



National Aeronautics and Space Administration

5...4...3...2...1...

SPACE LAUNCH SYSTEM

SLS Payload Delivery Capability Overview

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SLS SPIE XP50

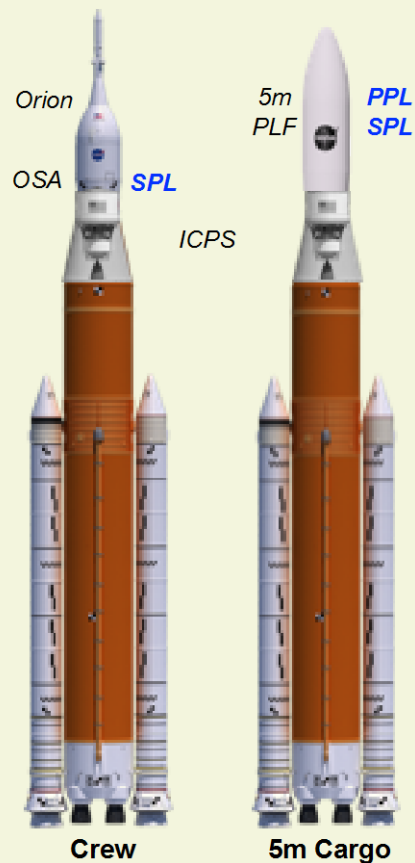
Meeting Objectives

- **Provide potential SLS users with insight on application of SLS payload accommodations against key requirements**
 - Mass to destination
 - Volume to destination
 - Time to destination
 - Cost to destination
- **Obtain SLS user feedback on specific spacecraft/payload service and accommodation needs from SLS**

SLS Block Configurations

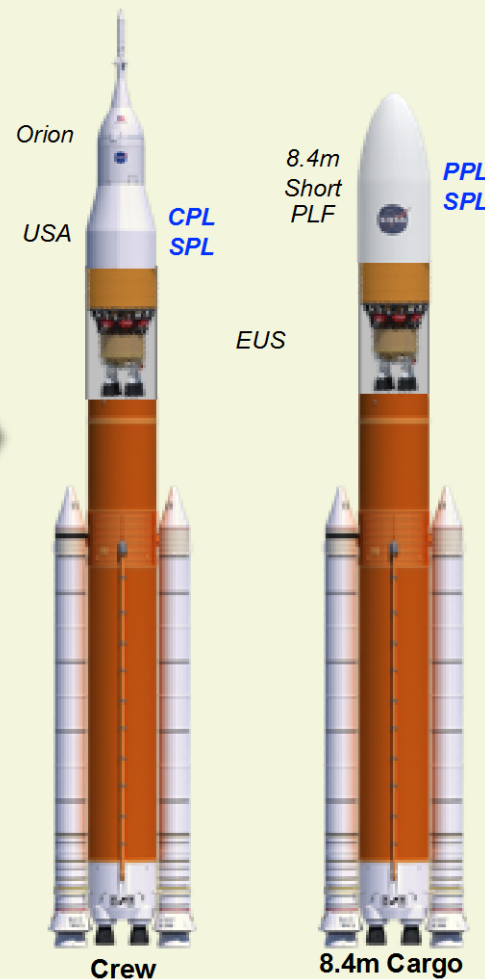
SLS Block 1

>26t to TLI
(No Earlier than 2019)



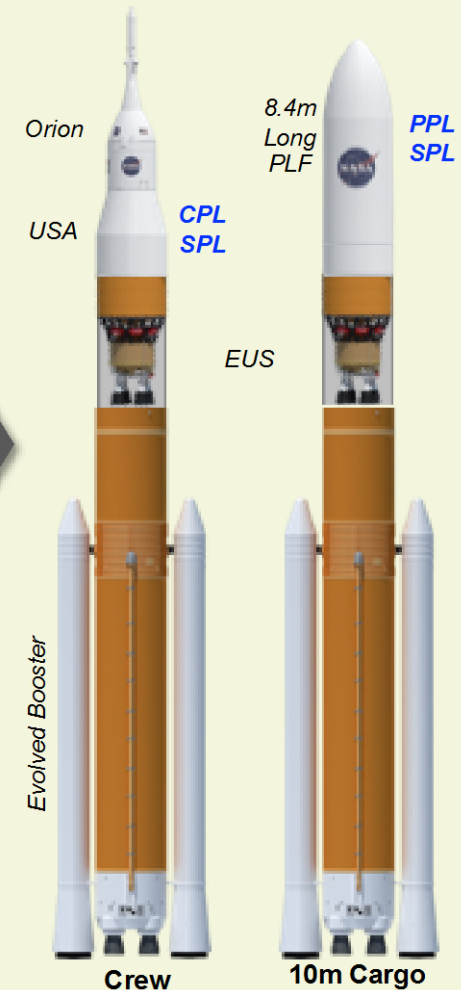
SLS Block 1B

34 - 40t to TLI
(No Earlier than 2022)



SLS Block 2

>45t to TLI
(No Earlier than 2028)



Orion Stage Adapter – OSA ICPS - Interim Cryogenic Propulsion Stage Payload Fairing - PLF EUS – Exploration Upper Stage USA – Universal Stage Adapter
PPL – Primary Payload CPL – Co-manifested Payload SPL – Secondary Payload

