

The background of the slide is a photograph of a Mars landscape. It features a large, layered rock formation in the foreground, with a small figure of an astronaut standing on the sandy ground to the right. The sky is a hazy, orange-brown color, typical of the Martian atmosphere.

AM V Breakout Group 1 Sortie-Class Missions to Mars

Hoppy Price

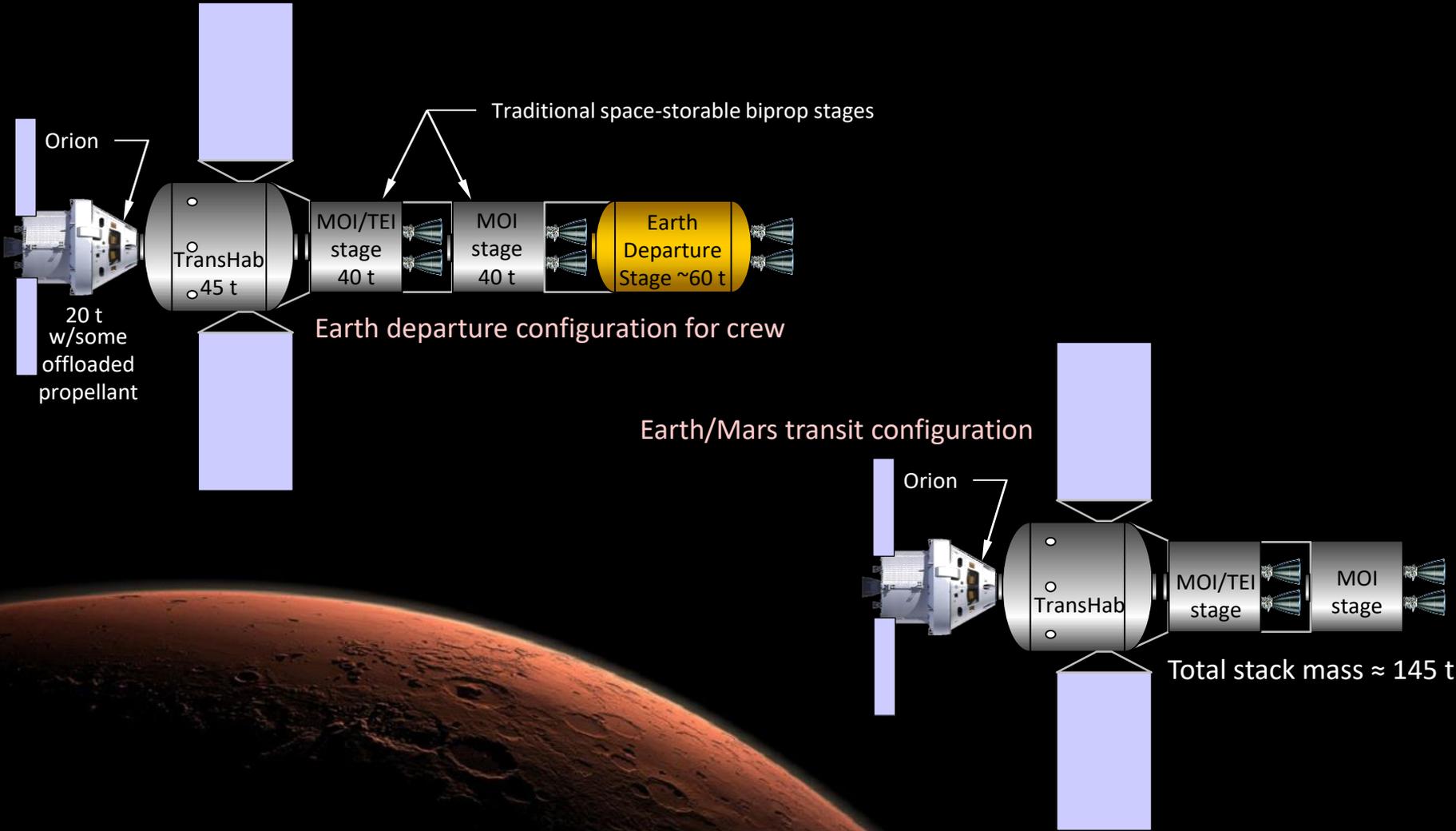
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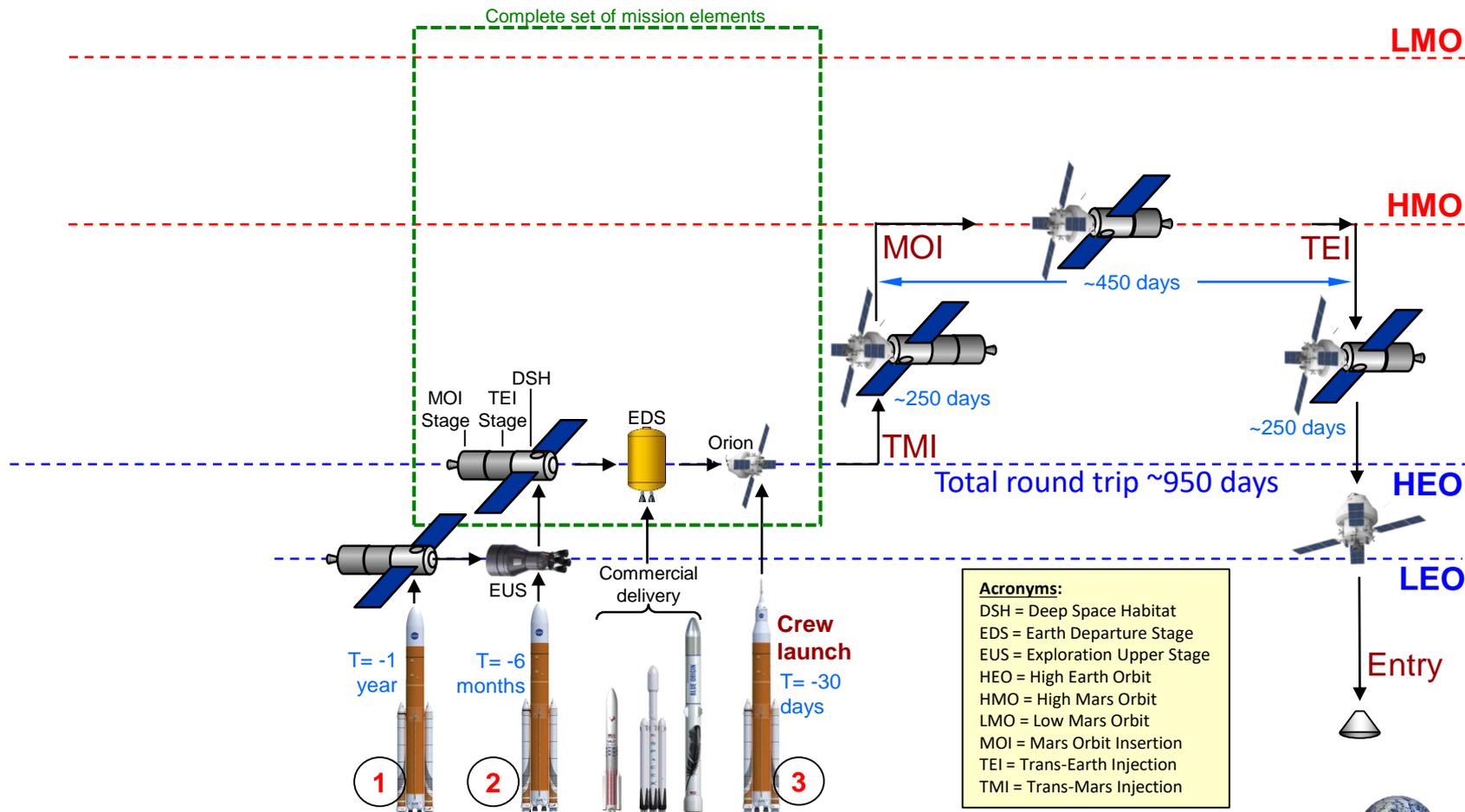
Notional Mars Transit Vehicle Configuration for AM V Architecture 1 - All-Up Departure Stack



