Moon Next Early DRMs

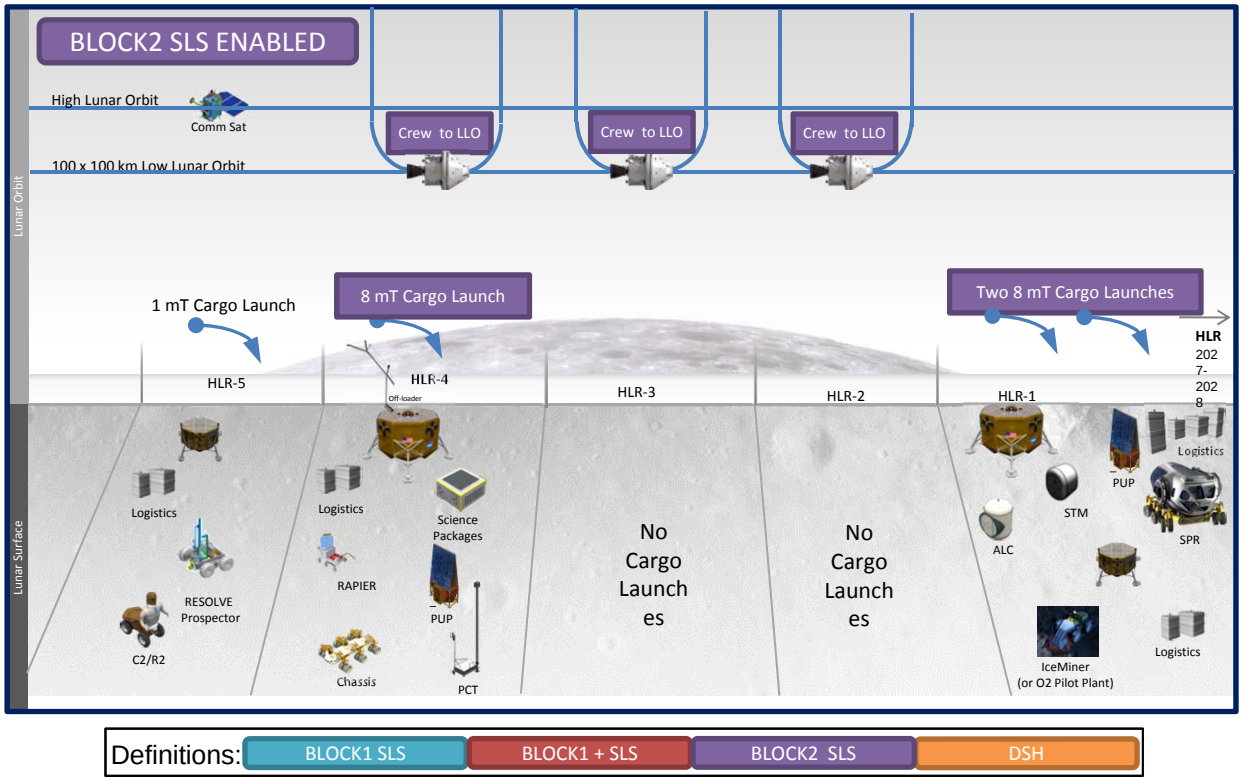
Outline

- Moon Next Options
- Streetview Architectures
- Human Lunar Return Assessment
- Overall Observations

