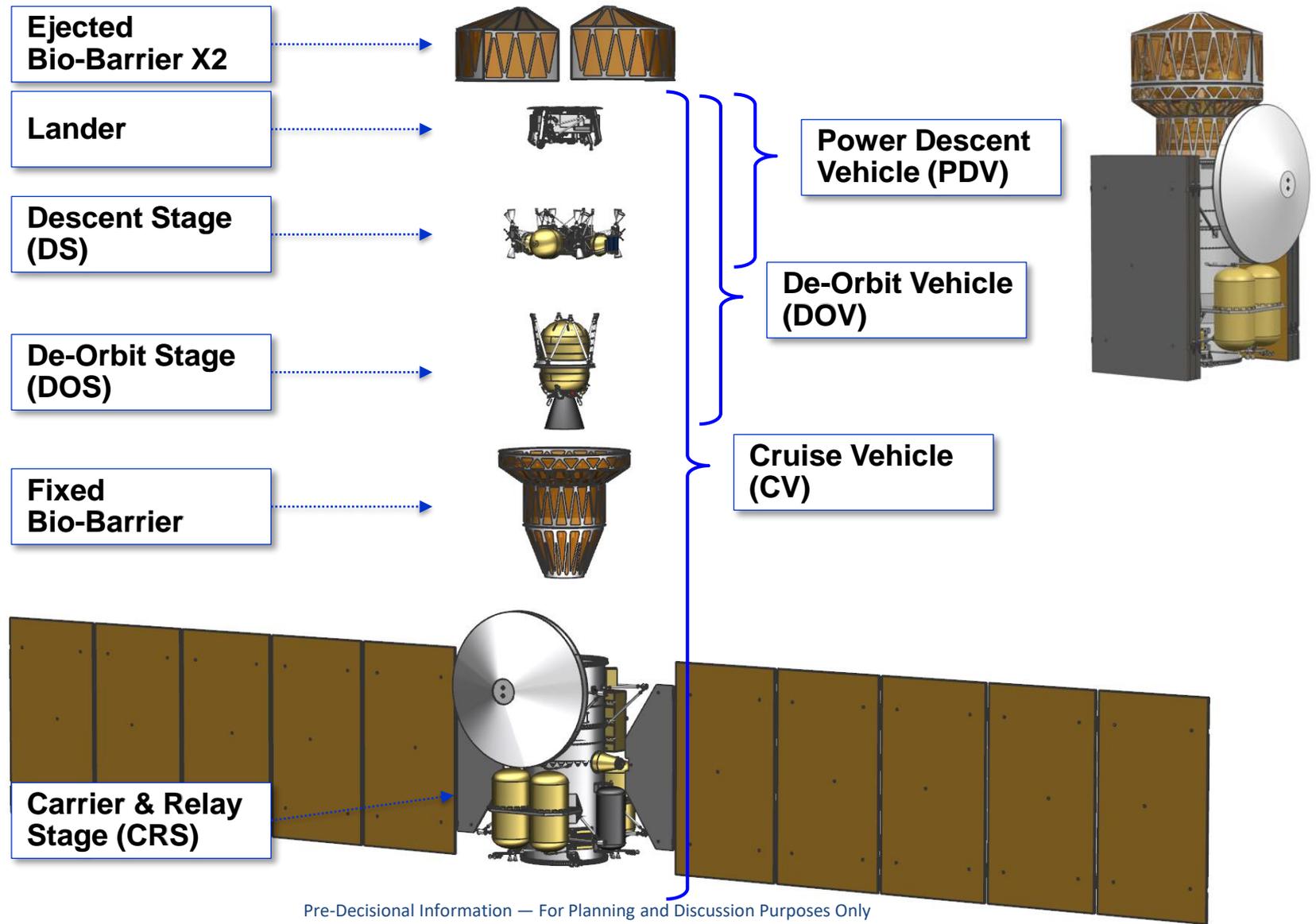
Europa Rough Topography at 10 and 12 m/pixel Drives Landing Safety

