

Surface Phase of the Europa Lander Concept

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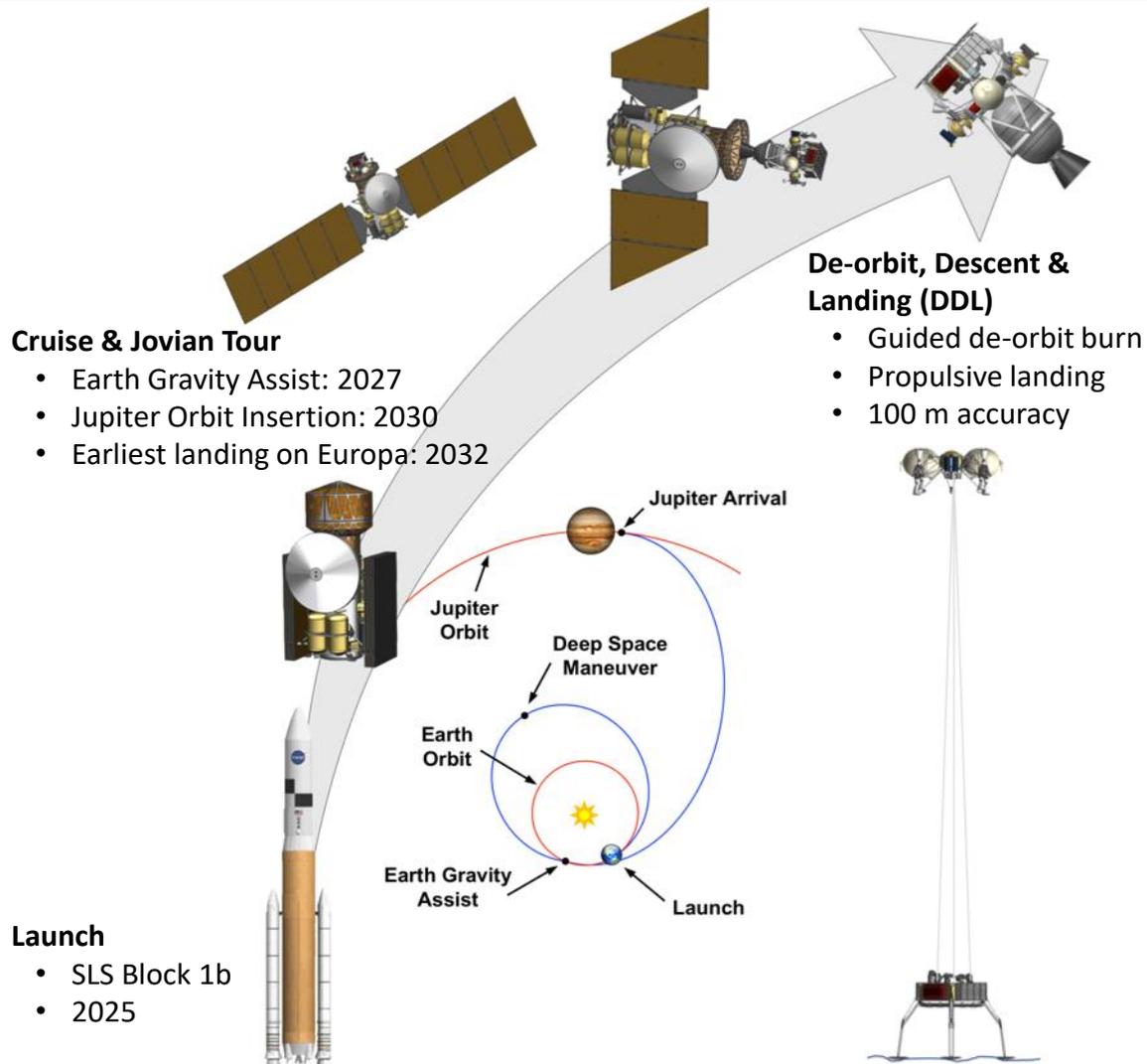
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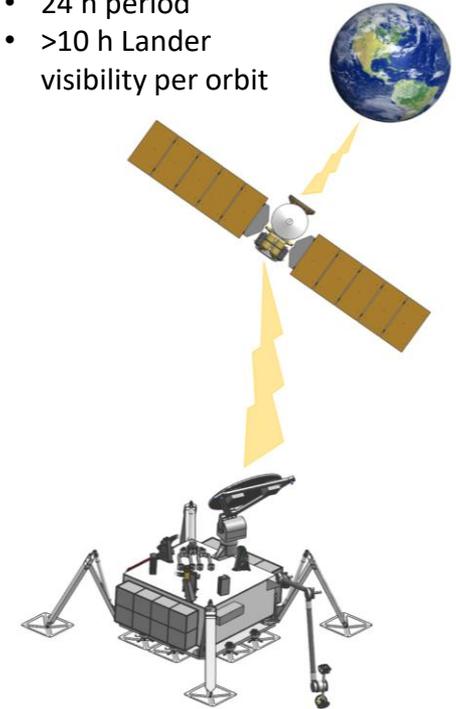