Mars Orbit Mission Concept

crew of 4; 3 SLS launches; ~4 commercial launches

Mars



Could possibly be a commercial delivery

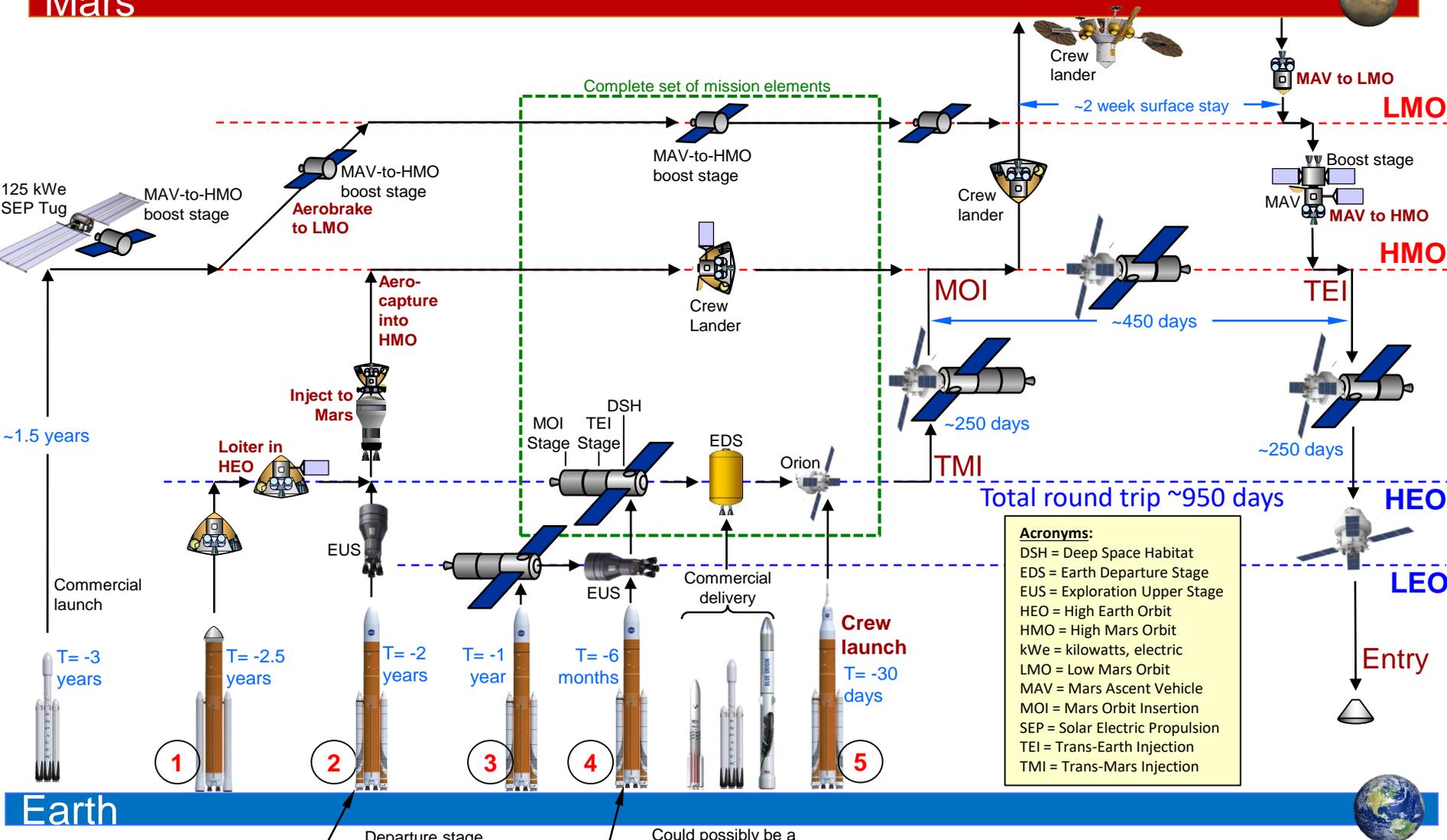
Pre-decisional. For discussion purposes only.