## 4 - Planetary Protection:

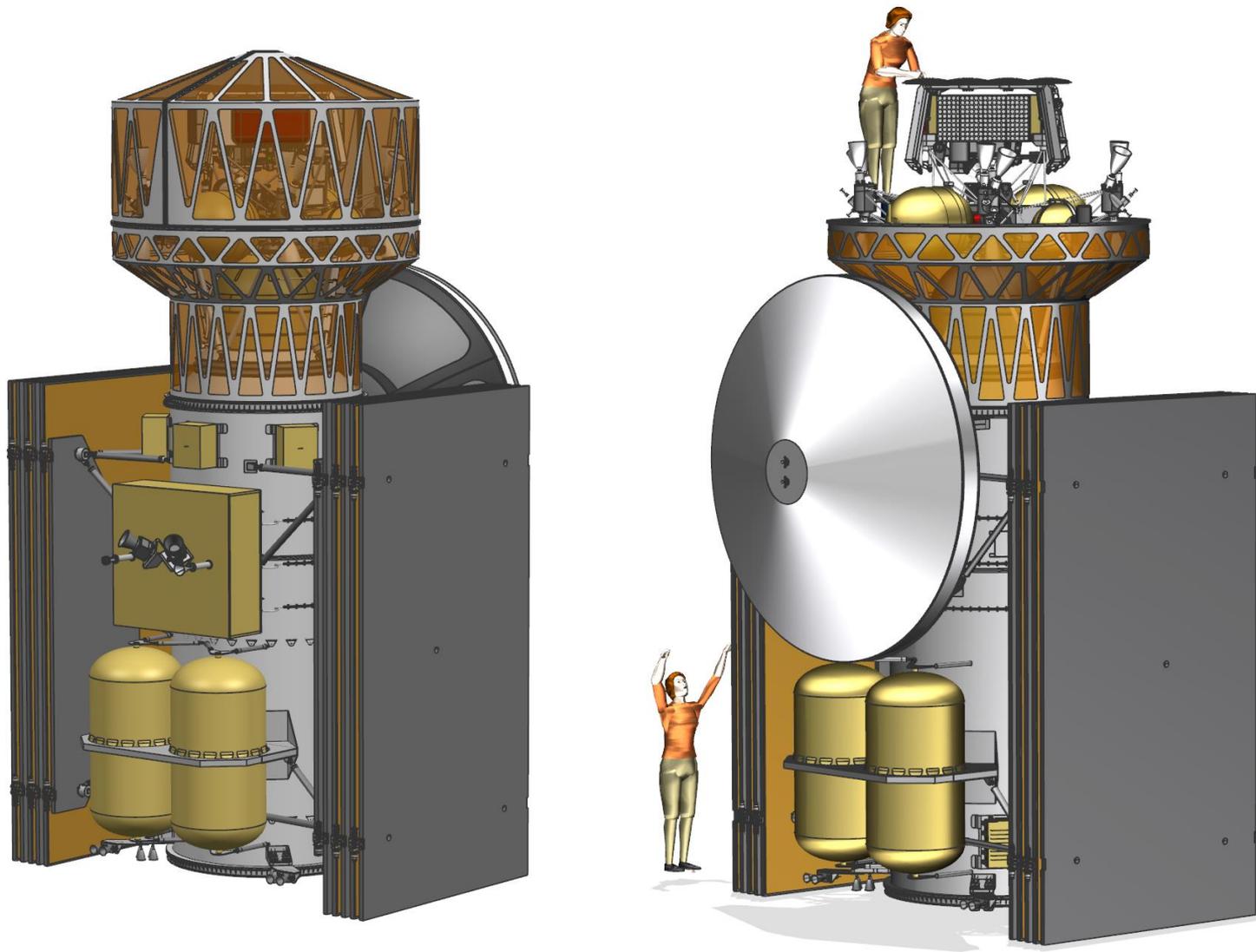
*Europa Lander would have to satisfy strict Planetary Protection requirements – Drives System Integration and Test*



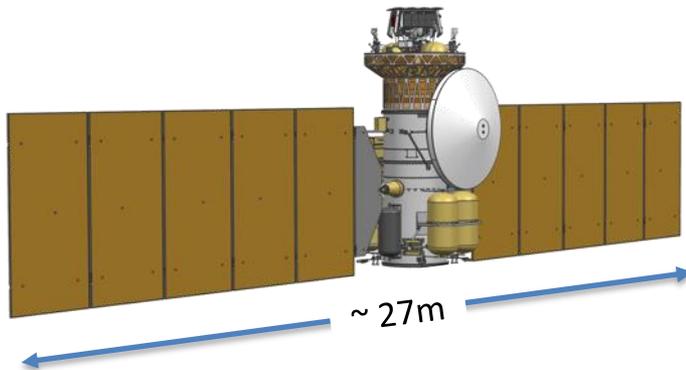
# Europa Lander Concept - Flight System Launch Assembly & Nomenclature