Recent Progress Toward First Launch



Core stage production at Michoud



Booster testing at Orbital ATK



Engine testing at Stennis Space Center



Test stand construction at Marshall

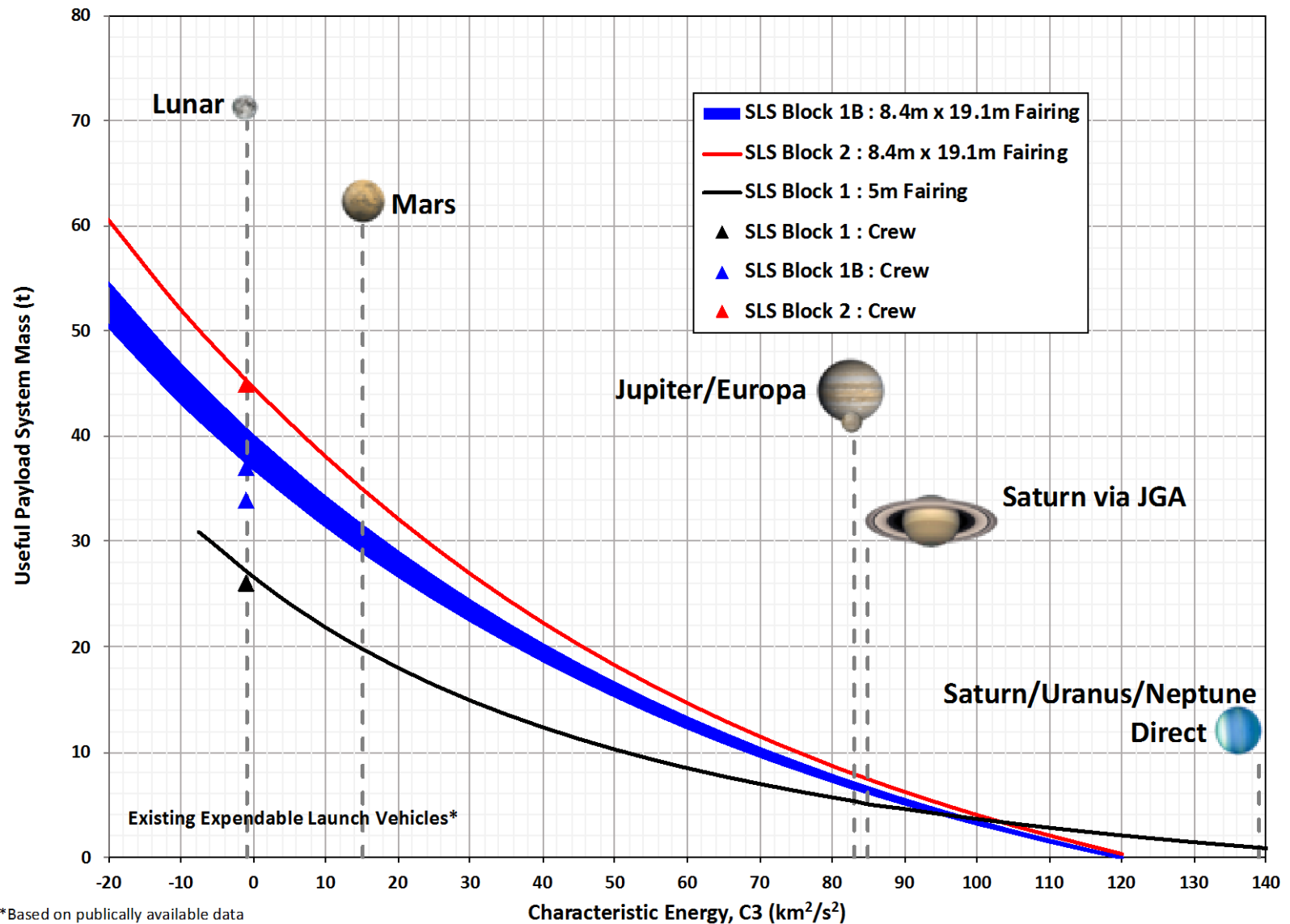


Stage adapter welding at Marshall



Upper stage production at ULA

SLS Payload Mission Capture



*Based on publicly available data

06-APR-2018

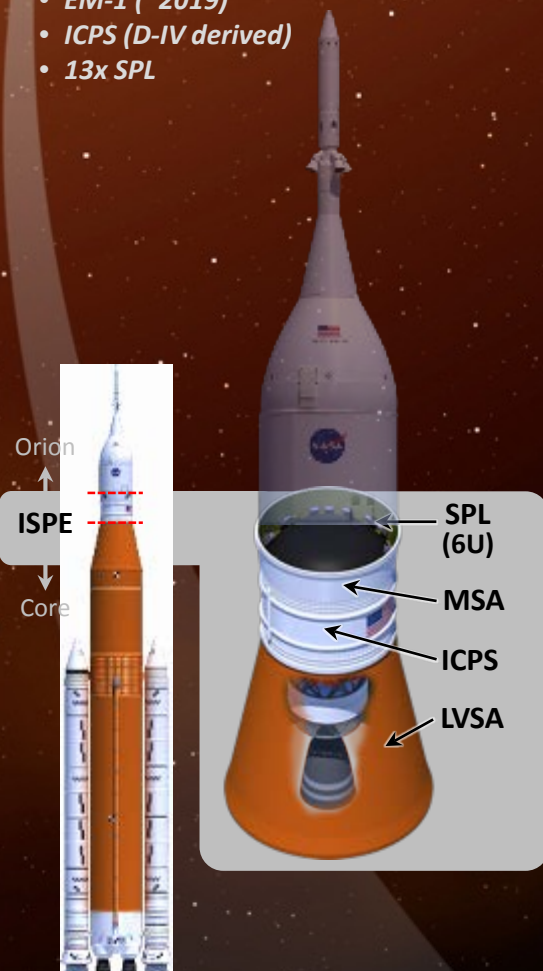
Rev. 4

Range of SLS Spacecraft/Payload Types

SLS Block 1

Test Flight

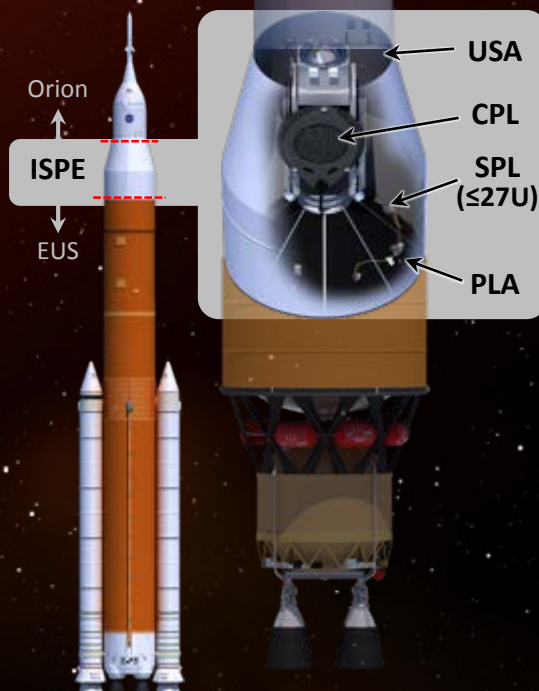
- EM-1 (~2019)
- ICPS (D-IV derived)
- 13x SPL