Two-Week Mars Surface Sortie Mission Concept

crew of 4; 5 SLS launches; ~5 commercial launches

Mars



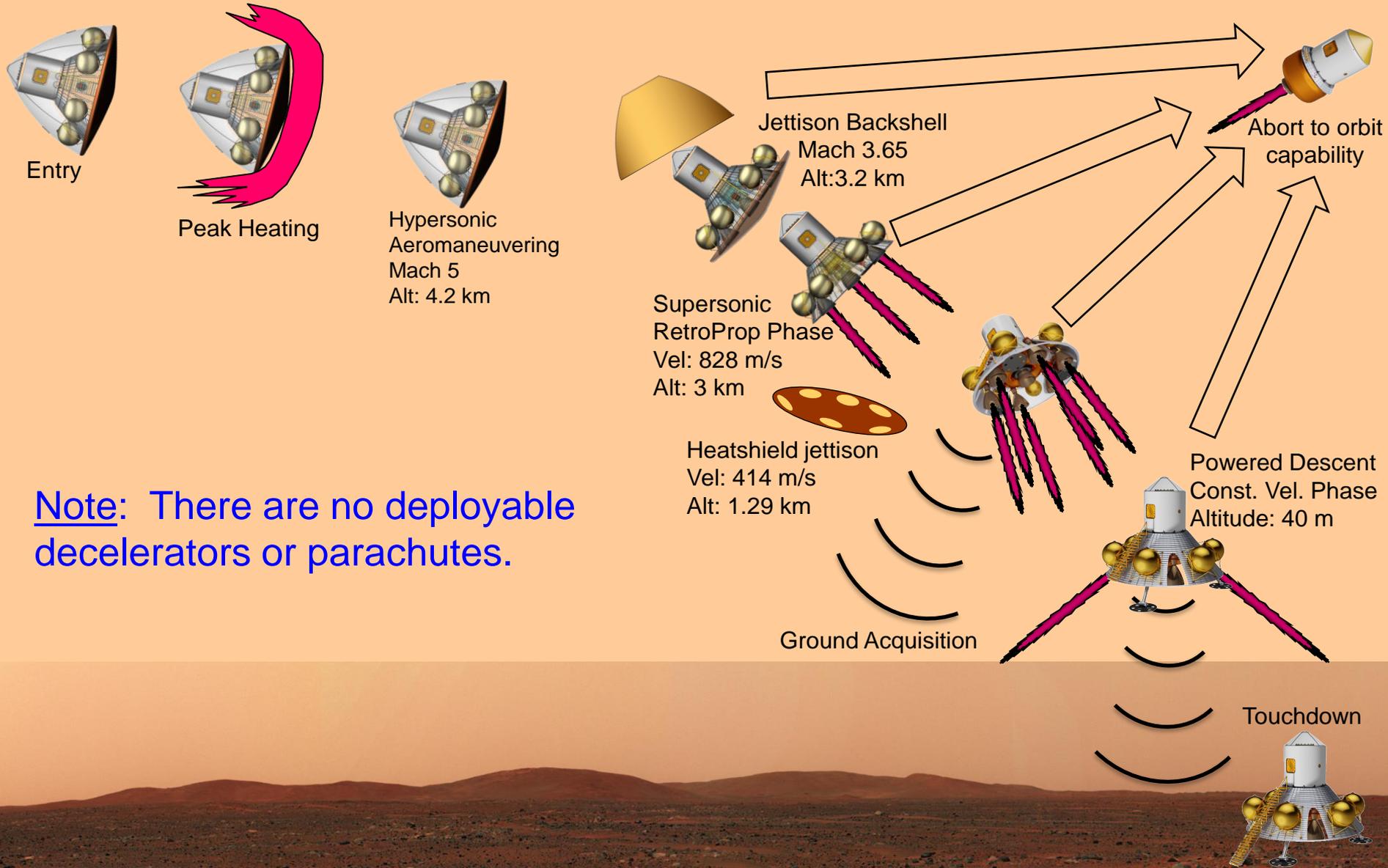
Acronyms:
 DSH = Deep Space Habitat
 EDS = Earth Departure Stage
 EUS = Exploration Upper Stage
 HEO = High Earth Orbit
 HMO = High Mars Orbit
 LMO = Low Mars Orbit
 MAV = Mars Ascent Vehicle
 MOI = Mars Orbit Insertion
 SEP = Solar Electric Propulsion
 TEI = Trans-Earth Injection
 TMI = Trans-Mars Injection