# Europa Lander Concept - Spacecraft Launch Configuration



# Europa Lander Concept - Cruise Configuration

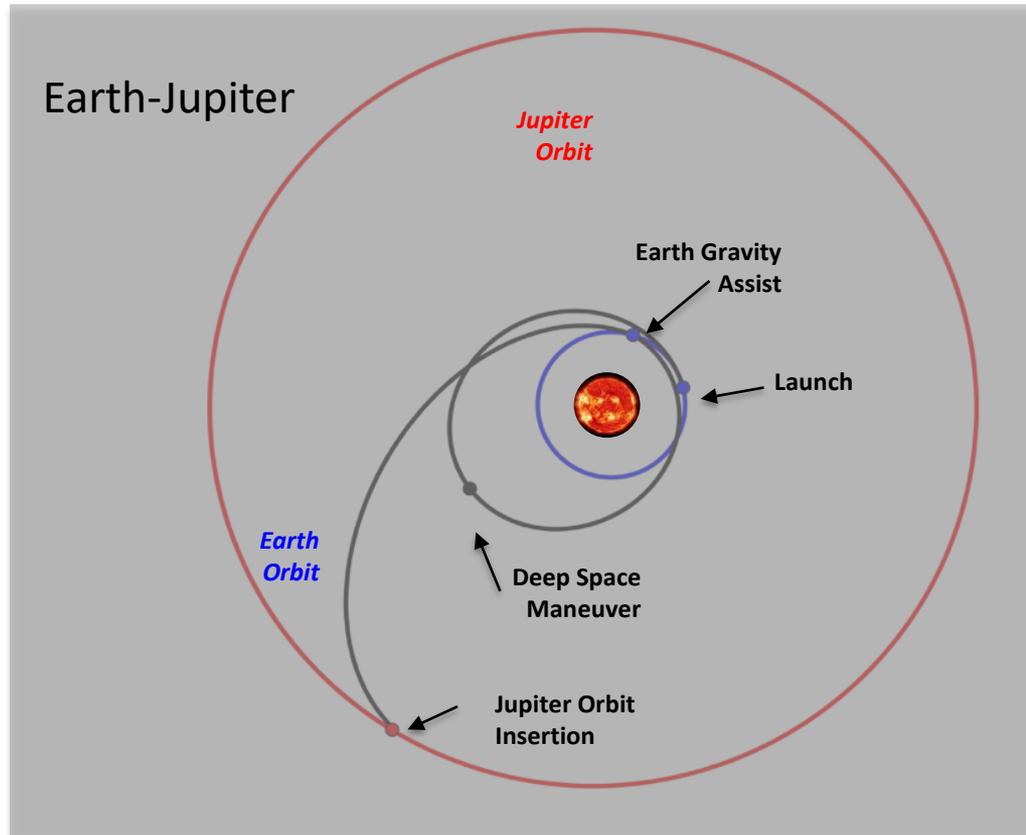


## CRS Fact Sheet

Array Size	117 m <sup>2</sup>
Array Output @ L-30 d	1200 W
Array Output @ L-0 d	1100 W
Array Output @ EOM	900 W
Communications	3m HGA X-band, 50W
Total CRS $\Delta V$	2660 m/s

- Clipper-like operations
  - Launch/Cruise
  - DSM
  - JOI
  - Much of Pump Down
- Passive thermal design
  - No HRS loop
- All vehicles powered on via CRS throughout cruise
  - Temperature control
- Ability to do checkouts, comm checks, etc.

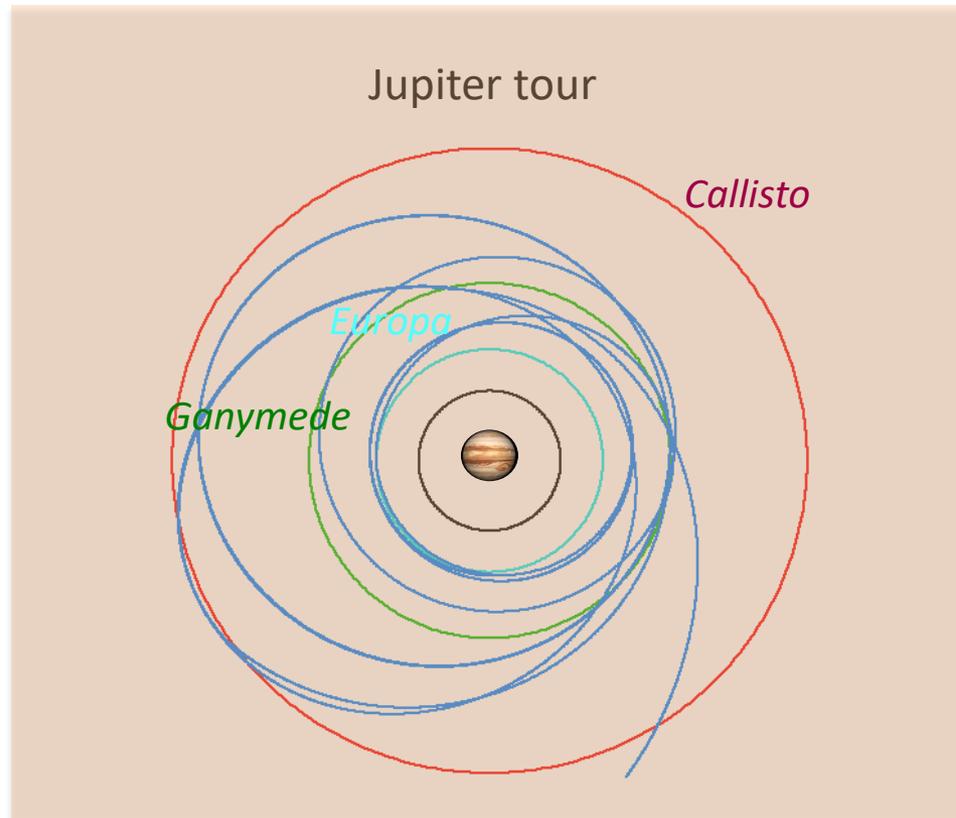
# Mission System Concept



## Mission Phases:

1. Launch
2. Interplanetary Cruise
3. Pump Down
4. Endgame
5. De-Orbit, Descent & Landing
6. Surface Mission & Relay
7. Sampling
8. Disposal