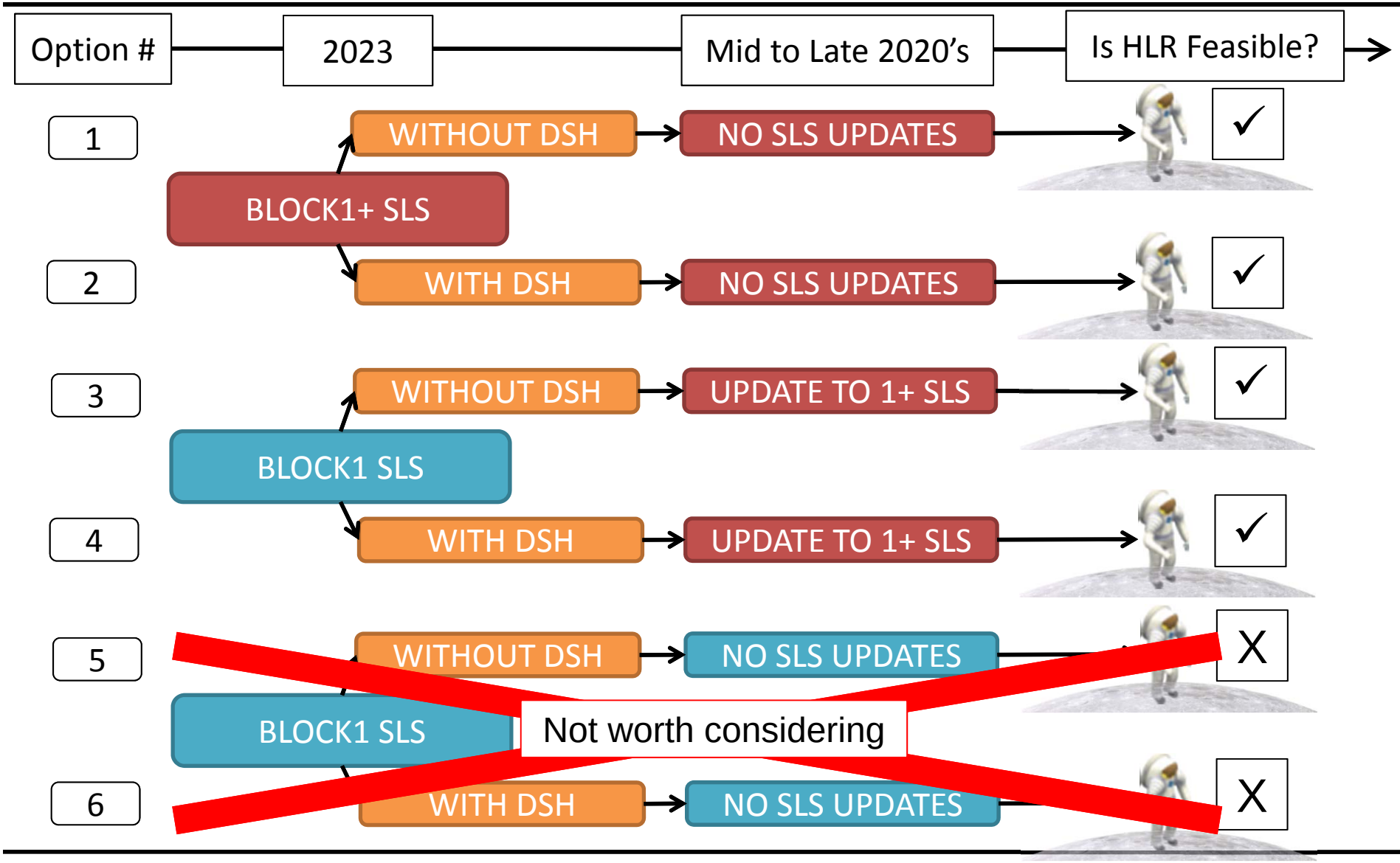
Current GER: Designed with SLS Block 2

Updates to GER-1 Assumptions

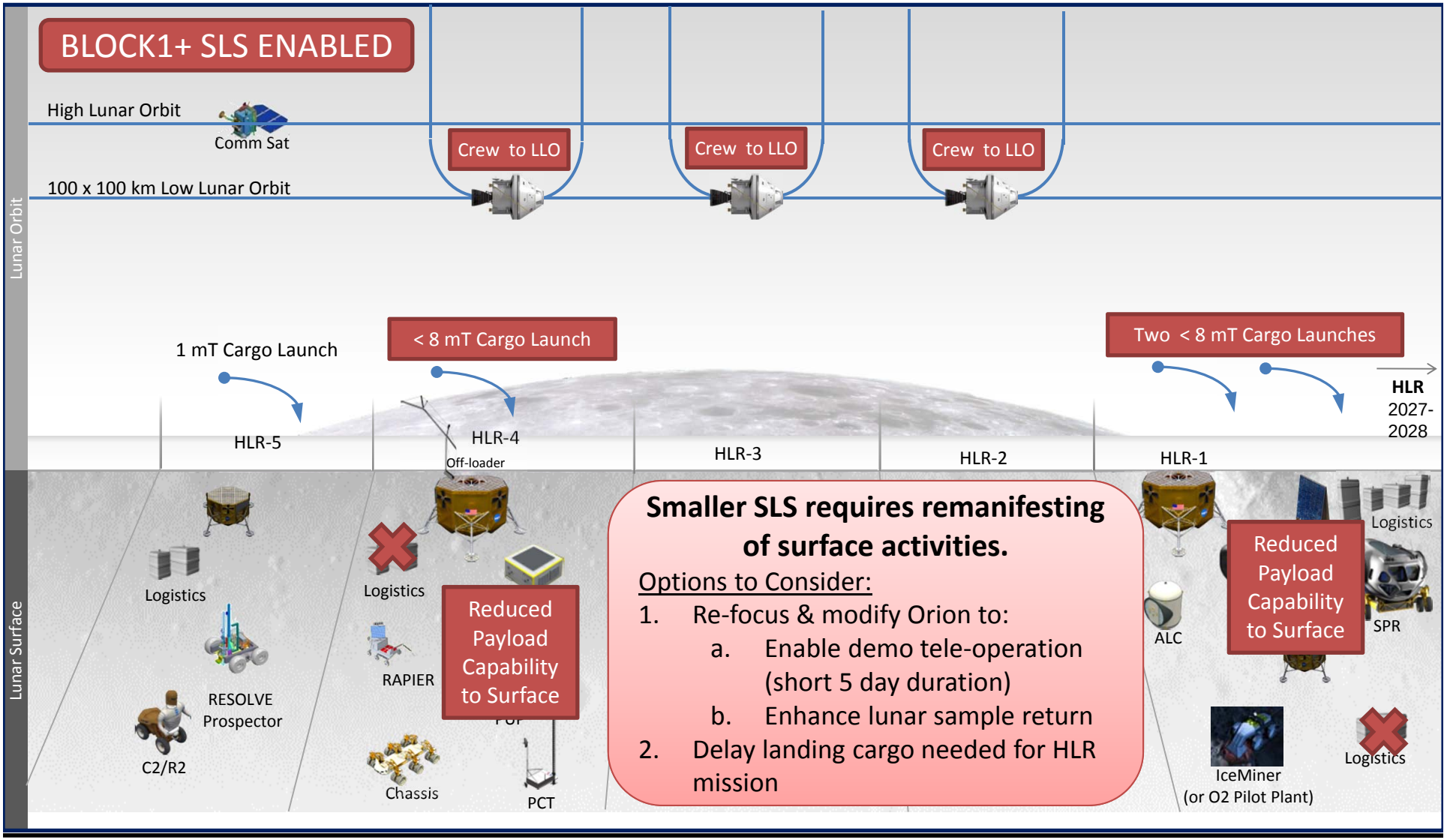
- All GER-1 mission scenarios assumed SLS Block 2 available
- Recent developments suggest Block 2 will not be available for Early DRM phase
- Need to examine Block 1 impacts to architecture
- As updates to Block 1 are still in work, Block 1A will be referred to as Block 1+
- Consider infusion of a to-be-defined DSH-prototype (DSH-p)