Earth



Departure stage for crew lander
 Could possibly be a commercial delivery

Entry, Descent, and Landing (EDL) Concept for Crewed Mars Lander

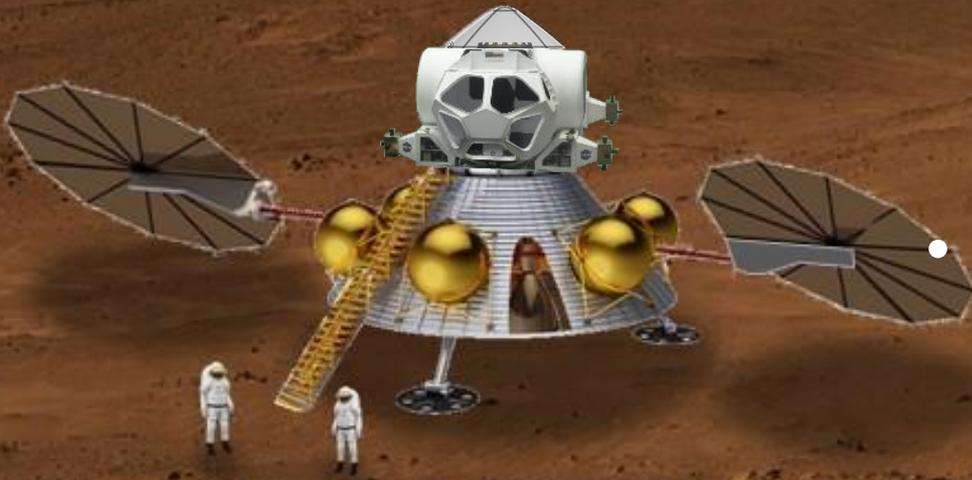


Note: There are no deployable decelerators or parachutes.

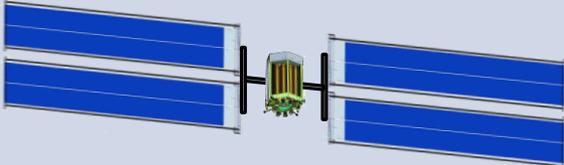
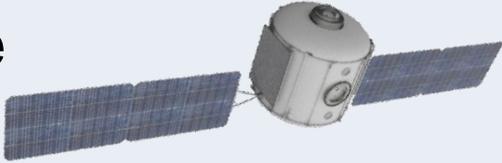
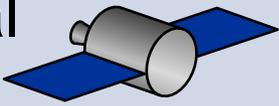
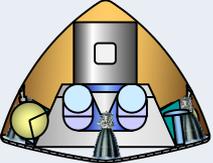
Mars Short Surface Stay Mission

First Crew on Mars

- Would be the pathfinder for a continuing series of crewed missions to Mars
- Would include a separate sky crane cargo lander with unpressurized rover and science equipment that would provide for crew surface transportation and could also be teleoperated from orbit