Europa Lander Mission Concept



Carrier Relay Orbit

- 24 h period
- >10 h Lander visibility per orbit



Surface Mission

- 20+ days surface mission
- 5 samples
- Relay communications through Carrier or Clipper (backup)
- 3-4 Gbit data return
- 45 kWh battery



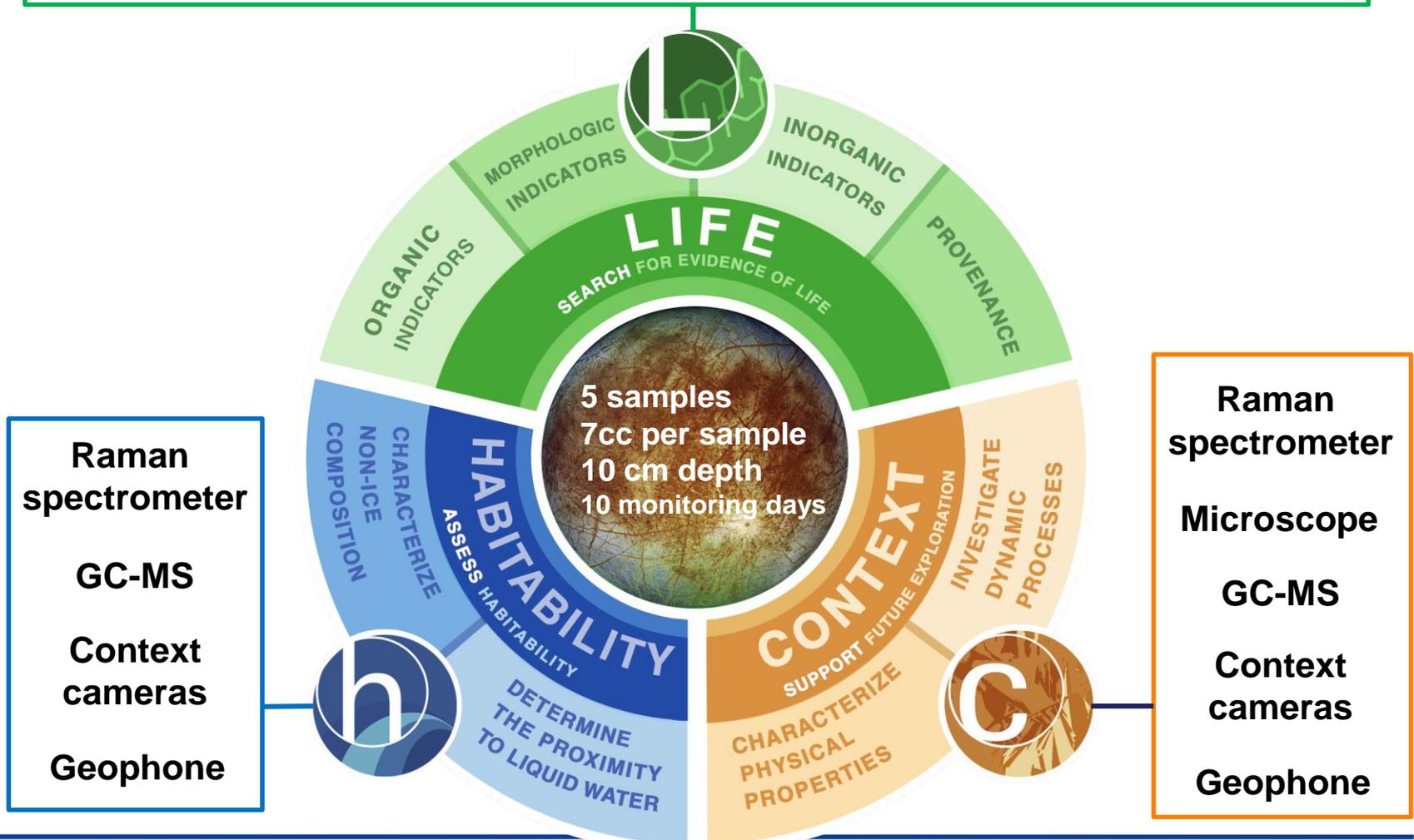
Science Definition Team Recommendations

GC-MS

Microscope

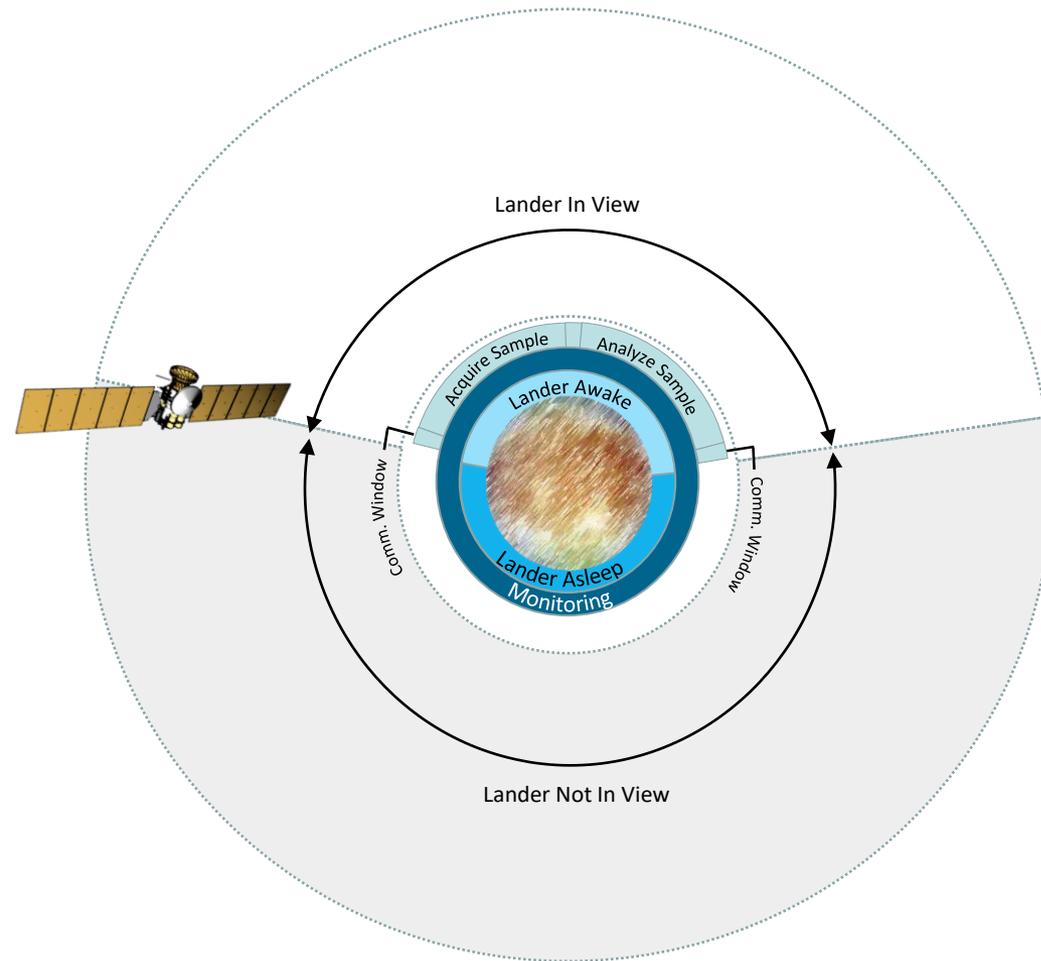
Raman spectrometer

Context cameras





Europa Lander Concept – Surface Phase Terminology



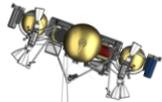
Tal*: The period of performance, defined by rise of CRS. Operationally similar to a sol for Mars operations.

Sample Cycle: Sequence of activities that include site excavation and the acquisition and onboard scientific analysis of a sample.

Sample tal: A tal where the primary activity is sampling and associated sample science.

Monitoring tal: A tal where the primary activity is monitoring science.