Optional Paths

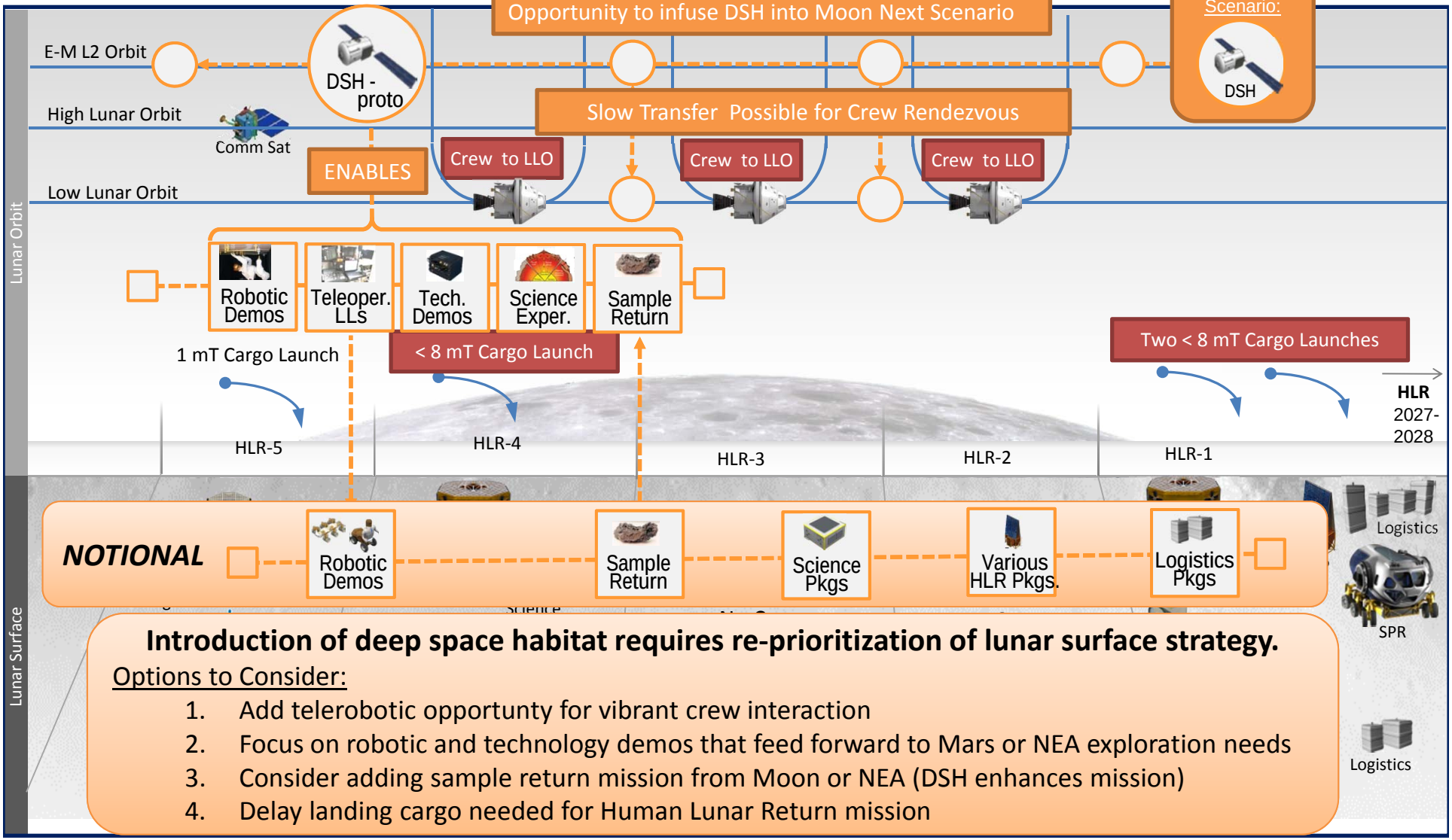


Option #1 with SLS Block 1+



Definitions: BLOCK1 SLS – 70 t to LEO | BLOCK1 + SLS – 105 t to LEO | DSH – Deep Space Habitat

Option #2 with SLS Block 1+ and DSH-Prototype



Introduction of deep space habitat requires re-prioritization of lunar surface strategy.