SLS Block 1B

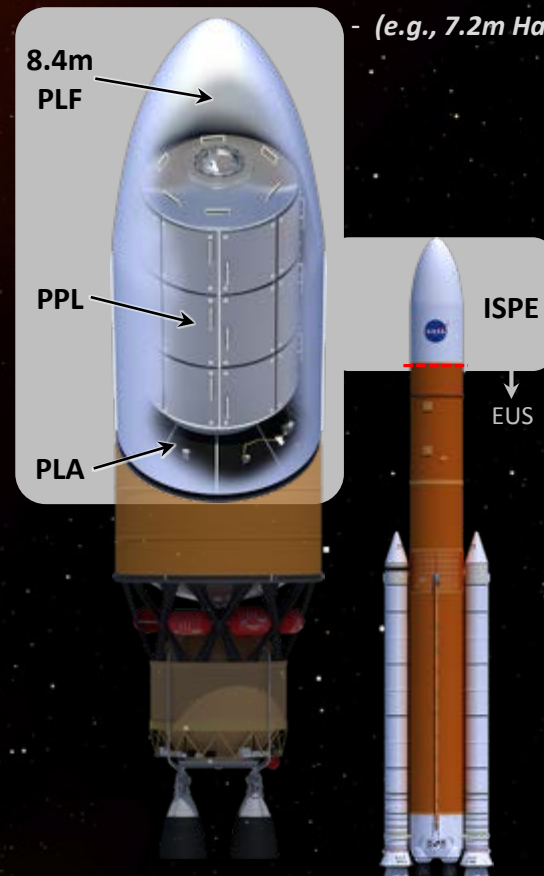
Crew

- EM-2 (~2023)
- EUS (new)
- USA & PAF (new)
- 1x CPL
- (e.g., Power SEP Bus)
- 14x SPL
- (e.g., 10x 6U; 2x 12U; 2x 27U)



Cargo

- EM-6 (~2027)
- EUS
- PLF (new)
- 1x PPL
- (e.g., 7.2m Habitat)

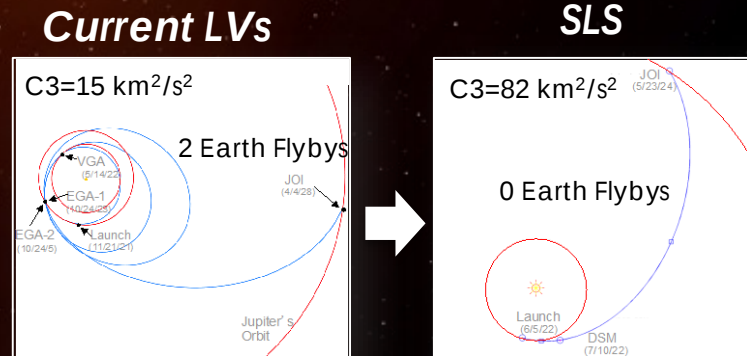


Notes: ISPE – Integrated Spacecraft Payload Element SPL – Secondary Payload MSA – MPCV Stage Adapter ICPS – Integrated Cryogenic Propulsion Stage LVSA – Launch Vehicle Stage Adapter EUS – Exploration Upper Stage USA – Universal Stage Adapter CPL – Co-manifested Payload PLA – Payload Adapter PLF – Payload Fairing PPL – Primary Payload

----- ISPE Separation Plane

SLS Time to Destination

- **Shorter Transit Times to Destination**
- **Europa Clipper**
 - Desired launch date of June 2022
 - Jovian system transit time reduced by 65% over existing launch vehicles
 - Reduced mission operations cost over time



Earliest Launch

*Period: 6/4/22 – 6/24/22 (SLS)
*Period: 6/18/22 – 7/8/22 (Atlas)



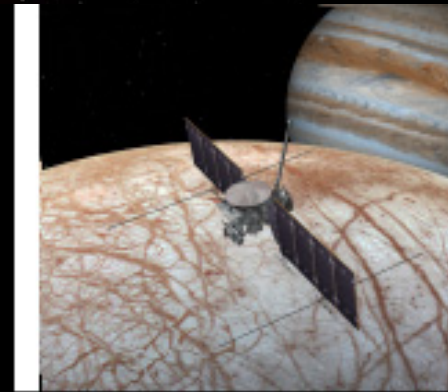
Cruise:

2.5 Years (SLS)
7.4 Years (Atlas)



Jupiter Orbit Insertion

12/24/24 or 5/1/25 (SLS)
11/26/29 (Atlas)



Jovian System Operations

Prime Europa Flyby
Campaign: 36 months

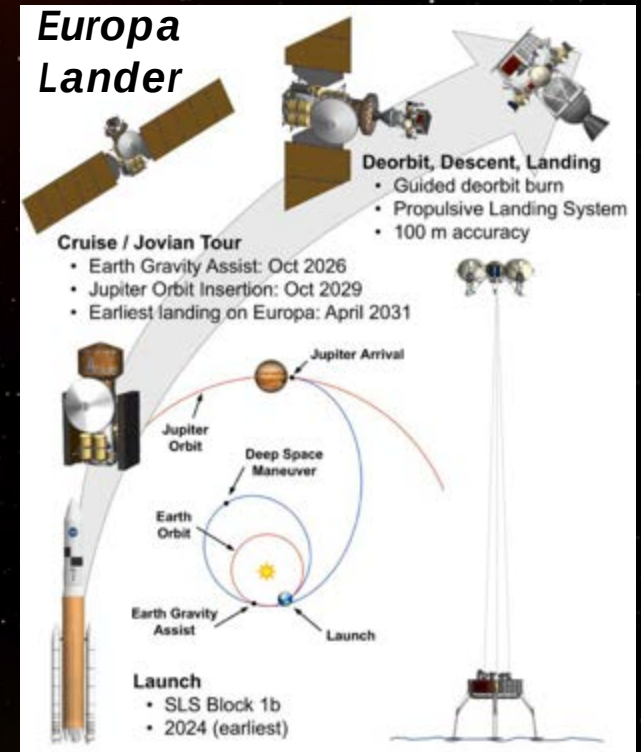
SLS Mass to Destination

- ◆ **Up to 5 times greater mass to orbit capability than current launch systems**
 - Increases payload mass margins
 - Offers range of injection propulsion options
- ◆ **New Horizons**
 - SLS would have doubled delivered payload mass to Pluto
- ◆ **Europa Lander**
 - 16 mT delivery to outer planets (with margin)