**Etymology: Talos was a bronze automaton, presented to Europa by Zeus as a protector on Crete. As part of its duties, Talos circled Crete three times daily. "Tal" is short for "talosian period" (similar to "sol", short for "solar day", in Mars surface operations).*



Europa Lander Concept – Surface Phase Overview



DDL

Transition : Prepare the Lander for safe Surface Operations



Bridle cut



Critical deployments



Comm with CRS

15 mins

1st Sample: Safely acquire, analyze and transmit data from first sample



Excavation

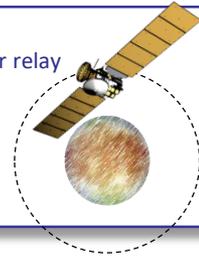


Sample Acquisition and transfer



Payload analysis

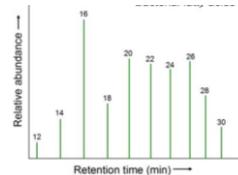
Achieve regular relay cadence



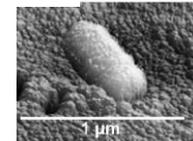
Day 4

Science: Search for evidence of life

4 additional sample cycles



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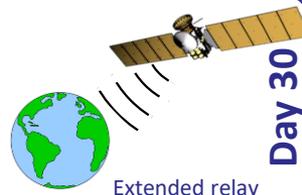


Day 20

Disposal: Planetary protection compliant disposal



Lander Incineration



Extended relay

Day 30

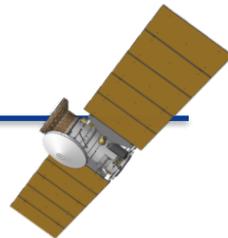
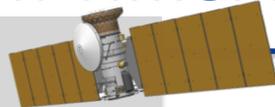
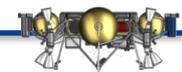


CRS disposition



Europa Lander Concept – Transition Timeline

Time



Touchdown Event

- Stabilizer Pose Lock
- Bridle Cut
- Post Landed Health Assessment

Deployments

- HGA/Cam Release and Deploy
- Lens Cover Deploy
- Arm Bio Barrier Release and Deploy
- Arm Release

Surface Priming Activities

- Workspace Imaging
- Attain Attitude Knowledge

Opportunistic Activities

- EPO Imaging

Transition to Surface

- Configure for Surface

TD

TD + 30 sec

TD + 4 min

TD + 7 min

TD + 15 min

TD + 0

Landed state health report
DS impact detection
Release and deployment report
Stabilizer and deck context imaging

Priority 1

TD + 4 m

Workspace imaging
Attitude Knowledge (3axis)