Options to Consider:

1. Add telerobotic opportunty for vibrant crew interaction
2. Focus on robotic and technology demos that feed forward to Mars or NEA exploration needs
3. Consider adding sample return mission from Moon or NEA (DSH enhances mission)
4. Delay landing cargo needed for Human Lunar Return mission

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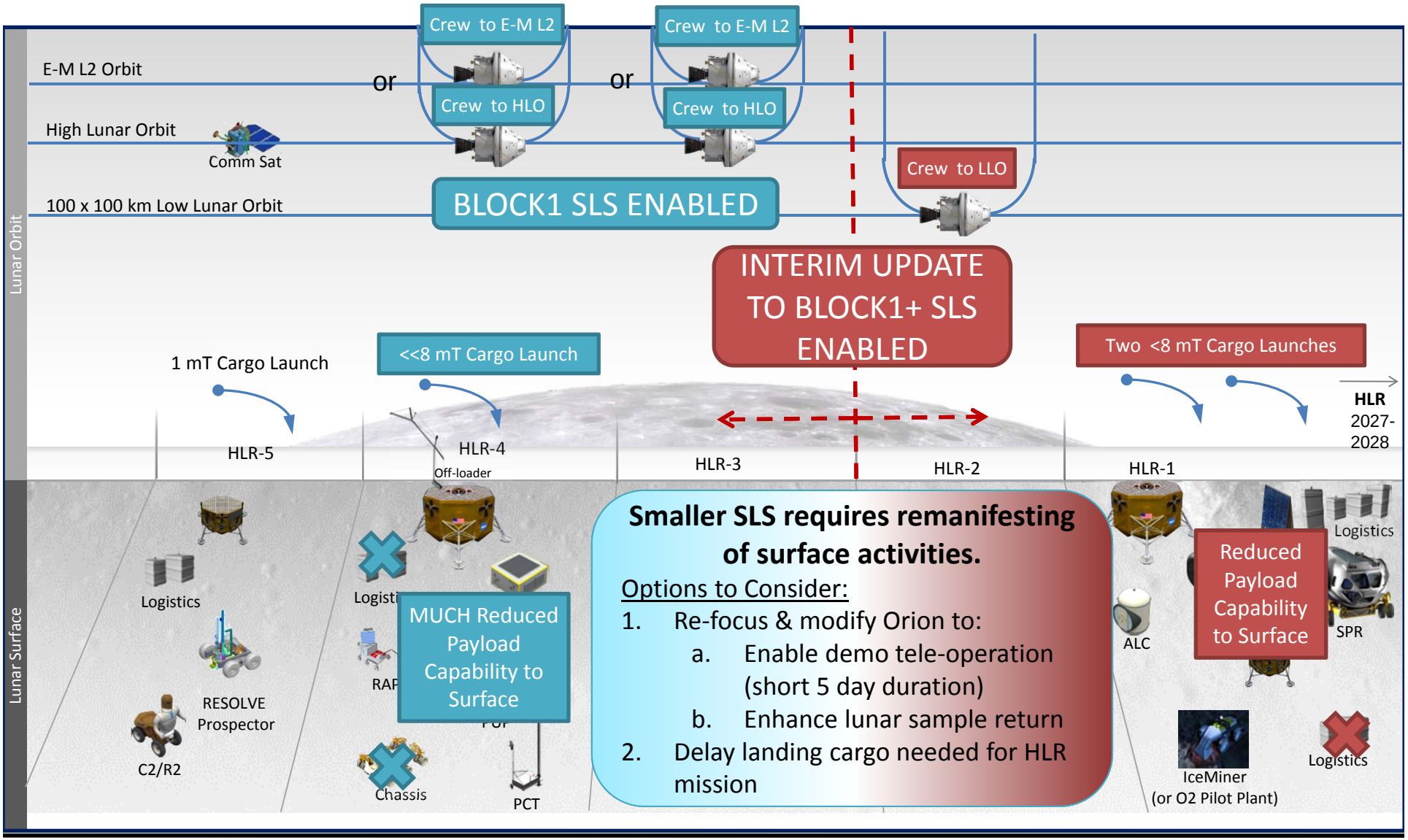
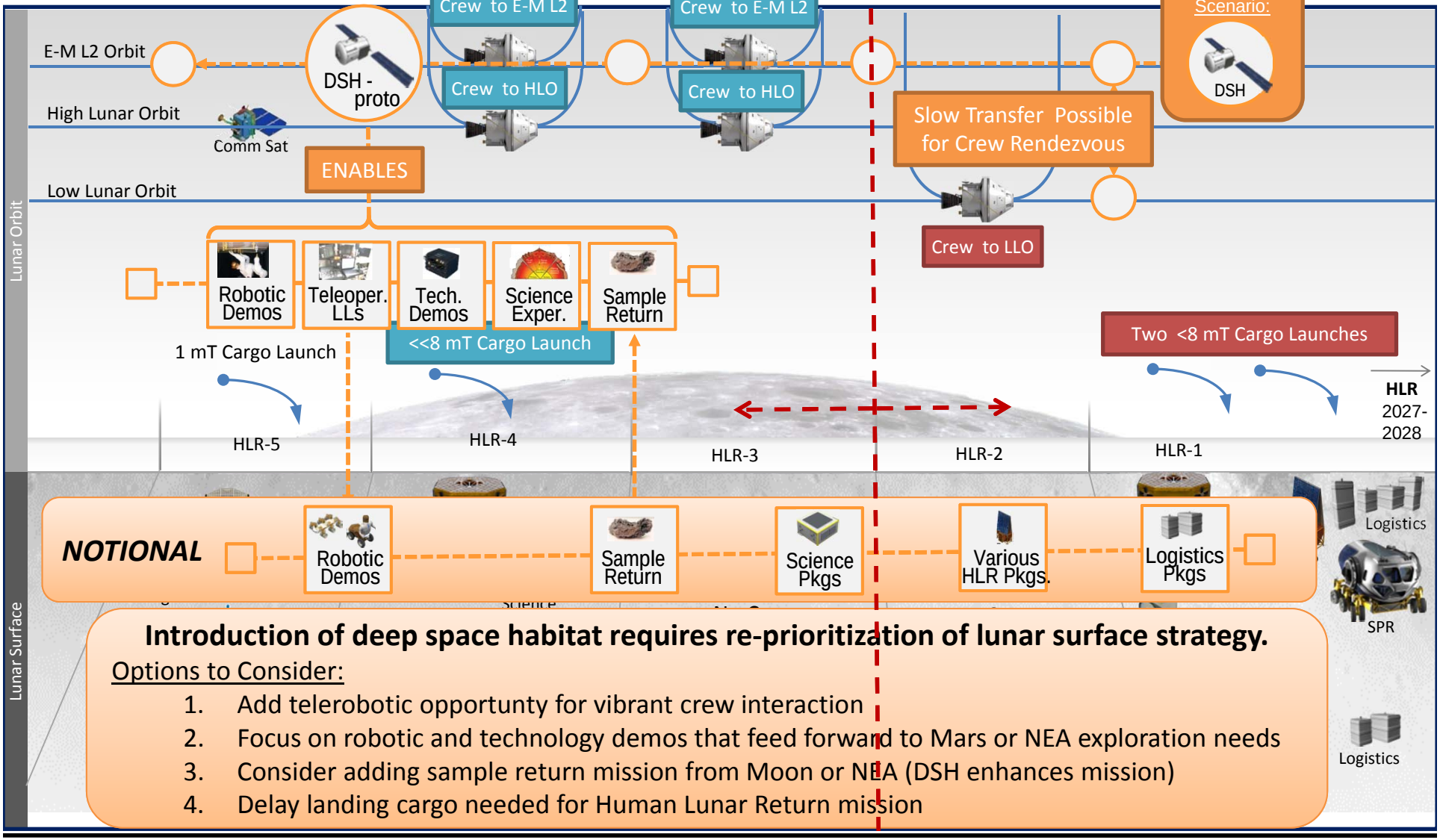
Option #3 with Update to Block 1+ from SLS Block 1