# Mission System Concept



## Mission Phases:

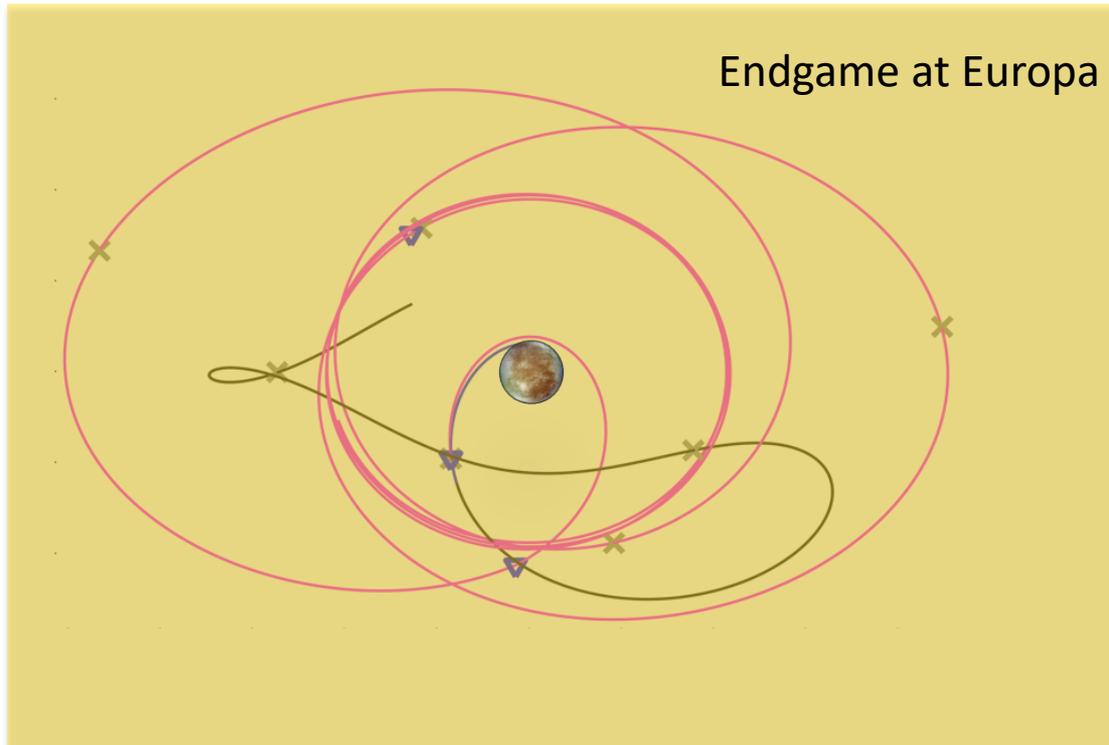
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# Mission System Concept



