LUNARSABER: Lunar Utility with Navigation, Advanced Remote Sensing, and Autonomous Beaming for Energy Redistribution

Lunar Surface Innovation Consortium (LSIC) Presentation – Spring 2024

DARPA LunA-10: 10-Year Lunar Architecture Capability Study

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HONEYBEE ROBOTICS
Exploration Technology

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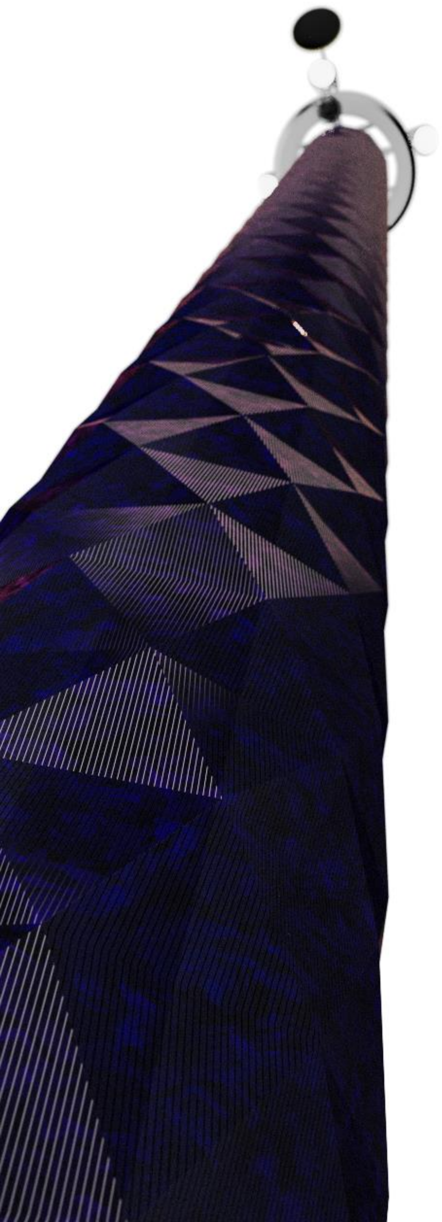
LUNARSABER Overview



LUNARSABER - Lunar Utility with Navigation, Advanced Remote Sensing, and Autonomous Beaming for Energy Redistribution

Payload Service Platform:

- High Availability Solar Energy and Power Transfer
  - IR Power Beaming
  - Wired Power Transmission (DC)
  - Battery Energy Storage
- Masthead Hosted Payloads
- Communications and Data Services
  - Local 3GPP network and Lasercomm terminals
  - Lunar Mesh Network including Direct-to-Earth
  - Edge computing and data storage
- Situational Awareness
  - Asset Monitoring
  - Local Position, Navigation, and Timing (PNT)
  - Lunar Surface Traffic Control