Definitions: BLOCK1 SLS – 70 t to LEO | BLOCK1 + SLS – 105 t to LEO | DSH – Deep Space Habitat

Option #4 with Update to Block 1+ from SLS Block 1 and DSH-p



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Assessing Core Activities by Option

Comparing with and without DSH-prototype

#	SLS	DSH	Common Cis-Lunar Activities										
			Demo. Internat. Transport Capab.	Test Deep Space Ops	Test Human/ Robotic Integ. Activities	Test Tech. in Deep Space	Demo. Critical Subsys. in Deep Space	Study Deep Space Radiation Enviro.	Assess Feasibility of Lunar Resources	Human Health Radiation Impacts	Monitor Space Weather	Enable Comm., Tracking and Nav.	Teler-obotic control of surface elements
3	BLOCK1 TO 1+	N	●	◒	·	○	·	◒	●	◒	·	·	○
4		Y	●	●	●	●	●	●	●	●	●	◒	●

Definitions: BLOCK1 SLS | BLOCK1 [illegible] | DSH

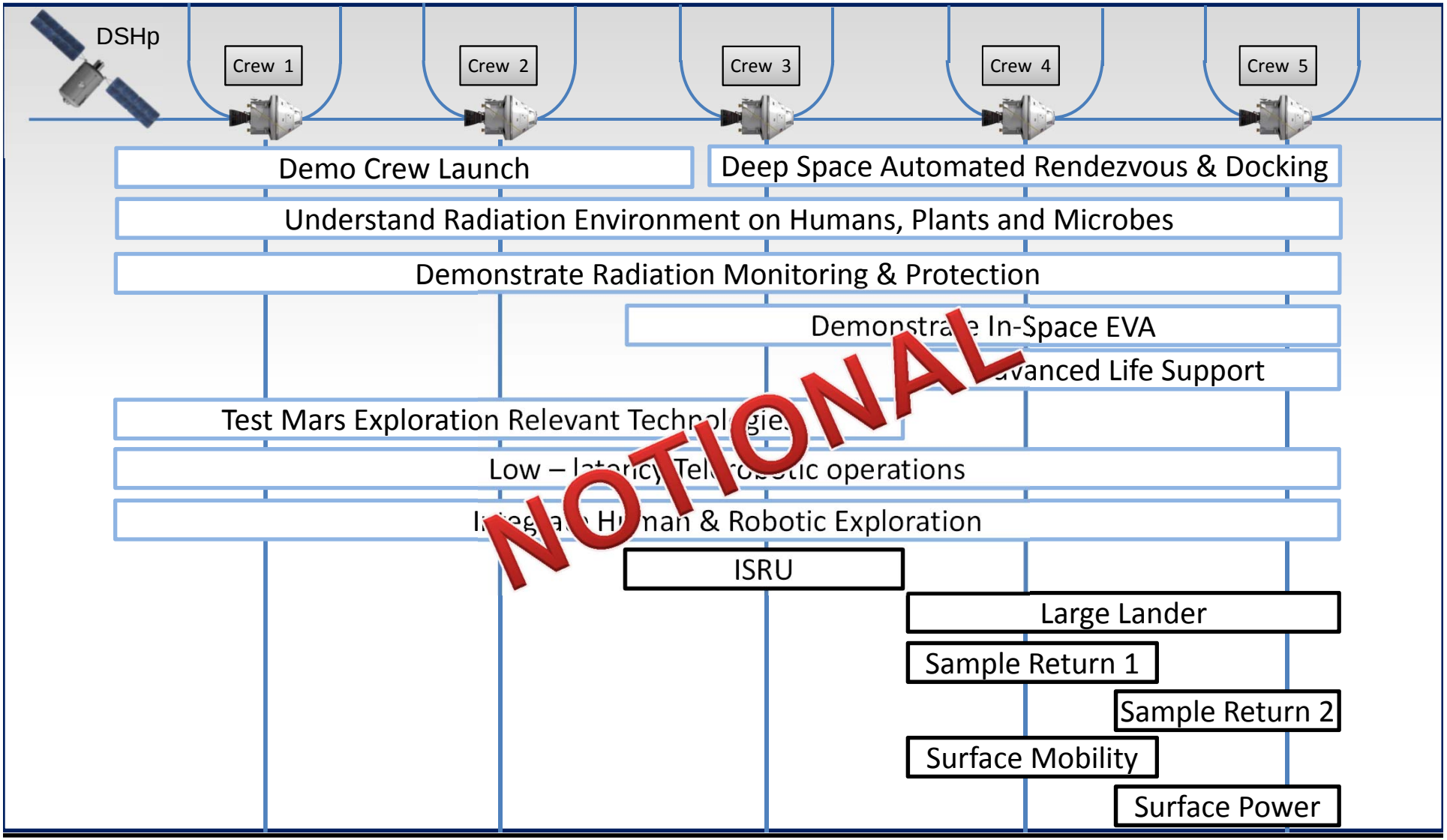
Scale: ○ · ◒ ●

Increasing Capability →

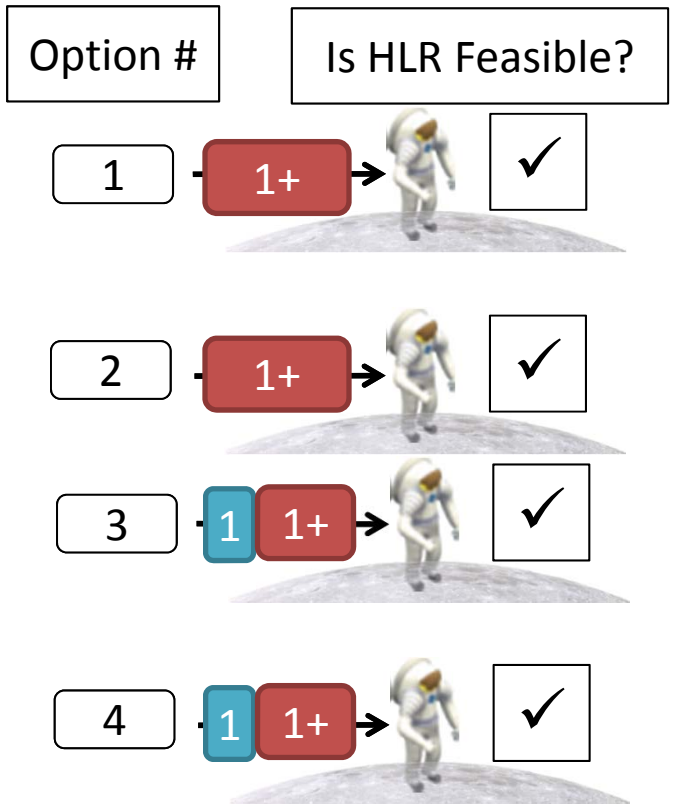
NOTIONAL

#	SLS	DSH	Moon Next Specific Activities					
			Enhance lunar sample return	In-Space Staging Experience	Crew Loiter for Landing Site Access	Crew Loiter for Earth Return Phasing	Contingency Scenarios	Supply Storage
3	BLOCK1 TO 1+	N	◒	●	○	○	·	○
4		Y	●	●	●	●	●	●