Priority 2

TD + 7 m

Panorama imaging

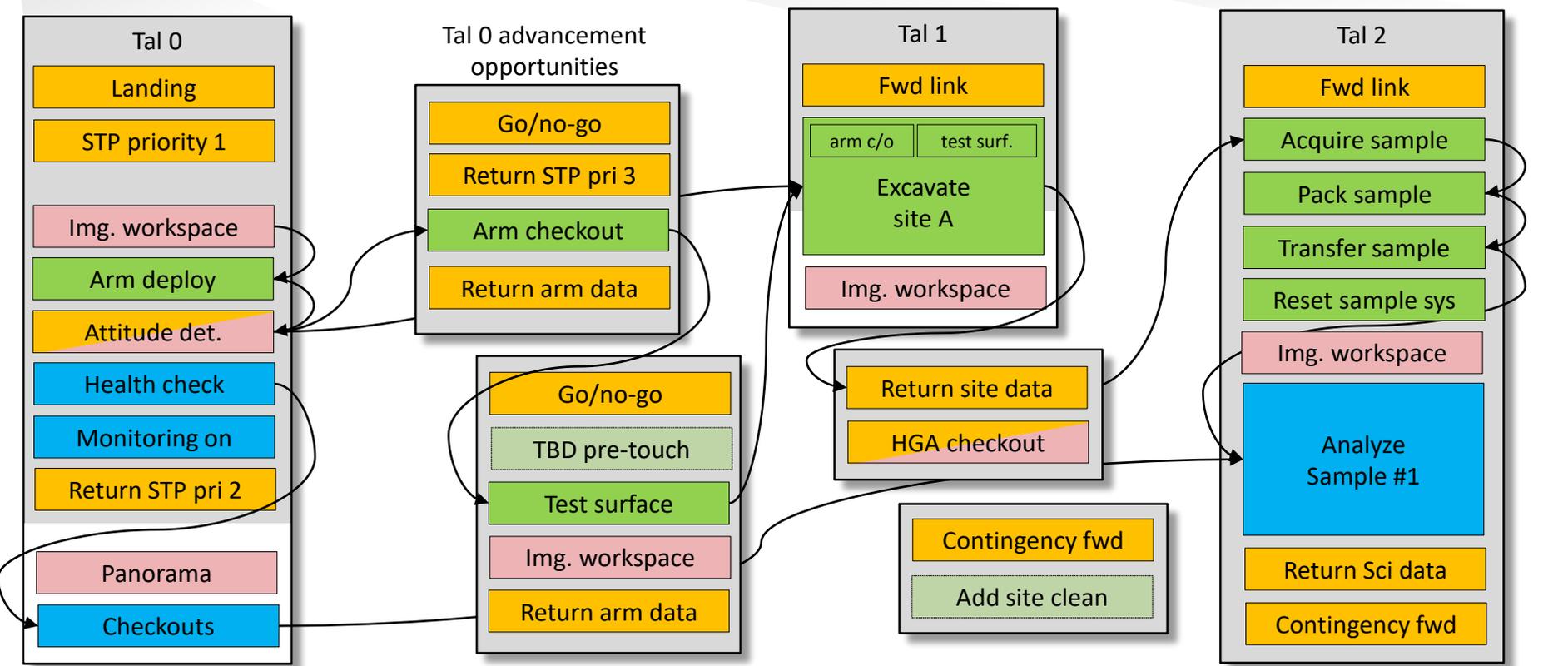
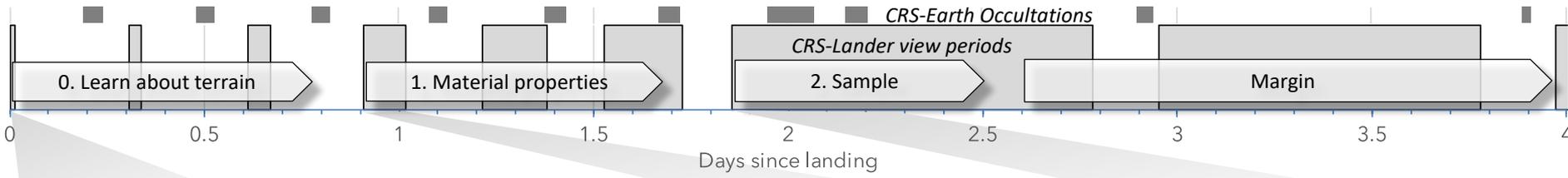