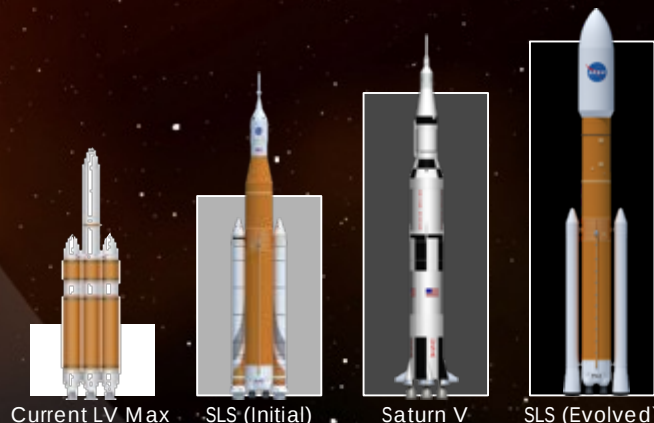
New Horizons



Europa Lander



Payload Lift Comparison



SLS Volume to Destination

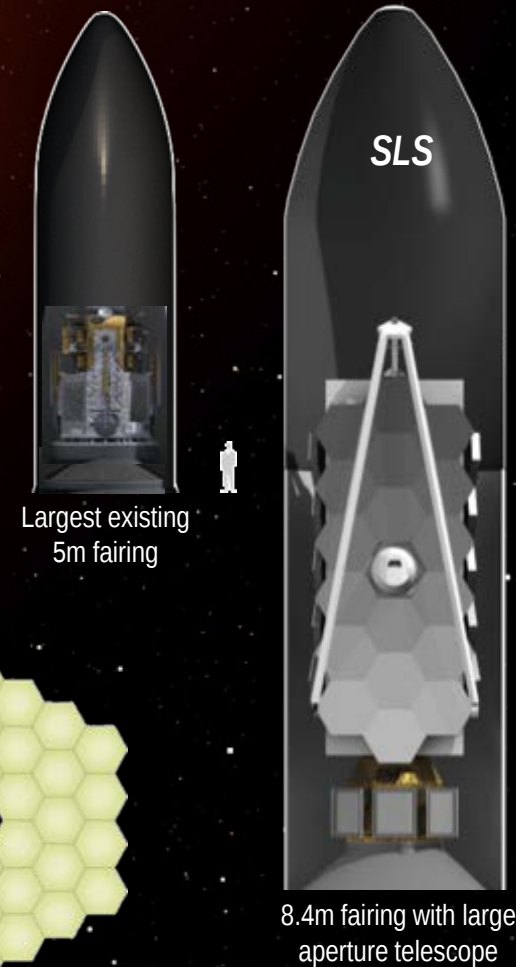
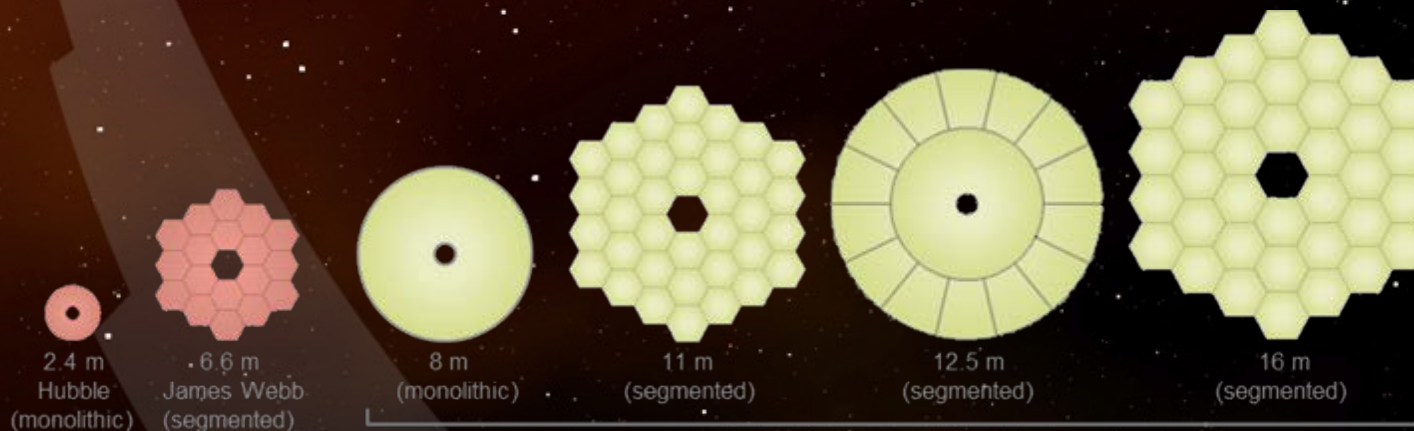
◆ Up to 6 times greater volume available

◆ Multiple payload combinations

- Dual manifesting within fairing
- Payload Constellations
- More powerful injection stages

◆ Telescopes

- Larger payloads translate into simpler orbital operations (fewer deployments)



SLS Cost to Destination

B1 B1B B2



Representative Timeline

Launch Date	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
SLS Opportunity	EM-1 ▽			EM-2 ▽ C	SM-1 Europa ▽ C	EM-3 ▽ C	EM-4 ▽ C	EM-5 ▽ C	EM-6 ▽ C	EM-7 ▽ C	EM-8 ▽ C	EM-9 ▽ C	EM-10 ▽ C