LUNARSABER Infrastructure

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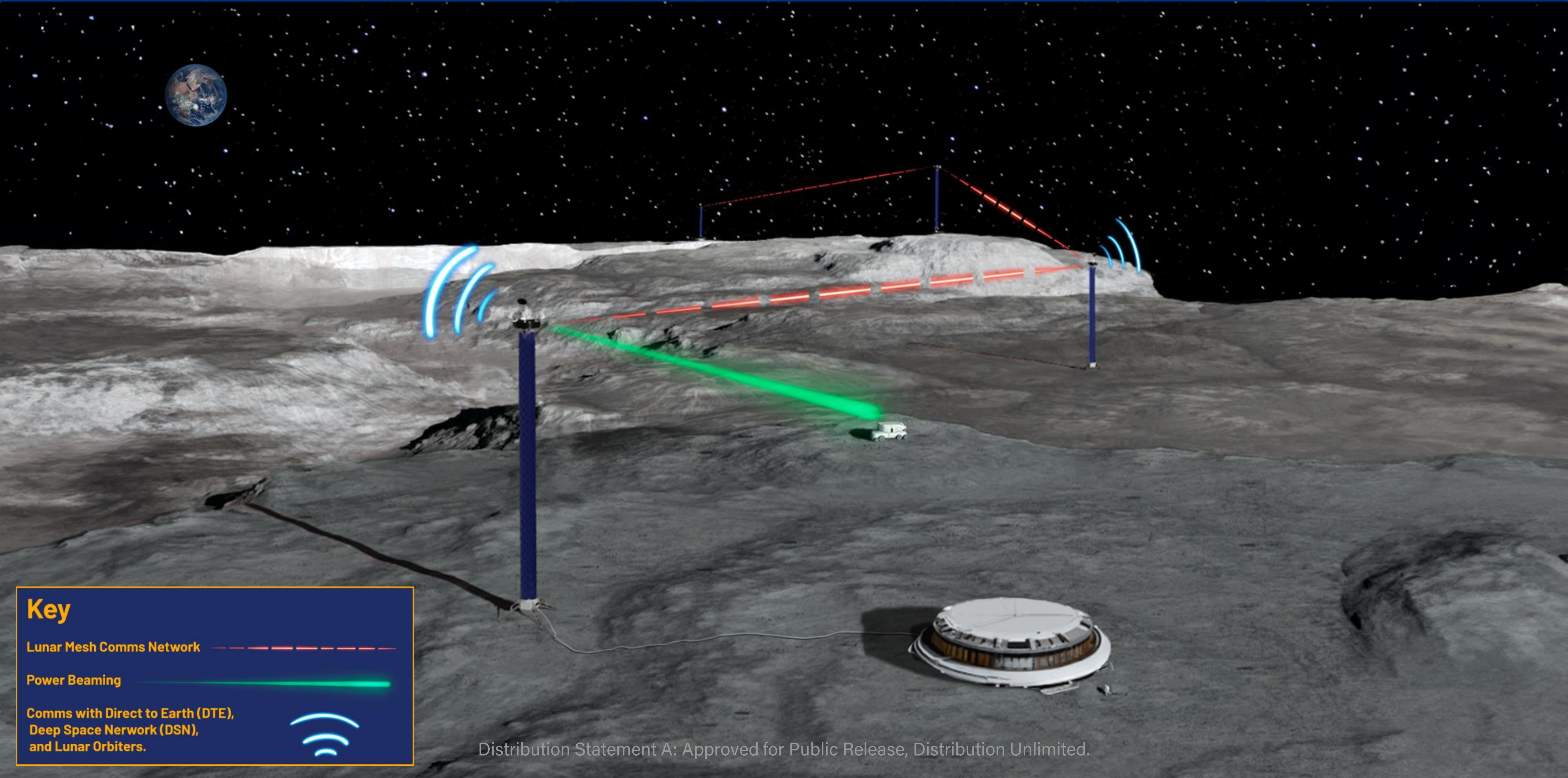

LUNARSABER Key Services

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Services on Masthead

Services at Base

crescent
RF Data and PNT service LunaNet Network Node

NOKIA BELL LABS
Local 4G/5G Data Service

SPACEX
Comms with Lunar Starlink

Comms/PNT

FIBERTEK, INC.
1+ kW Power Beaming

Wireless Power Transmission

- Cameras for Asset Monitoring
- Localized PNT
- Instruments

Honeybee Masthead Services

- Solar Energy (30kW)
- Energy Storage

Honeybee Dust Tolerant Connector

Wired Power Transmission

GITAI
SIERRA SPACE
ICON
HELIOS
CISLUNAR INDUSTRIES
NORTHROP GRUMMAN

Users

Distribution Statement A: Approved for Public Release, Distribution Unlimited.