Six Vehicles to Enable Crewed Missions to Mars

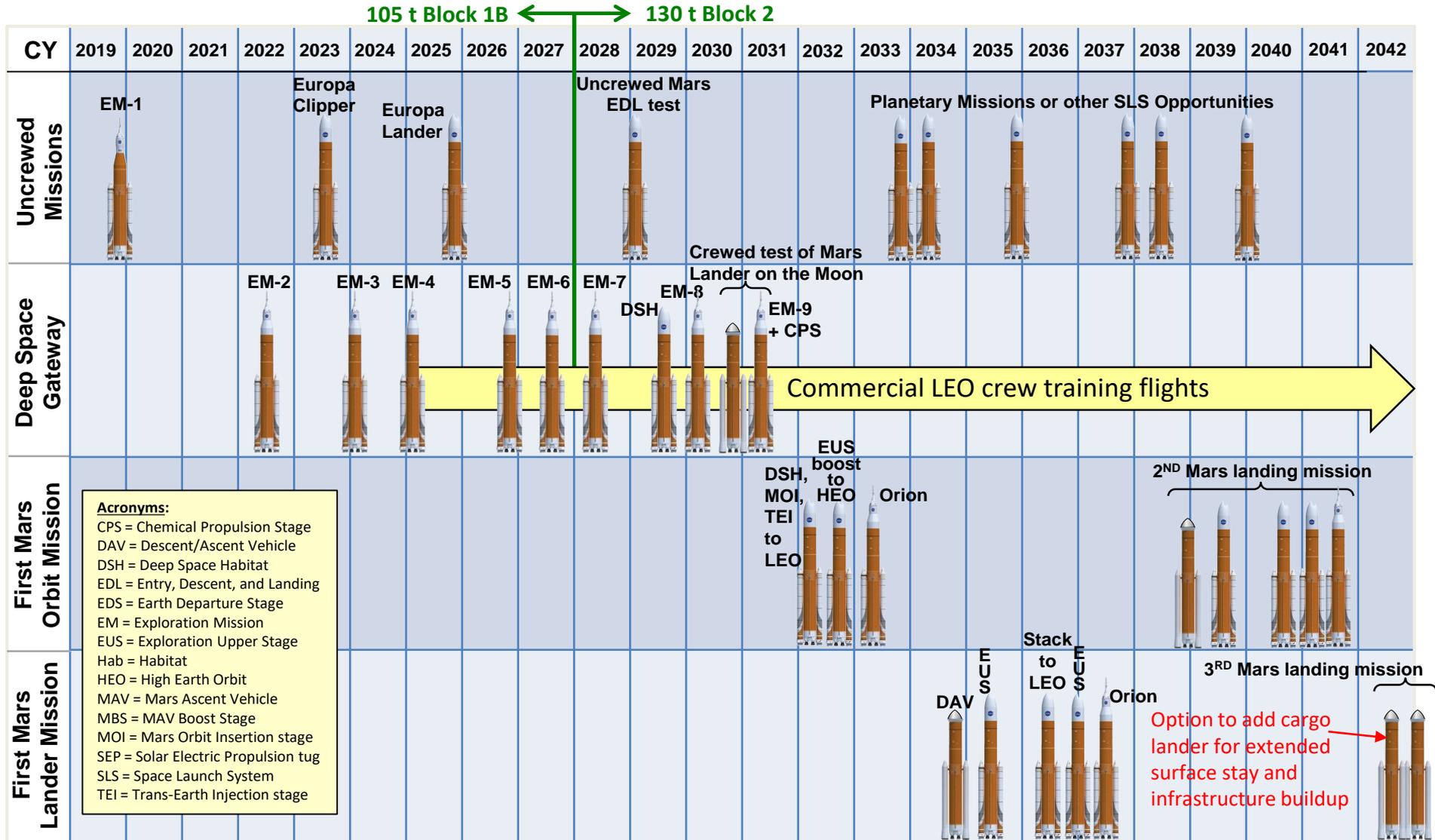
Vehicles	# Vehicles per Mission	Production Rate	
Orion 	1	1 every 4 years	In development
SLS 	5	1.25 per year	In development
SEP Tug ~125 kWe 	1	1 every 4 years	Studies are on contract
Deep Space Habitat 	1	1 every 4 years	Studies are on contract
In-Space Chemical Propulsion Stage 	4	1 per year	Could be an international contribution
Mars Lander 	1	1 every 4 years	Development would need to start

Notional Mars Mission Sequence



- Mars orbit-only mission in 2033
- Separate robotic sky crane mission would deliver 1 t unpressurized rover with science equipment
 - Could be controlled from Earth for site characterization
 - Could be teleoperated from Mars orbit
 - Would serve as unpressurized rover for the landing crew
- 1ST two-week landing sortie in 2037
- 2ND two-week landing sortie in 2041
- 3RD and following missions could include cargo landers, habitats, and/or pressurized rovers and other equipment
- Flight rate could potentially be increased to a new crew every Mars opportunity
- Program could expand to add more cargo landers, have longer stays, on-ramp new technologies, and build up a base

Notional SLS Flight Scenario



Commercial launches:

EDS Sky crane with rover
 SEP/MBS Sky crane with rover
 EDS Sky crane with rover
 SEP/MBS Sky crane with rover
 EDS Sky crane with rover