C - Crew ▽ Block 1 ▽ Block 1B ▽ Block 2

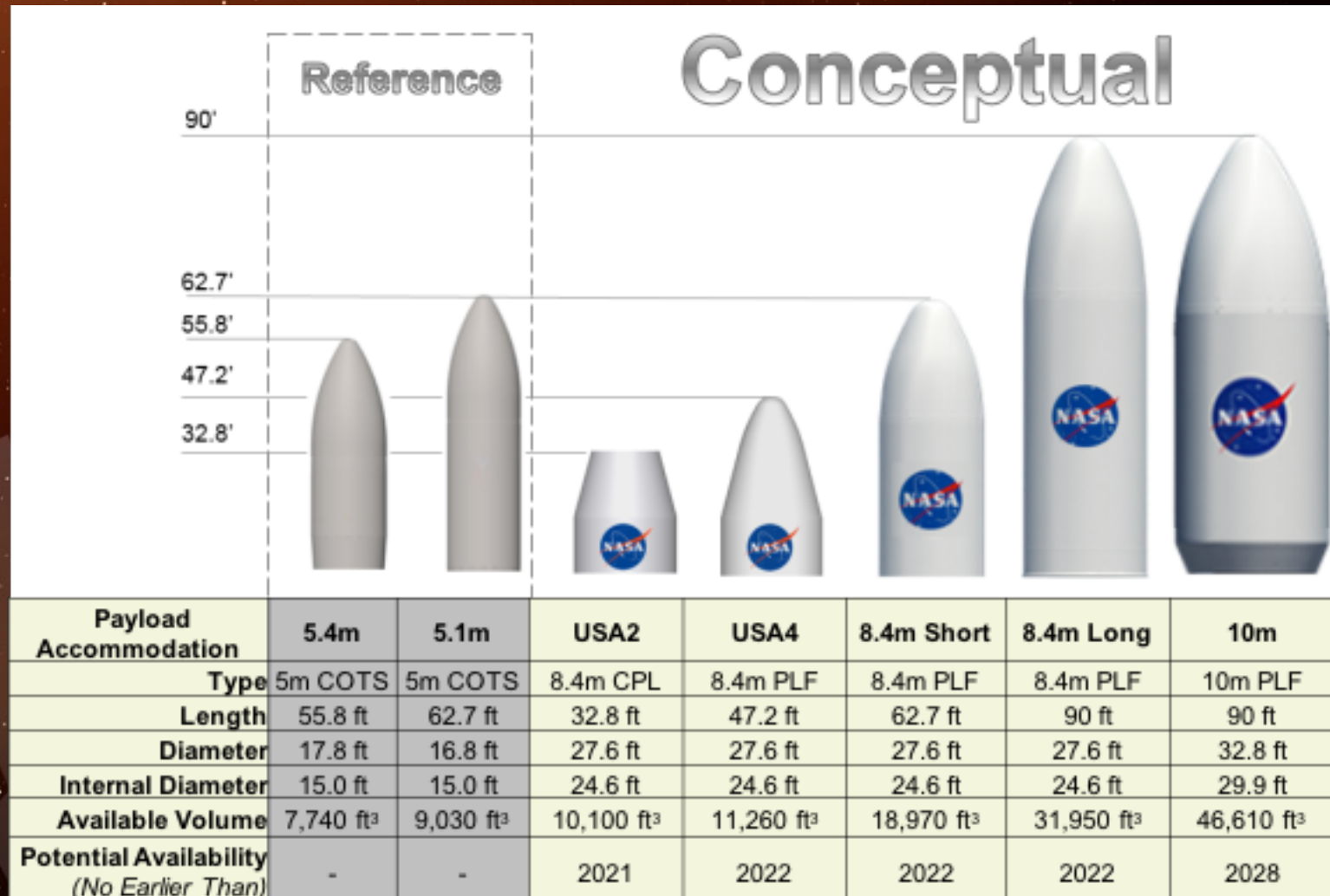
- ◆ **Plan to fly at least 1 crewed SLS per year**
 - System has capability to fly up to 3 SLS's per year
- ◆ **Orion Co-manifested Payloads cost limited to launch vehicle integration activities**
 - More volume than Shuttle Payload Bay
 - Up to 10 mT of payload to cis-lunar space
- ◆ **Multiple payload combinations possible**
 - New 8.4m class (w/COTS separation systems)
 - ELV 5m class (w/COTS separation systems)
 - ESPA ring class (w/COTS separation systems)
 - Up to 27U Cubesats (w/COTS dispenser systems)



Largest existing
5m fairing

Orion Co-manifested
Payload (8.4m USA)

Range of Payload Encapsulation

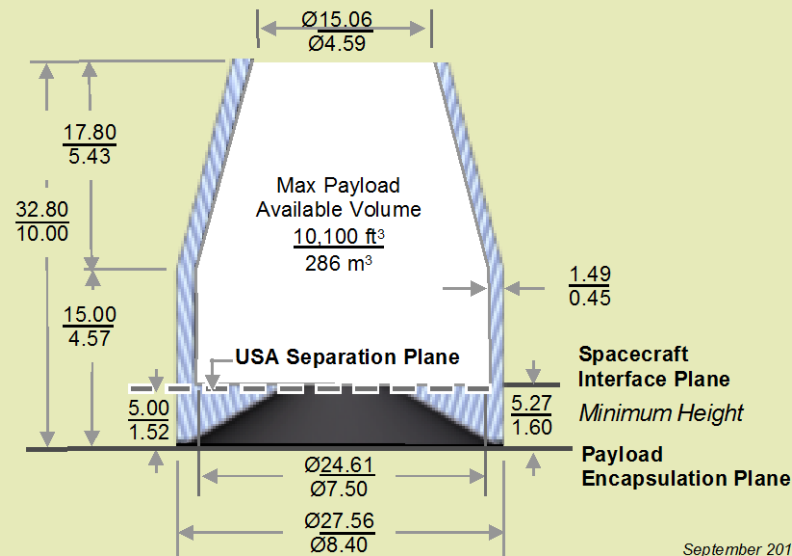


Blk 1B

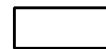
COTS: Commercial Off-the-Shelf; PLF: Payload Launcher; CPL: Commercial Payload Launcher

SLS Block 1B Crew Configuration Payload Envelopes

8.4m USA Concept



September 2016



Available Payload Dynamic Envelope



Fairing Envelope (w/acoustic attenuation)