Priority 3



Notional Path to First Sample

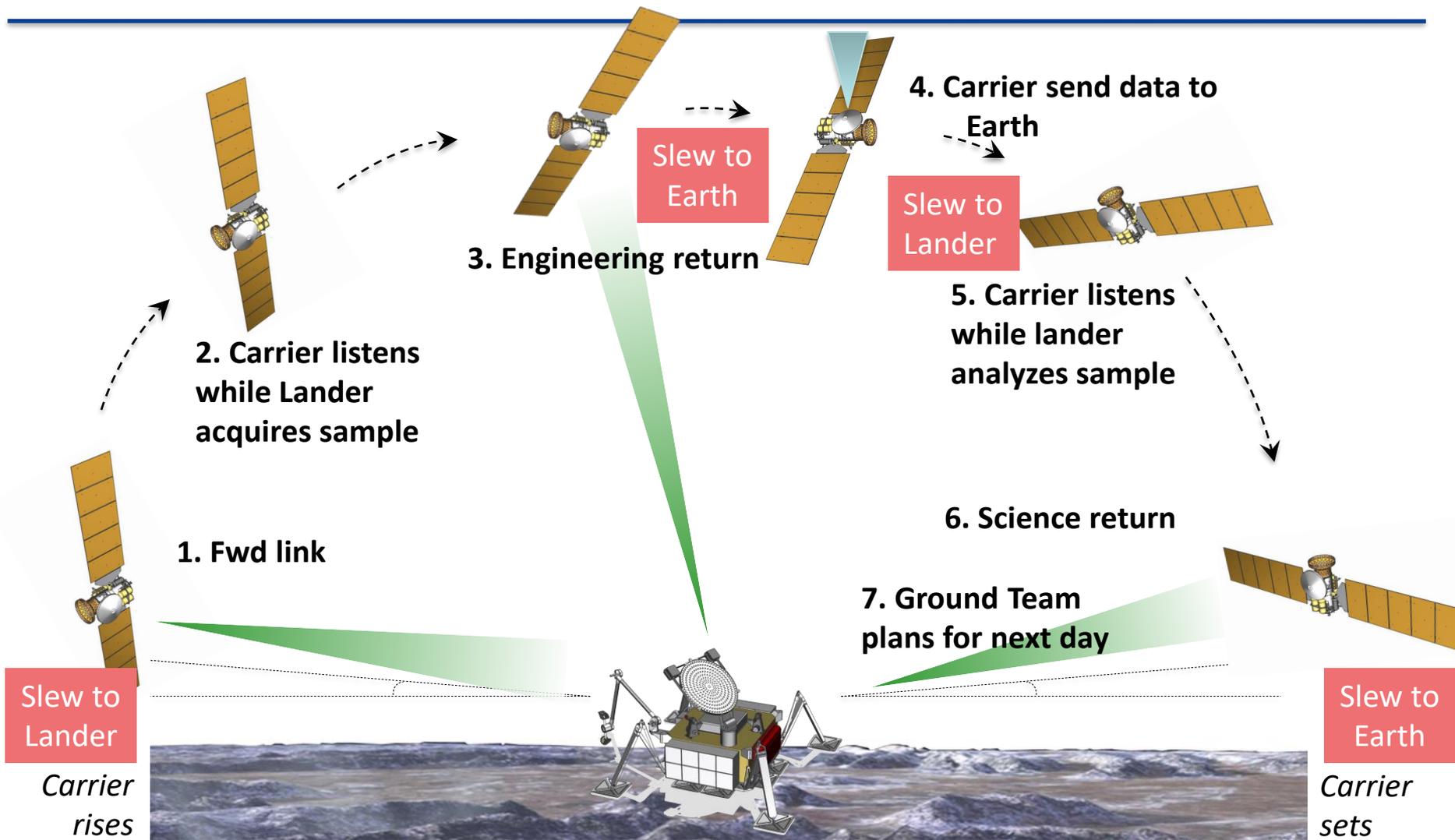
Legend:

- Lander (Yellow)
- Camera (Pink)
- Sampling sys (Green)
- Payload (Blue)
- Critical path (Arrow)



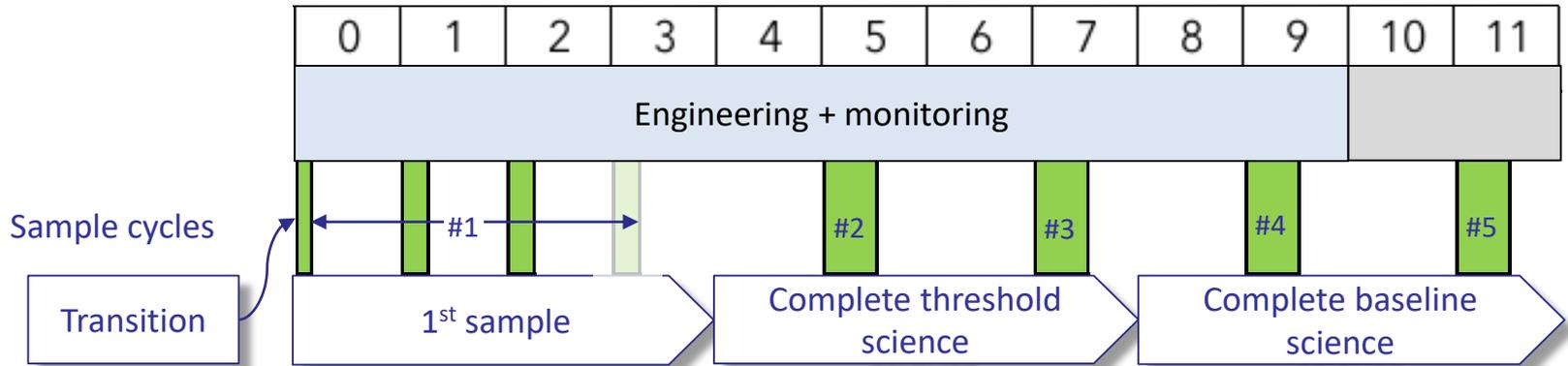
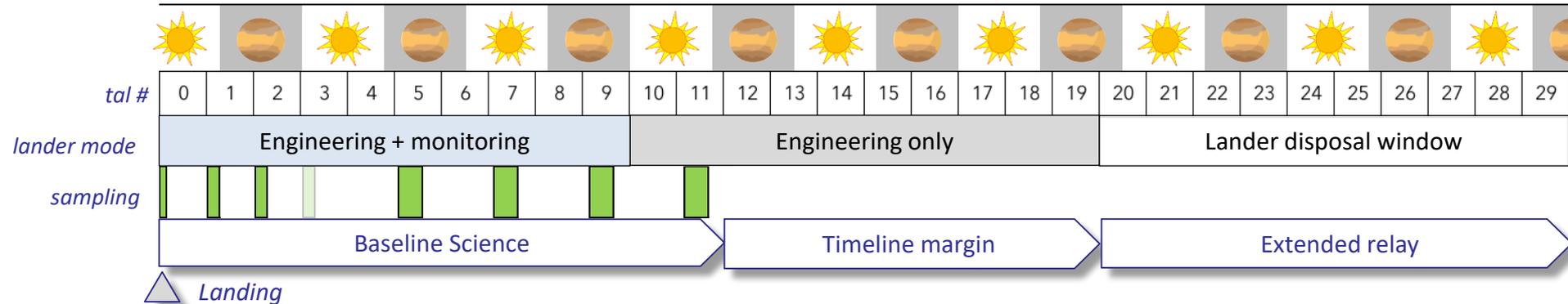