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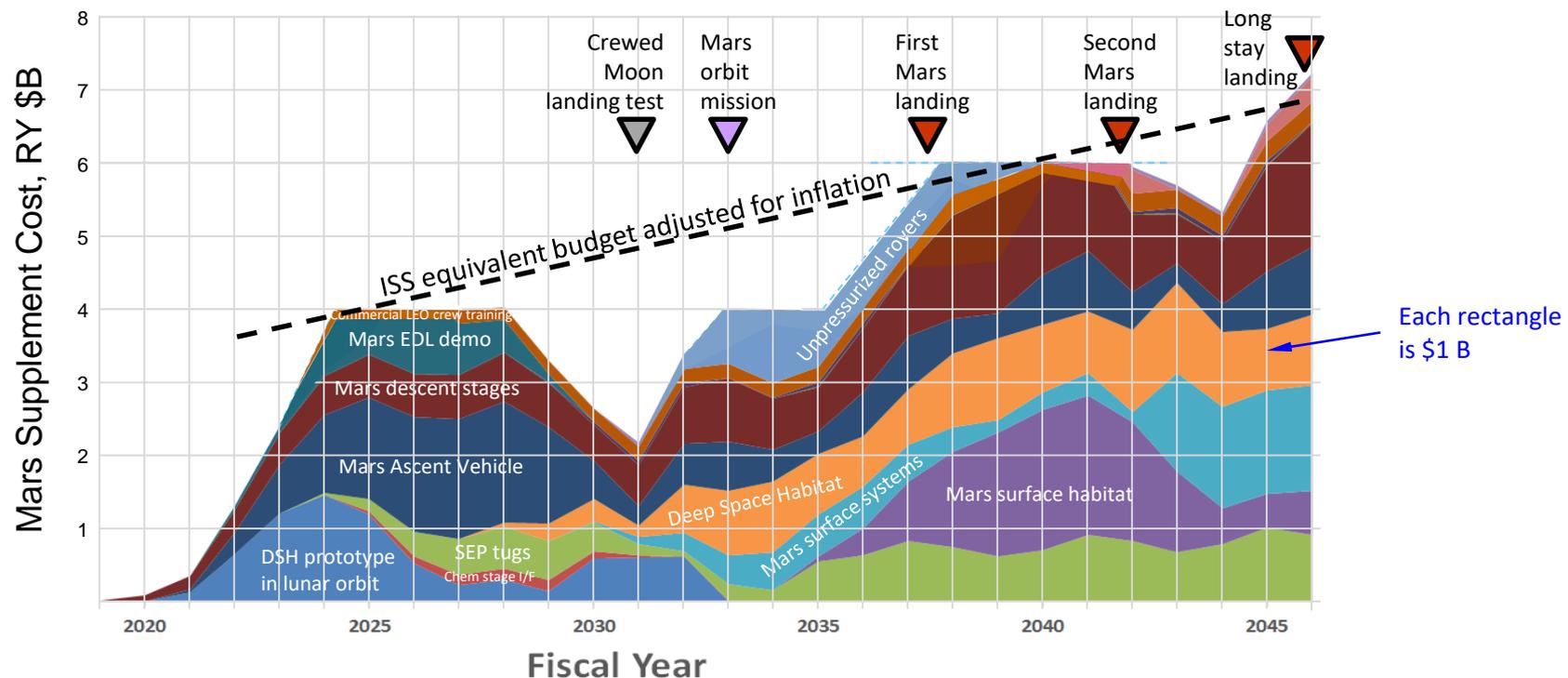
AM V Group 1 Program Cost Estimate

Mars budget supplement only, in real year dollars (includes 2.6% inflation)

Assumes SLS, Orion, and Gateway funded as separate budget items

Assumes international partners provide in-space chemical propulsion stages

- Cost methodology developed by the Aerospace Corporation
- Same methodology as 2014 NRC “Pathways” and 2017 OIG report
- Results suggest a similar annual cost and total cost as ISS, over ~25 years, adjusted for inflation



The cost information contained in this document is of a budgetary and planning nature and is intended for informational purposes only. It does not constitute a commitment on the part of JPL and/or Caltech. Pre-decisional. For discussion purposes only.