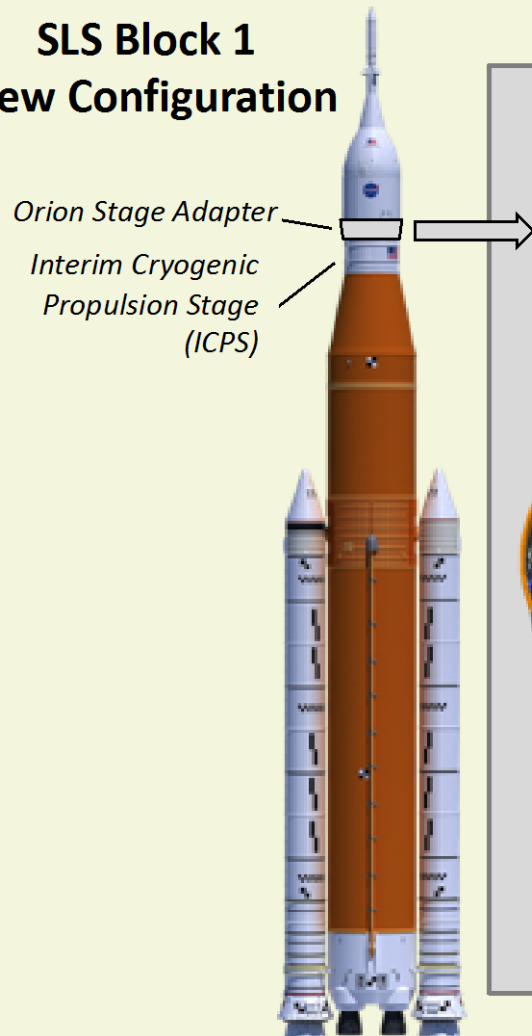


Minimum Payload Adapter Envelope

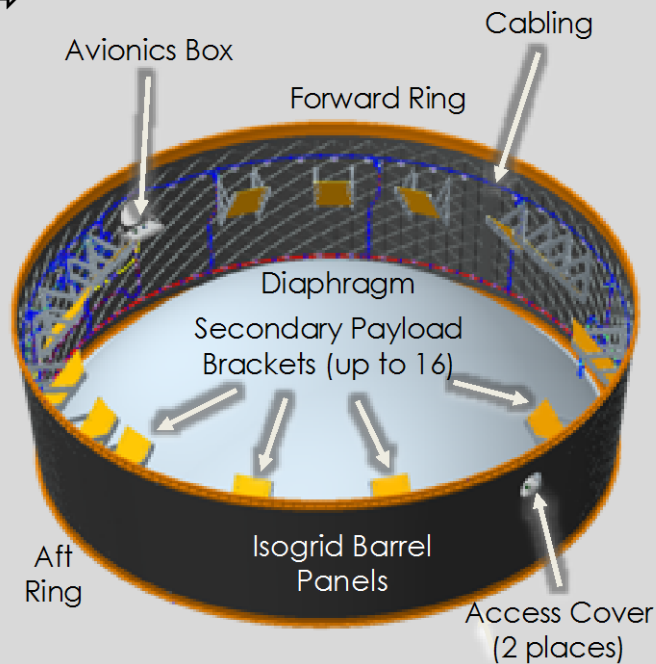
- All dimensions in $\frac{\text{Feet}}{\text{m}}$
- Height of the spacecraft separation/interface plane depends on spacecraft/PAF attach diameter and PAF cone angle
- Spacecraft appendages projecting below spacecraft interface plane may be permitted; coordinate with SLS/SPIE

SLS Block 1 Crew Configuration Payload Envelopes

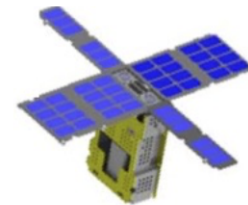
SLS Block 1 Crew Configuration



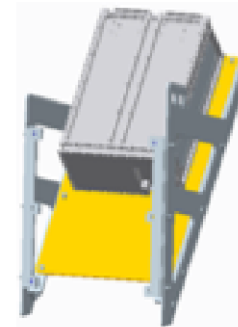
Orion Stage Adapter (OSA)