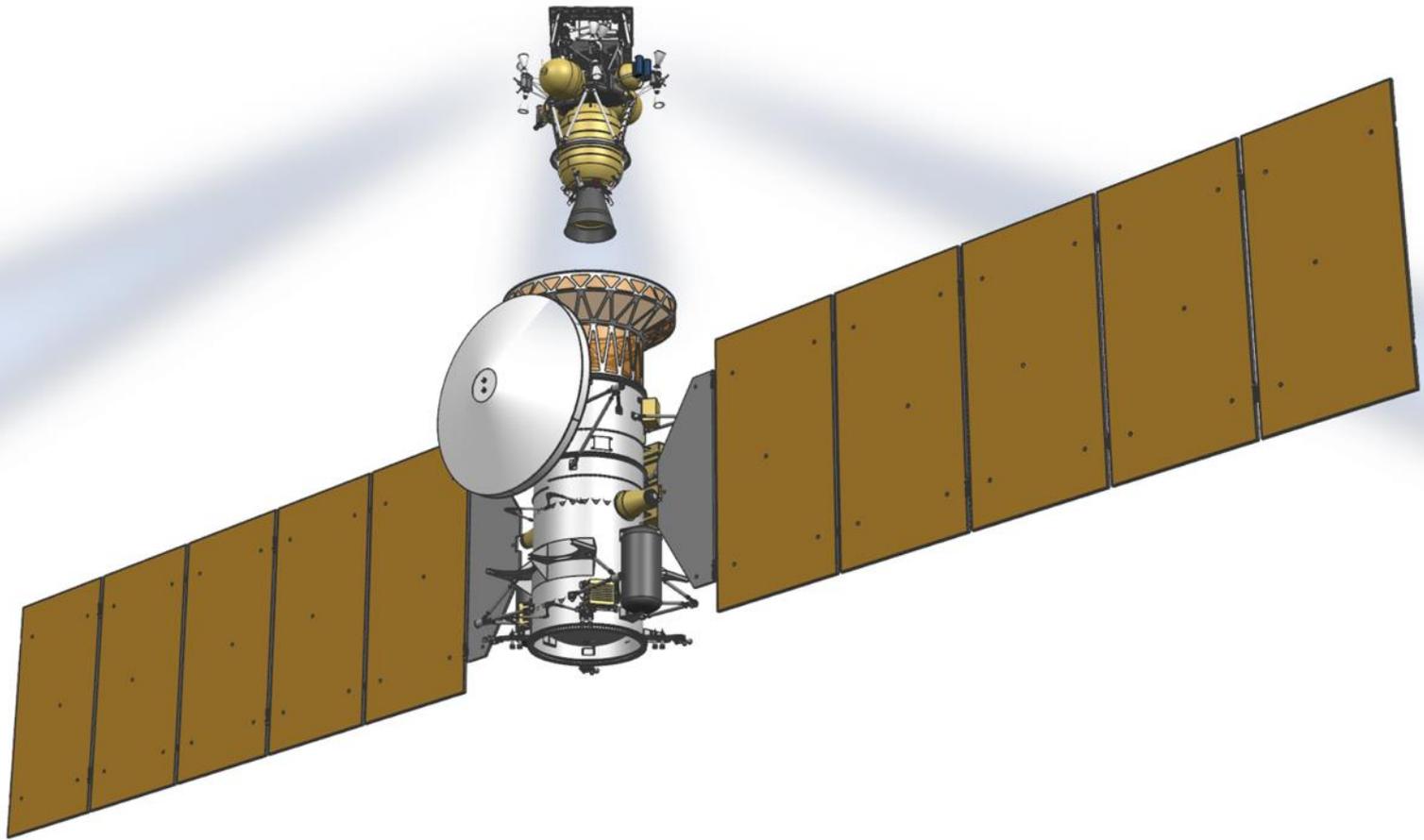
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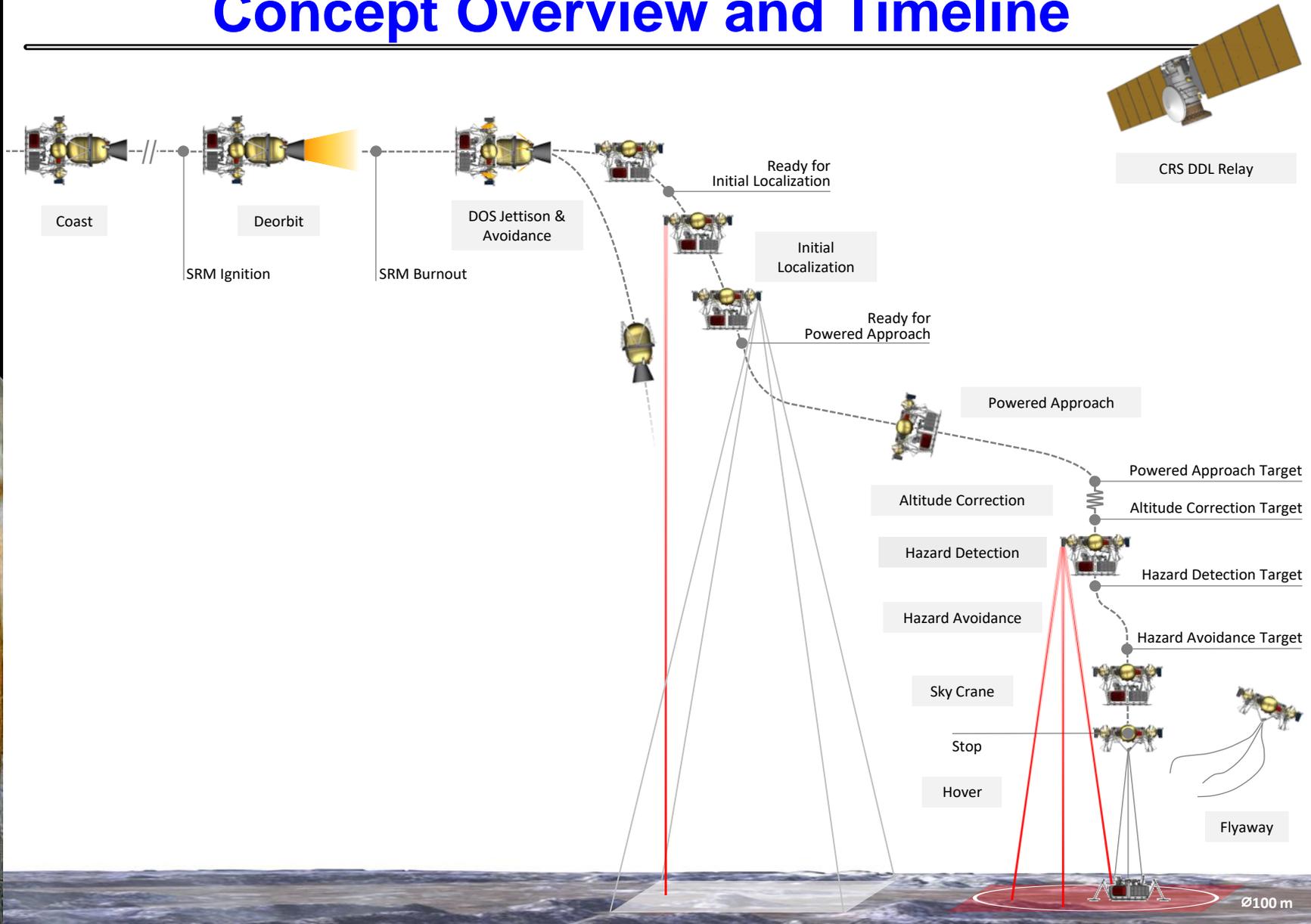