Honeybee Robotics - Lunar Vertical Systems

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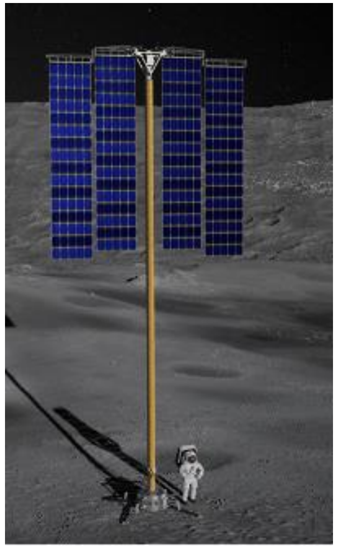
- LUNARSABER is configured to serve a variety of market needs
- Build out of Lunar Mesh network using a combination of LS-30 and LS-100 towers deployed one or more per landing
- LS-30 sized to deploy on Blue Moon MK1 and Starship

	LAMPS	LS-15 Mobile	LS-30	LS-100
Height	16 m	15m	30m	100m
Solar Power	10 kW	10 kW	30 kW	100 kW
Hosted Payload Mass	N/A	N/A	300 kg	300 kg
Mass to Lunar Surface	600 kg	1400 kg	2200 kg	3500 kg
Re-stowable	Yes	Yes	No	No



LAMPS
Lunar Array Mast and Power System

LUNARSABER Configurations

Strategic Deployment and Optimization

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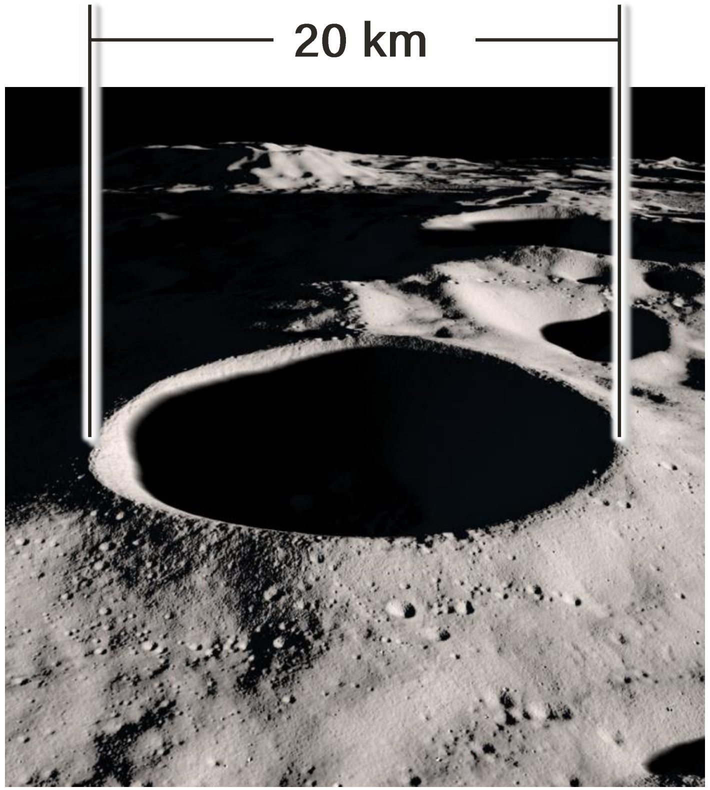