6U Cubesat Payload

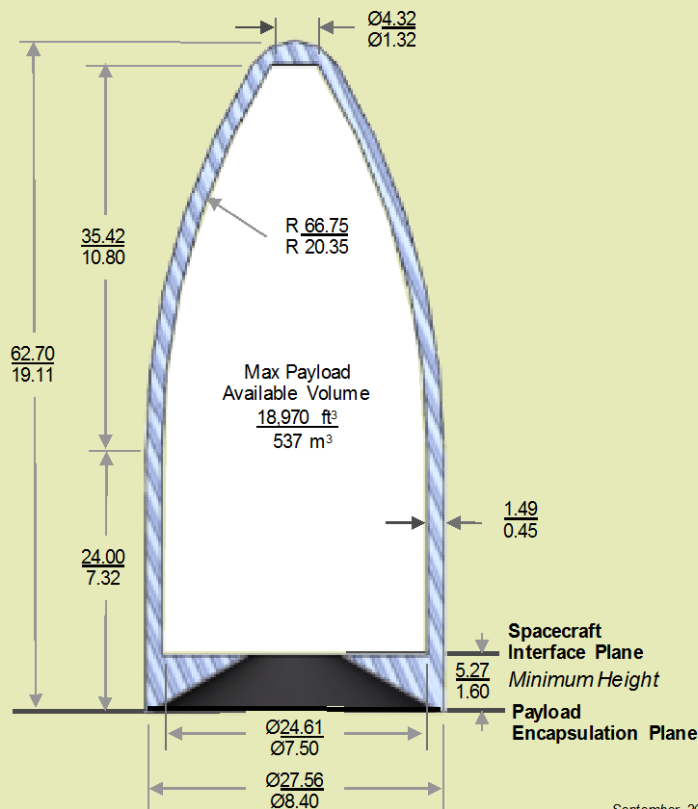


6U Cubesat Dispenser



SLS Block 1B Cargo Configuration Payload Envelopes

8.4m PLF, Short Concept

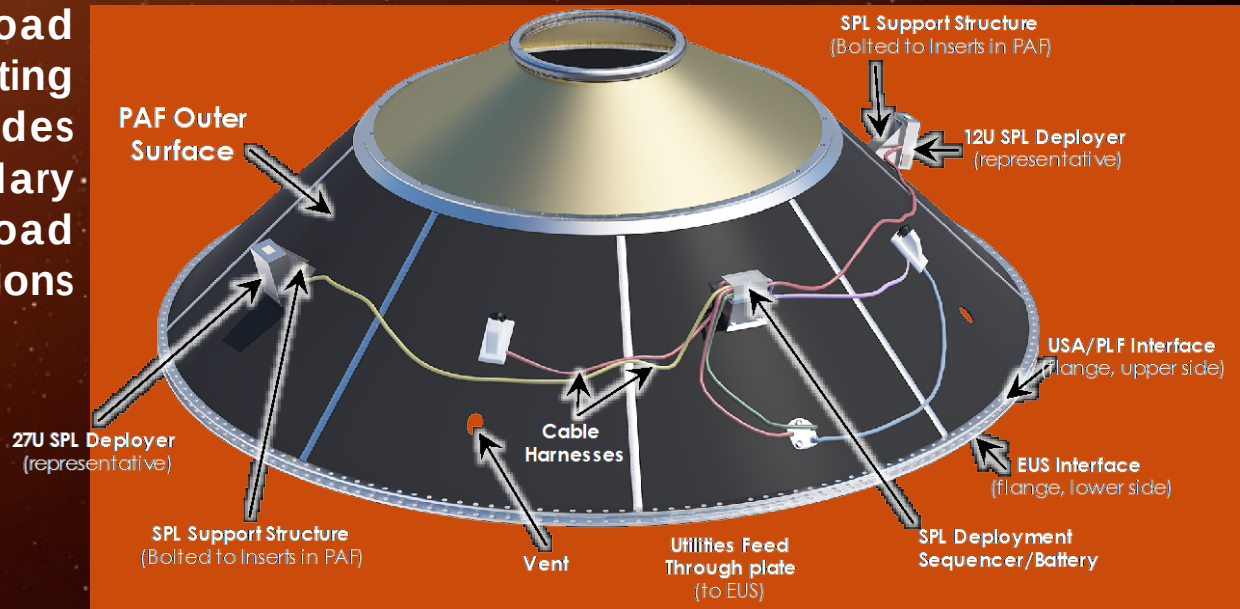


-  Available Payload Dynamic Envelope
-  Faring Envelope (w/acoustic attenuation)
-  Minimum Payload Adapter Envelope

- All dimensions in ^{Feet}_m
- Height of the spacecraft separation/interface plane depends on spacecraft/PNF attach diameter and PNF cone angle
- Spacecraft appendages projecting below spacecraft interface plane may be permitted; coordinate with SLS/SPIE

SLS Secondary Payload Capability

SLS Payload Attach Fitting (PAF) provides Secondary Payload accommodations

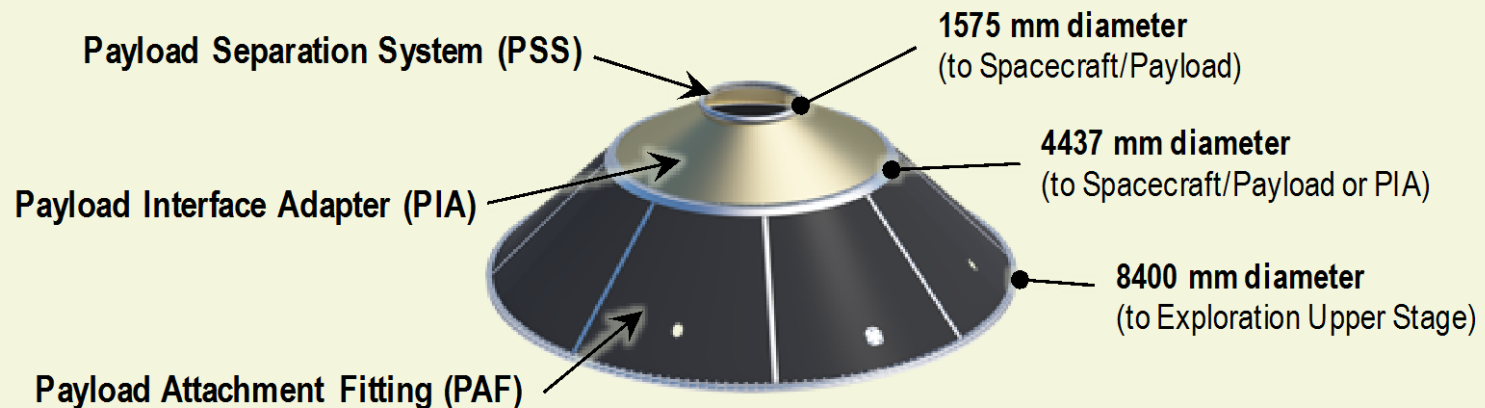


- Block 1B vehicle offers up to seven 12U to 27U payload locations (or their volume equivalent) on the PAF outer face
- Payloads will be “off” from roll-out through Orion separation and payload deployment
- Payload Deployment System Sequencer; payload deployment will begin with pre-loaded sequence following Orion separation and Upper Stage disposal burn
- Payload requirements captured in a Interface Definition and Requirements Document