# Europa Lander Concept - Lander Separation

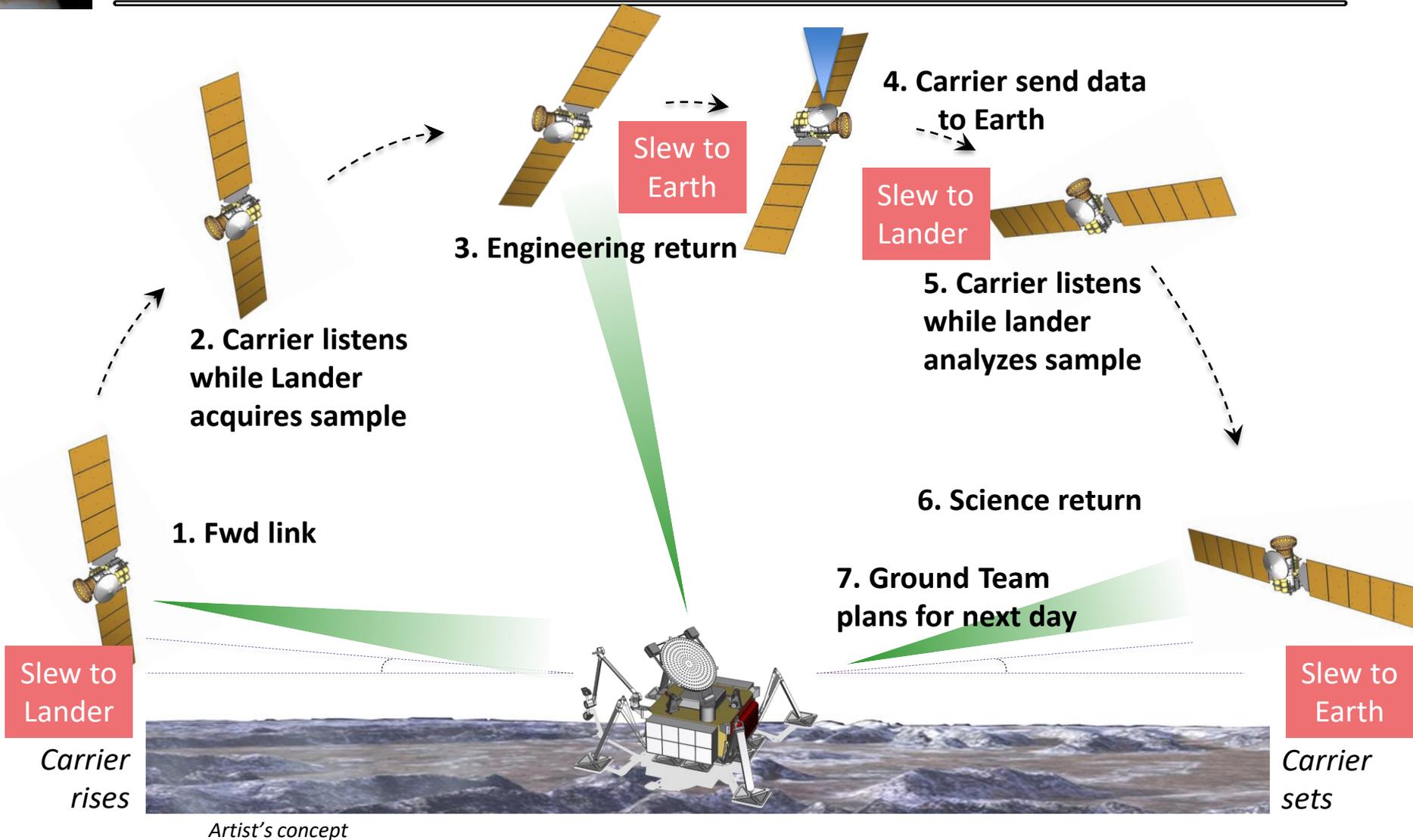
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# De-Orbit, Descent and Landing (DDL) Concept Overview and Timeline

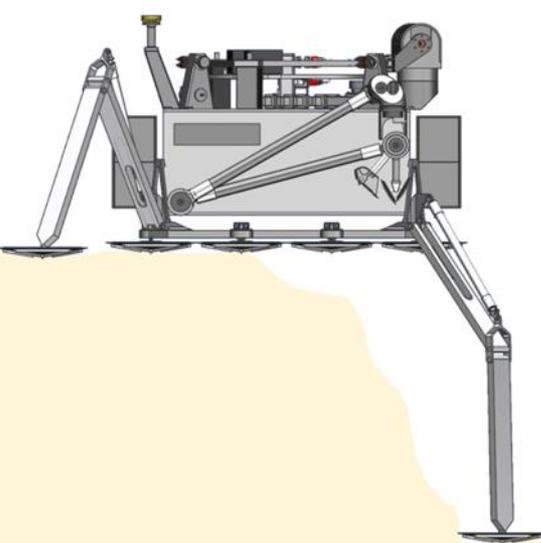
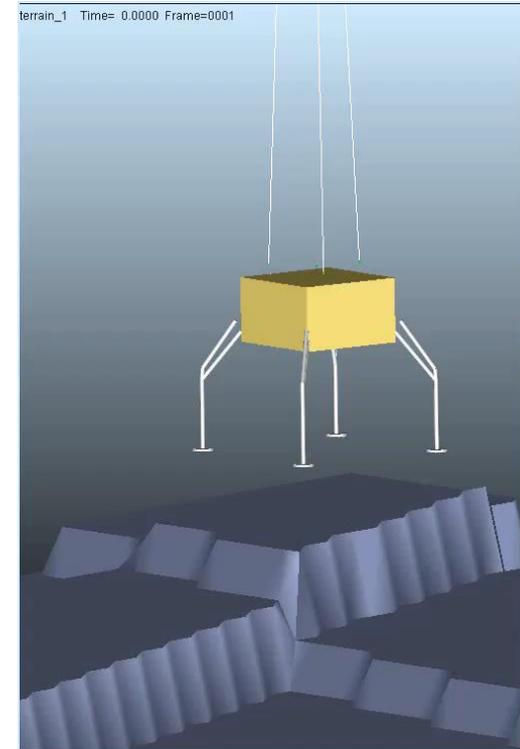