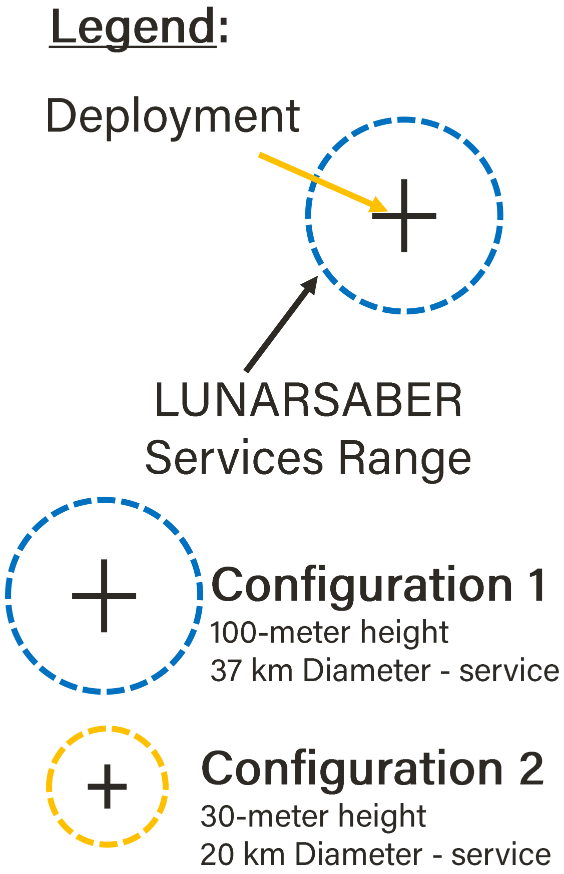

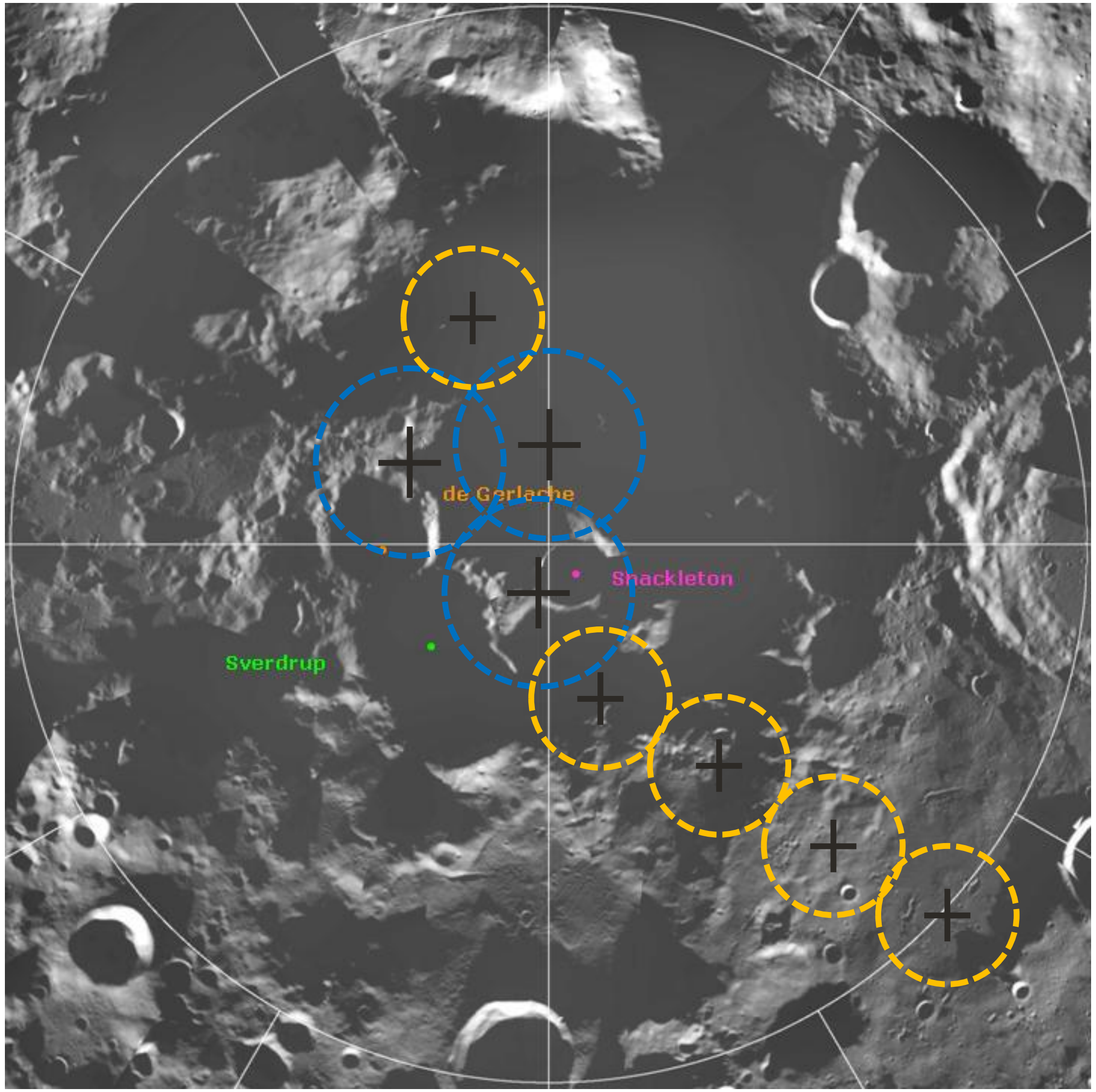

A LUNARSABER placed near the rim of Shackleton crater can provide key services such as power and communication to lunar assets inside of Permanently Shadowed Region (PSR)

LUNARSABER Strategic Deployment near South Pole (NOTIONAL)