Assessing Core Activities by Mission



GER: Moon Next Scenario: Two Choices with 6 Possible Paths

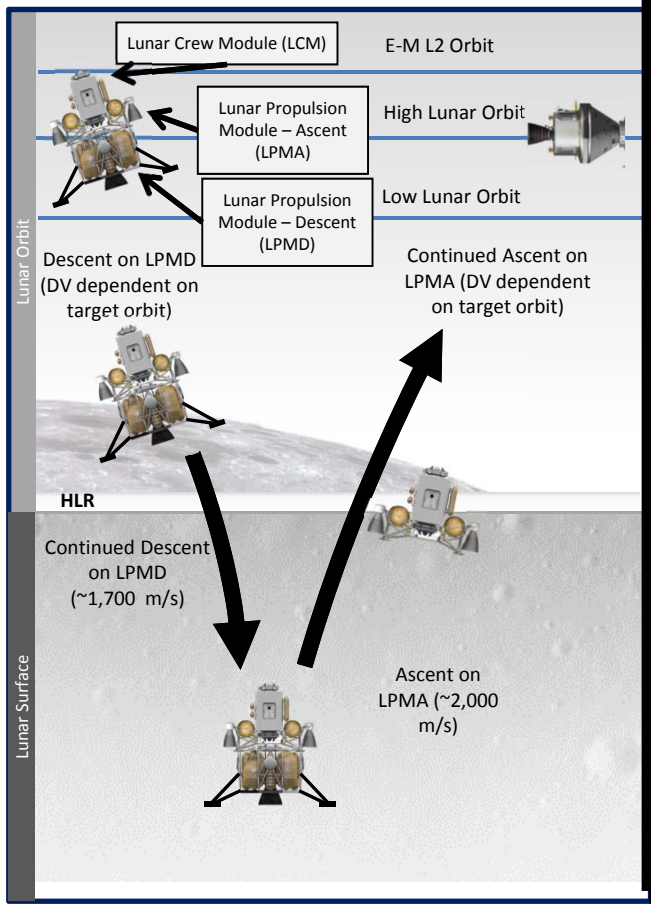


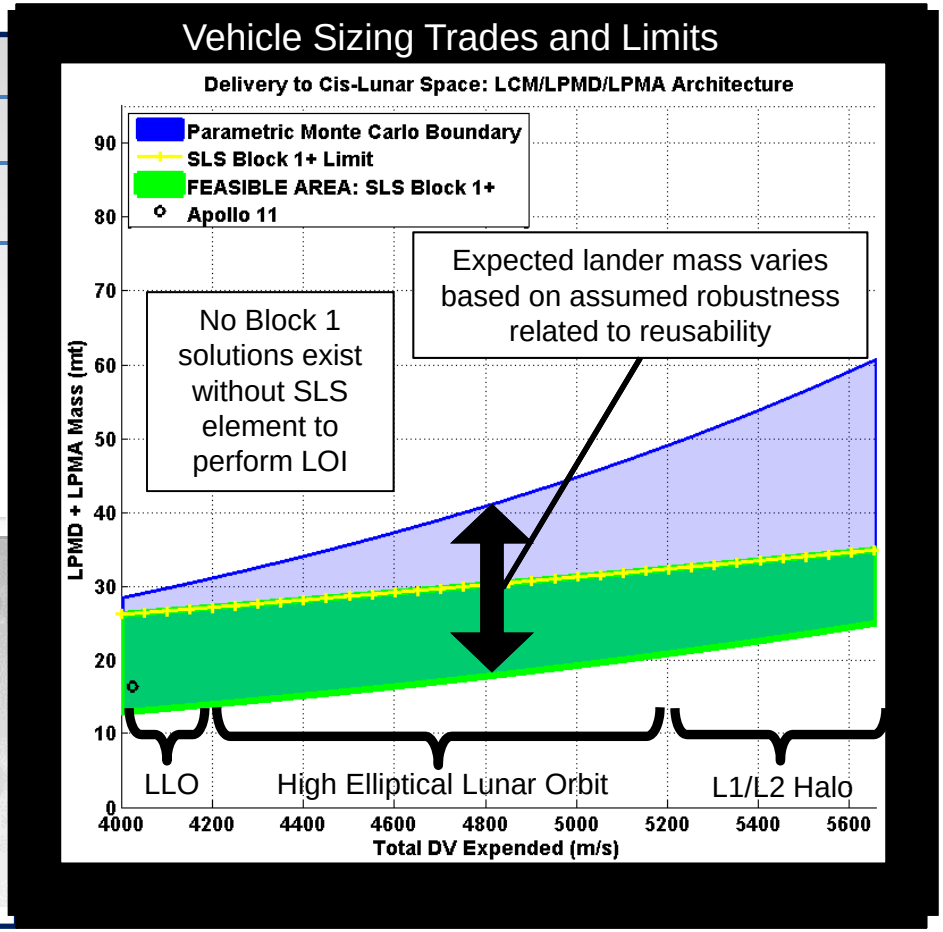
- **Maximize Usage of Available Architecture Elements**
  - Availability of Service Module as strategic lunar lander asset
  - If DSH is available, could lander be reusable
  - Trade number of stages versus reusability
- **Assess Required Capabiliy**
  - SLS Block 1 Limits
  - SLS Block 1+ Limits
  - Desired capability: Number of crew, duration
  - Impact of reuse on mass and cost
- **2-Crew Options Analyzed**
  - 2-Stage Lander with Reusable Crew Module
  - 1-Stage Lander with Reusable Crew Module and disposable Service Module

Modified HLR Option: 2-Stage Lander with Reusable Crew Module

Reusable Lander Concept

- Two part lunar lander stages on the ground like Apollo
- A Lunar Crew Module (LCM) is reusable; descent stage remains on surface.