A Sample Tal in the Life of the Lander





Proposed Surface Timeline

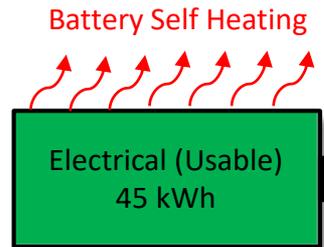




Resources

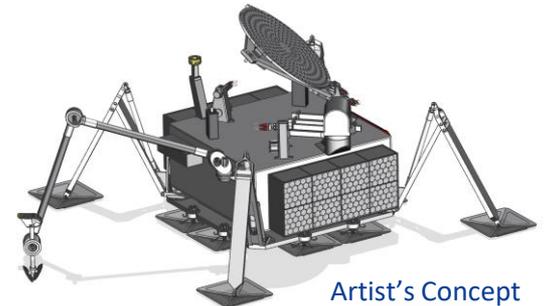
Surface mission would be energy constrained

- Primary battery is baselined to be the sole energy source
- Tightly couples energy, thermal, mass, timeline
- Maximize electrical + thermal energy



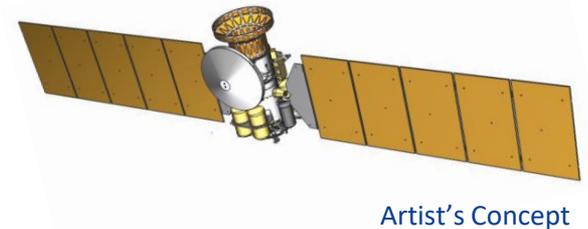
Energy dissipated in battery and vault would be used to maintain Allowable Flight Temperatures

- Significant battery self heating
- Europa ambient temperature > 50 K



Data relay would not be constraining

- High data rate from Lander \rightarrow CRS
- Large data volume from CRS \rightarrow DSN
- CRS \rightarrow DSN is bottleneck for decisional data