Lunar Cartography tool for LUNARSABER

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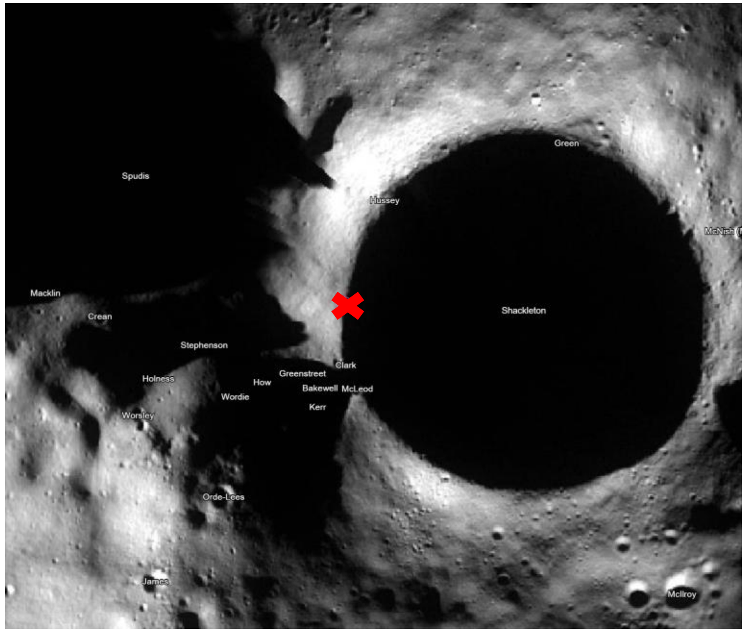
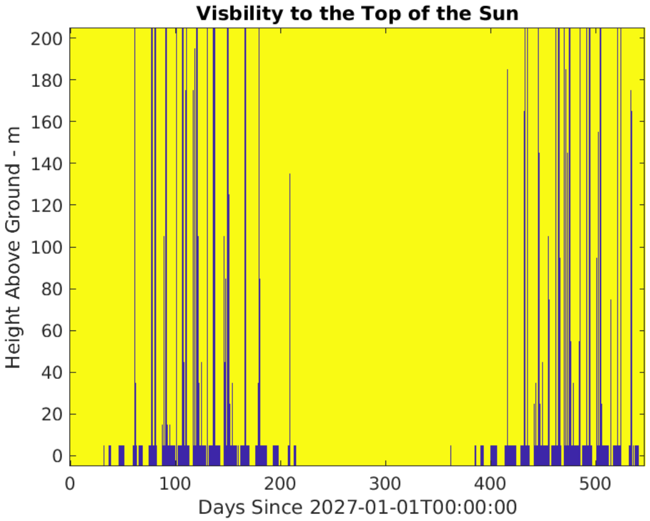
Lunar Cartography – tool setup to analyze the best LUNARSABER configuration based on location for various mission phases of LunA-10