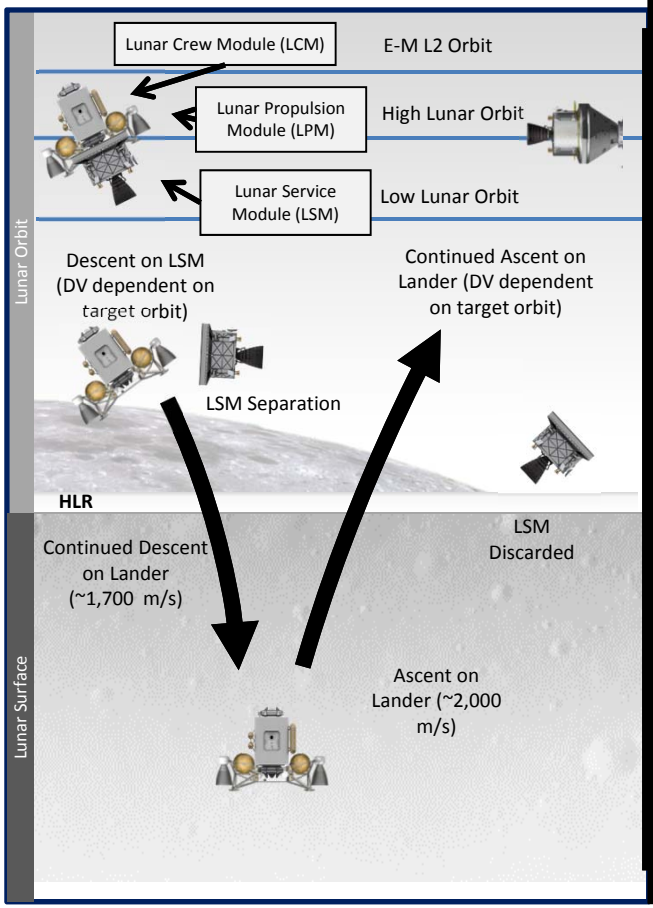


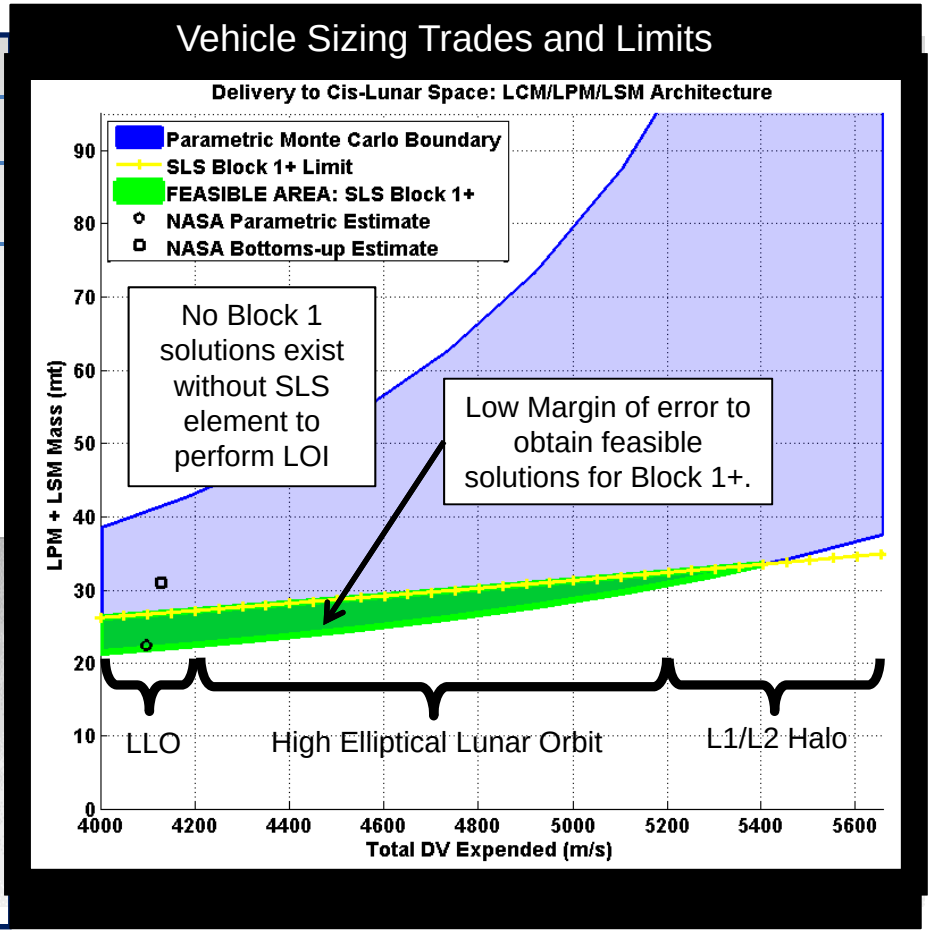
Key Takeaway: A sizeable solution space for a 2-stage lander exists within SLS Block 1+ capability.

New HLR Option: 1-Stage Lander with Service Module

3-Part Modular and Reusable Lander Concept

- Use of Service Module for multiple purposes minmizes new element costs
- Lunar Crew Module (LCM) could dock to DSH-prototype





Key Takeaway: A small solution space for a single stage lander exists within the Block 1+ capability.

Observations

- **Advantages of adding DSH-prototype option to Early DRM Phase**
  - Enables unique opportunities for science, technology and robotic/human interaction
  - Enables reusability which offers opportunity for fewer launches
  - Enables smaller launch vehicle access (e.g. EELV, Arianne, H-II class) with cis-lunar aggregation point (staging node)
  - Enables options for contingency scenarios and additional robustness in architecture
- **Need to assess how inclusion of DSH-prototype will impact GER 1 Strategy for surface exploration (forward work post GER V2 publication)**