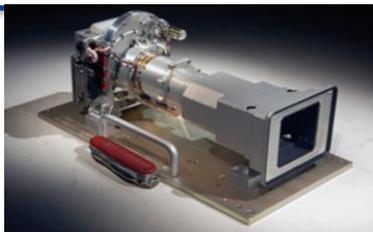




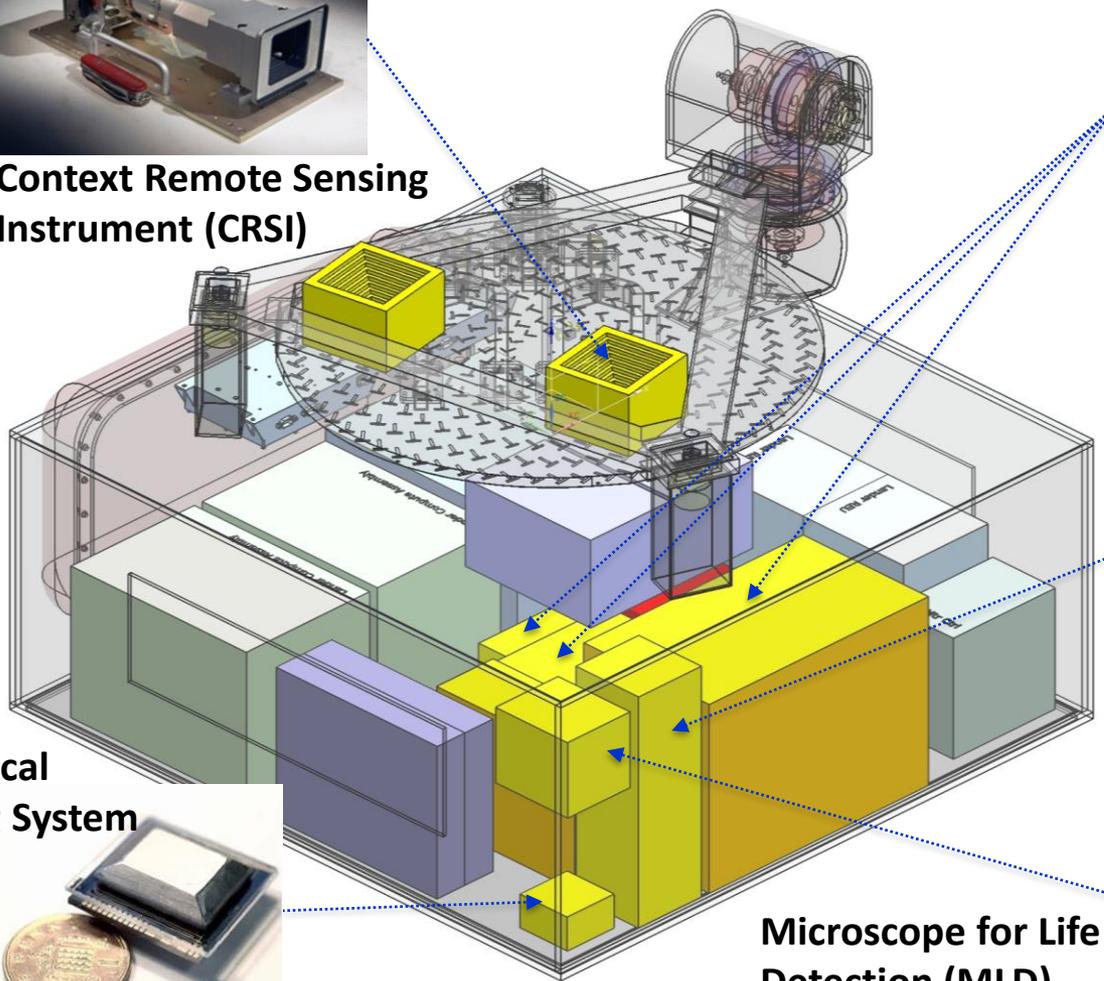
Backup



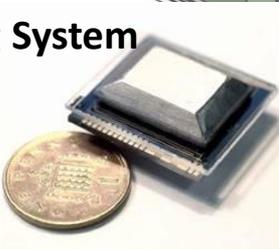
Science Definition Team (SDT) Sample Payload



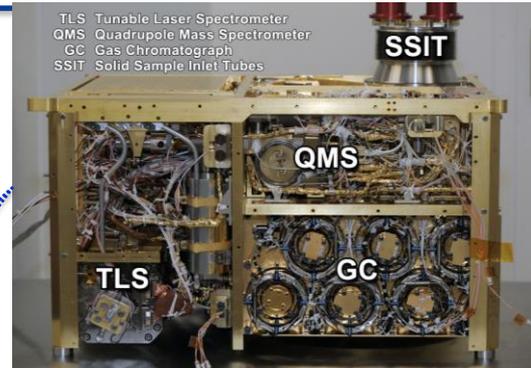
Context Remote Sensing Instrument (CRSI)



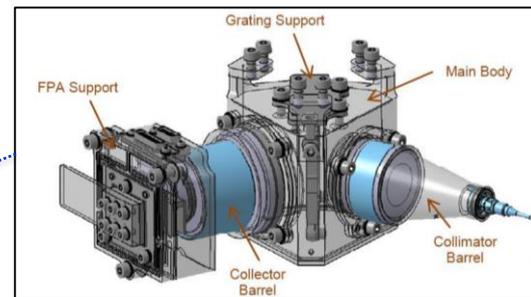
Geophysical Sounding System (GSS)



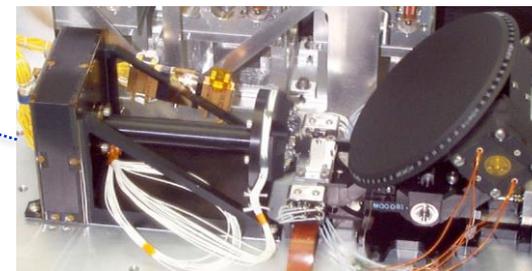
Microscope for Life Detection (MLD)



Organic Compositional Analyzer (OCA)



Vibrational Spectrometer (VS)





Europa at a Glance