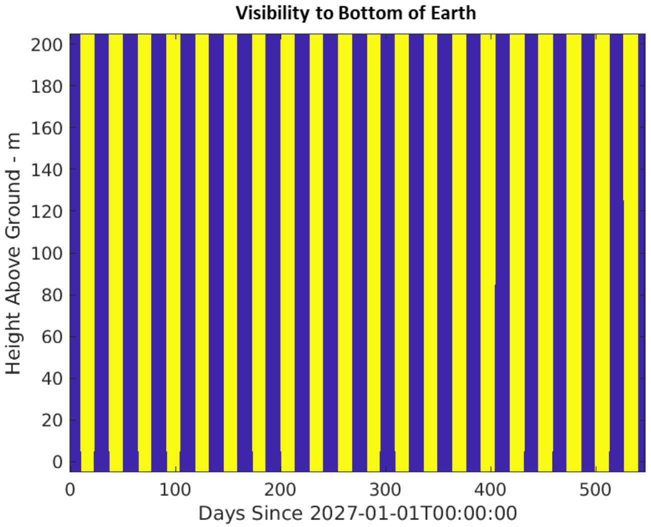
- Increased illumination and power generation >90% through out the year
- 1% illumination increase -> 9 MWh



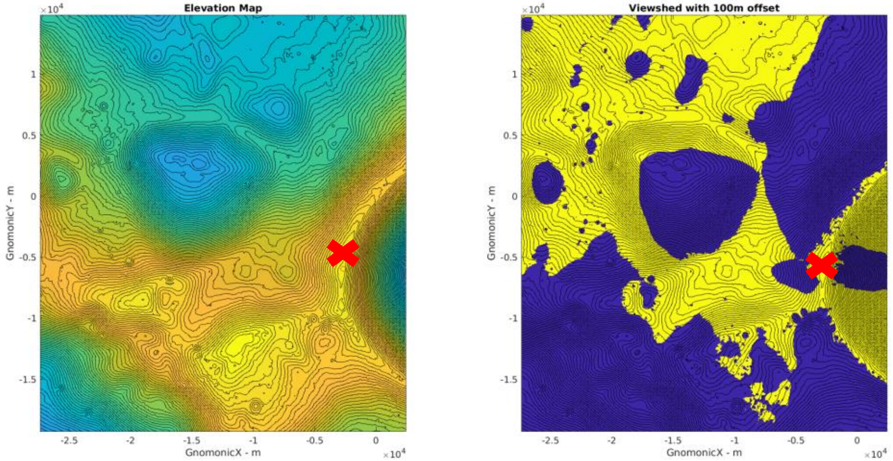
Sample Site – Shackleton Rim



Solar Illumination



DTE Communications



Viewshed for Hosted Payloads at 100+ meters

Honeybee Robotics has developed a cartography tool to rapidly assess potential sites

Commercialization

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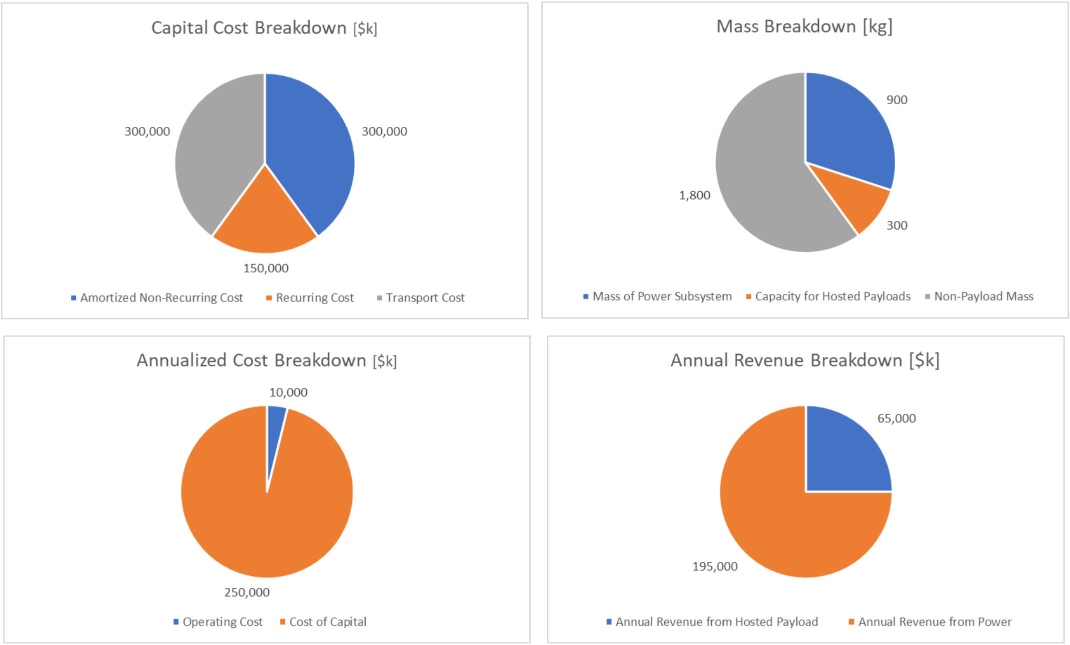
LUNARSABER Cost Model based on:

- Mass-based cost parametrics for non-recurring, recurring, and transportation
- Non-recurring costs are amortized over the first few units
- Capital repayment over the first few years
- Model has optimistic and pessimistic parameter sets to determine a range of cost values

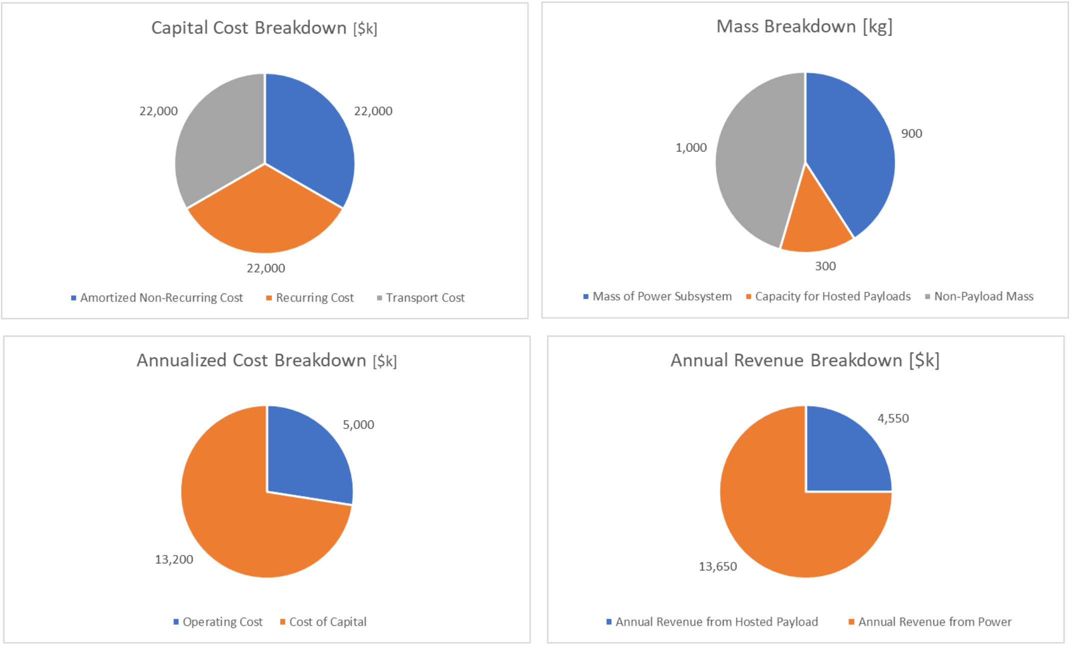
Service	Unit	Price Range*
Hosted Payload	$M/kg	< 1.0
Power (Day)	$k/kWh	< 1.2
Beamed Power (received)	$k/kWh	10 - 80

*Service costs are first-order as they are heavily dependent on future costs. Cost estimates are notional and do not represent an offer of services.

Pessimistic Cost Model



Optimistic Cost Model



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