Conceptual

SLS Payload Adapter



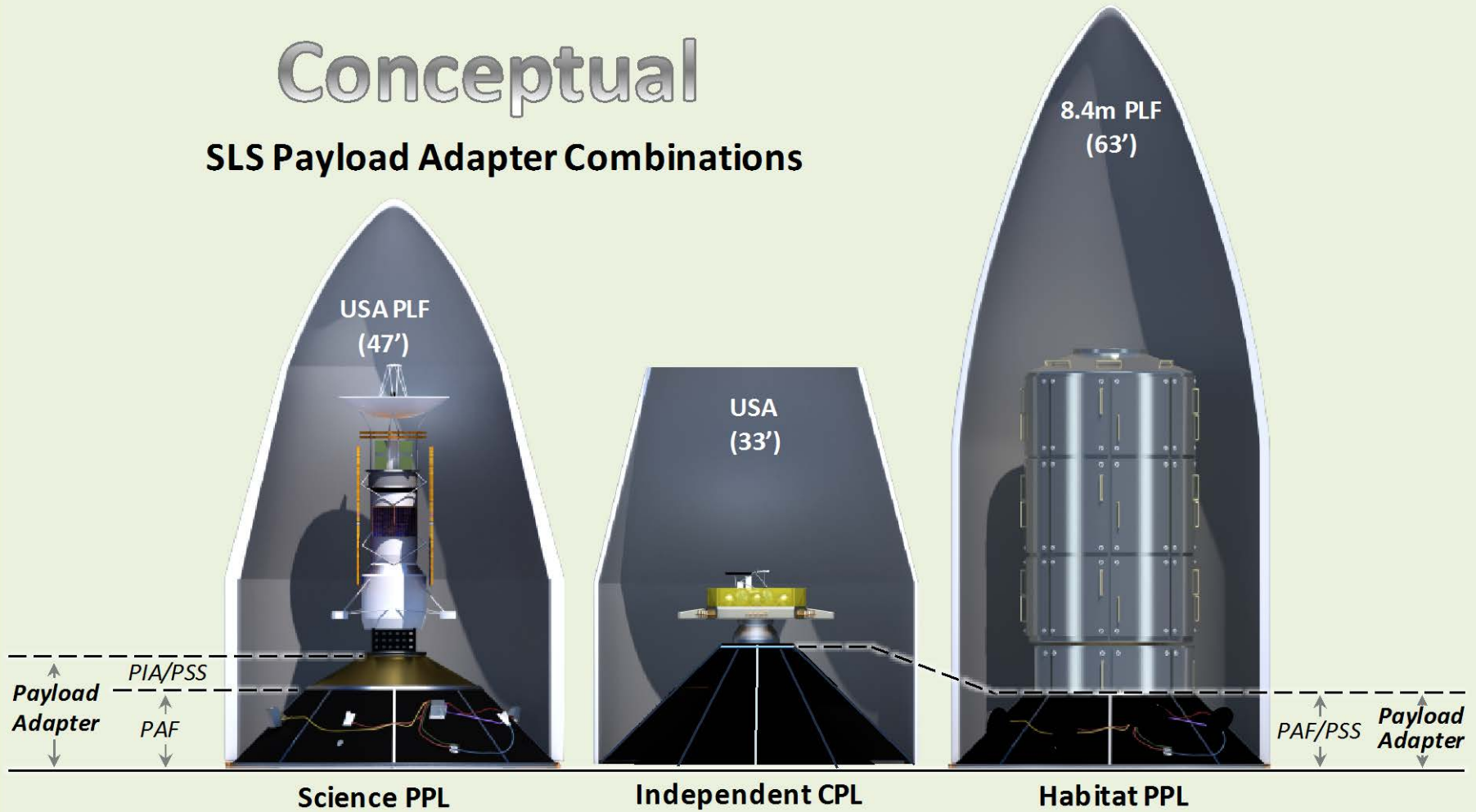
Concept	Payload		Payload Adapter Attributes				
	Interface Diameter	Load (L) Range (1)	PAF	PIA	PSS	Mass	Height
1	62.01 in (1575 mm)	L ≤ 22,046 lb (10.0 t)	X	X	X	(2)	106 in (2701 mm)
2	174.7 in (4437mm)	L ≤ 22,046 lb (10.0 t)	X	-	X	(2)	74.9 in (1903 mm)
3	174.7 in (4437mm)	L ≤ 88,185 lb (40.0 t)	X	-	X	(2)	74.9 in (1903 mm)

(1) As constrained by Block 1B Payload c.c. envelopes

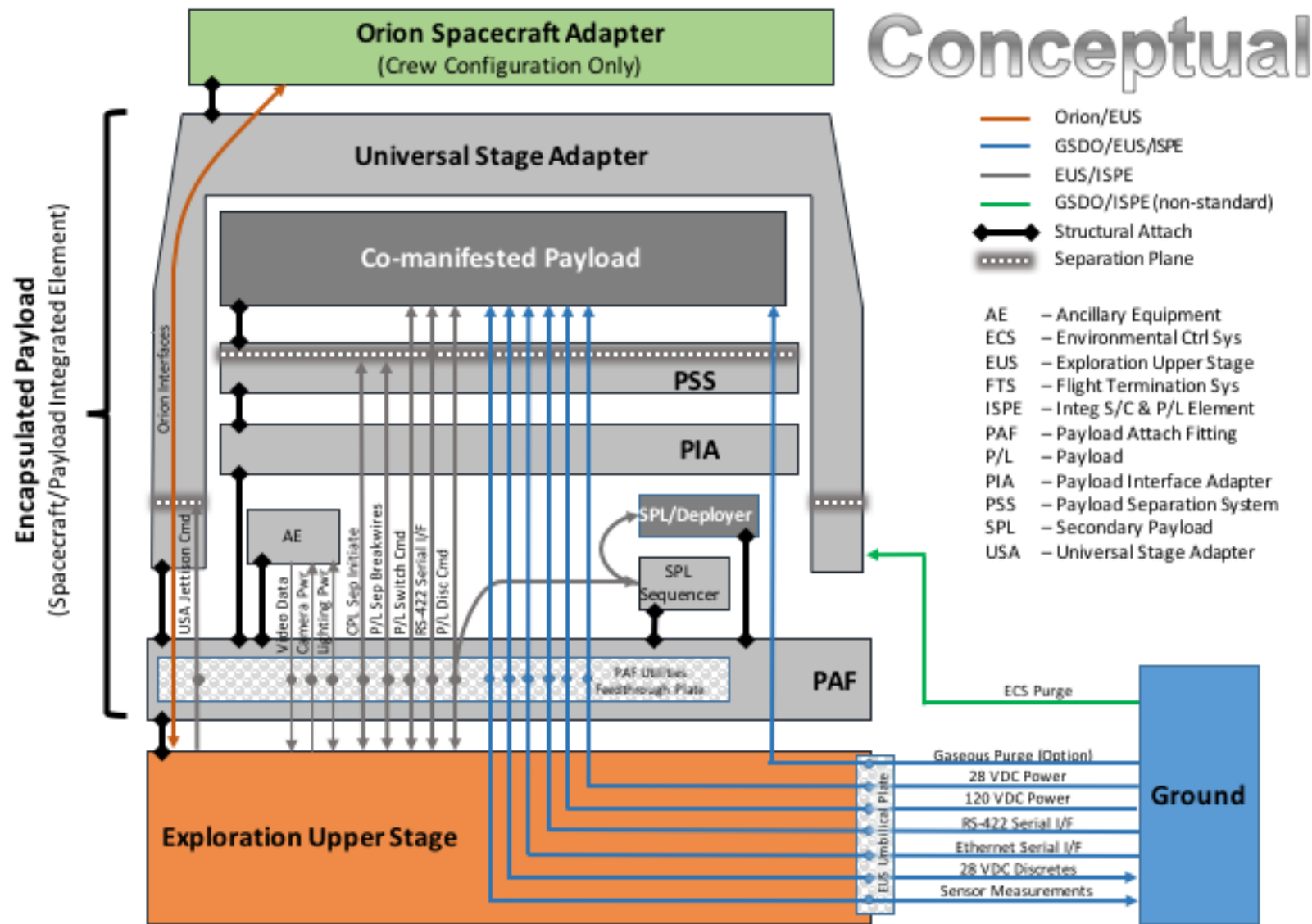
(2) Current Payload Adapter concept mass estimates range from 1,764 lb (0.8 t) to 3,307 lb (1.5 t)

Conceptual

SLS Payload Adapter Combinations



SLS Payload Resources



SLS Payload Ground Operations