# A Day in the Life of Lander



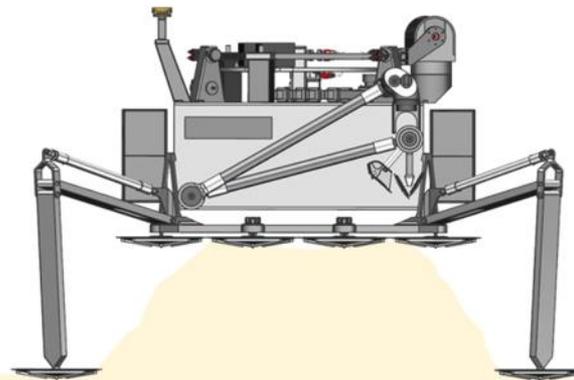
# Landing Stabilizer Performance

- Max Vertical Descent Rate: 0.8m/s
- Max Lateral Descent Rate: 0.3 m/s
- Max Landing Path Angle: 30 deg
  - Equivalent to 0.5m/s vert/0.3m/s lat
- <5 deg vault tilt expected



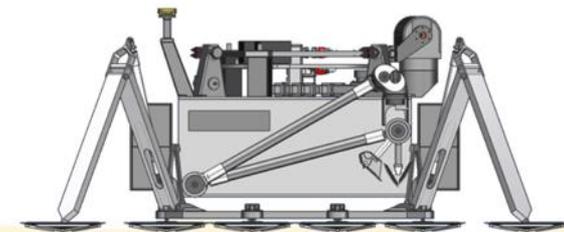
SURVIVAL  
(1m)

*Artist's concept*



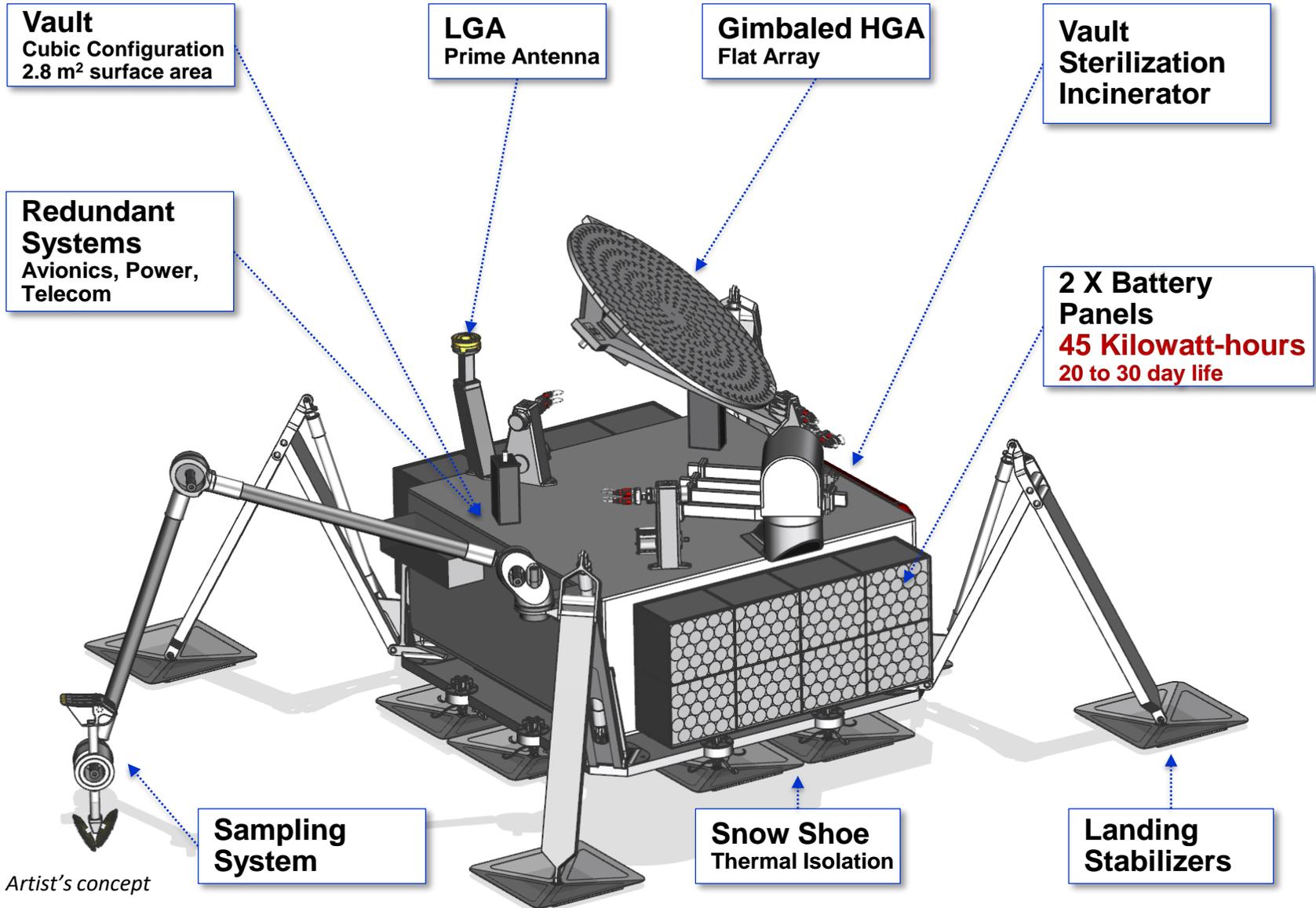
OFF-NOMINAL  
(0.5m)

Pre-Decisional Information — For Planning and Discussion Purposes Only



NOMINAL  
(0m)

# Lander Surface Configuration



Artist's concept

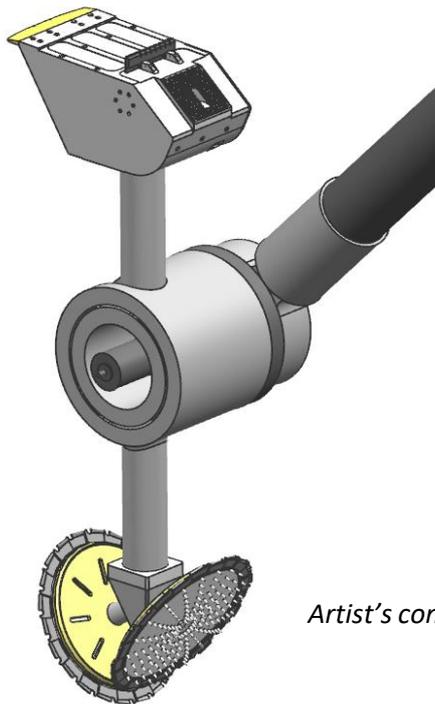
# Surface Sampling Concept

5 DOF Robotic Arm, Excavation Saw, Collection Scoop/Rasp, Transfer System

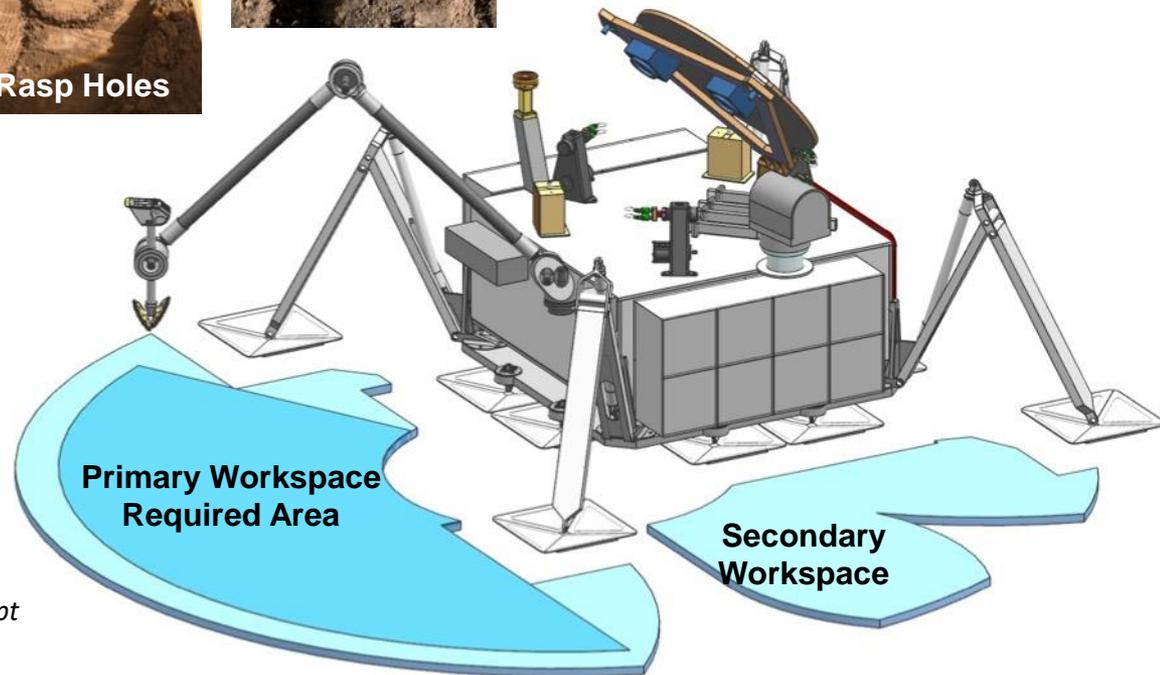
Phoenix Rasp and Scoop Heritage



5 Samples Required  
10 cm minimum depth  
7 cc per sample  
1.8 m<sup>2</sup> workspace



Artist's concept



Trenching Saw  
Multiple Tools Tested



# Surface Phase Overview

**Transition : Prepare the Lander for safe for Surface Operations**

DDL

Bridle cut

Critical deployments

Comm with CRS

15 mins

**1<sup>st</sup> Sample: Safely acquire, analyze and transmit data from first sample**

Excavation

Sample Acquisition and transfer

Payload analysis

Achieve regular relay cadence

Day 4

**Science: Search for evidence of life**

4 additional sample cycles

Relative abundance

Retention time (min)

1 μm

? = Life?

Day 20

**Disposal: Planetary protection compliant disposal**

Lander Incineration

Extended relay

Day 30

CRS disposition

# Europa Lander Mission Concept

