NASA’s Space Launch System: An Enabling Capability for Discovery

Stephen Creech
Assistant Program Manager, Strategy & Partnerships
Space Launch System (SLS) Program
March 2014
SLS Initial Configuration

- Solid Rocket Boosters (2)
- RS-25 Engines (4)
- Core Stage and Avionics
- Interim Cryogenic Propulsion Stage (ICPS)
- MPCV/Stage Adapter (MSA)
- Encapsulated Service Module Panels
- Service Module
- Crew Module
- Launch Abort System
- Orion Multi-Purpose Crew Vehicle (MPCV)
- Launch Vehicle/Stage Adapter
SLS Initial Configuration Performance

- Lunar
- Mars
- Jupiter/Europa Saturn via JGA (mid 2030's)
- Saturn/Uranus Direct

Payload System Mass (mt) vs. Launch Energy, C3 (km²/s²)

- Block 1 SLS with DCSS
- Delta IV-H
- Atlas V 551
- Falcon Heavy
SLS Block Commonality

Launch Abort System

Commonality of Payload Interfaces

Orion, Multi-Purpose Crew Vehicle (MPCV- LMCO)

Interim Cryogenic Propulsion Stage (ICPS) (EELV 5m DCSS – Boeing/ULA)

Commonality of Engines

Core Stage/Avionics (Boeing)

5-Segment Solid Rocket Booster (SRB) (ATK)

Core Stage Engines (RS-25) (PWR)

Commonality of Engines

Evolutionary Path to Future Capabilities
- Minimizes unique configurations
- Allows incremental development
- Evolve for Expanding Mission Capability

Block 1
Initial Capability, 2017-21
70 metric ton Payload

Block 2 Capability
130 metric ton Payload

Evolutionary Path to Future Capabilities
- Minimizes unique configurations
- Allows incremental development
- Builds on Ares heritage

Upper Stage

Advanced Solid or Liquid (i.e., RP Engines) Boosters
SLS Evolved Performance

SLS Offers Reduced Transit Times to Outer Planets

- 70 t SLS Shaves **5 Years** off the Cruise Time for Titan Saturn System Mission
- 70 t SLS Shaves **4 Years** off the Cruise Time for Uranus Orbiter and Probe

Payload System Mass (mt)

Characteristic Energy, $c_3$ (km$^2$/s$^2$)

- Lunar
- Mars
- Jupiter/Europa (mid 2030s)
- Saturn via JGA
- Saturn/Uranus Direct

Dec. 2013
SLS Offers Unrivaled Payload Volume

- SLS is investigating utilizing existing fairings for early cargo flights, offering payload envelope compatibility with design for current EELVs.

- Phase A studies in work for 8.4m and 10 m fairing options.

<table>
<thead>
<tr>
<th>Size</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>4m x 12m</td>
<td>100 m³</td>
</tr>
<tr>
<td>5m x 14m</td>
<td>200 m³</td>
</tr>
<tr>
<td>5m x 19m</td>
<td>300 m³</td>
</tr>
<tr>
<td>8.4m x 31m</td>
<td>1200 m³</td>
</tr>
<tr>
<td>10m x 31m</td>
<td>1800 m³</td>
</tr>
</tbody>
</table>
Global Exploration Roadmap

International Space Station
General Research and Exploration Preparatory Activities

Note: ISS partner agencies have agreed to use the ISS until at least 2020.

Commercial or Government Low-Earth Orbit Platforms and Missions

Robotic Missions to Discover and Prepare
- LADEE
- Luna-25
- Chandrayaan-2
- Luna-26
- Luna 27
- RESOLVE
- SELENE-2
- Luna 28/29
- SELENE-3
- Rosetta
- Hayabusa2
- OSIRIS-REx
- Apophis
- MAVEN
- ISRO Mars
- ExoMars
- InSight
- ExoMars
- Mars 2020
- JAXA Mars Precursor

Mars Sample Return and Precursor Opportunities

Human Missions Beyond Low-Earth Orbit
- Explore Near-Earth Asteroid
- Extended Duration Crew Missions
- Humans to Lunar Surface
- Missions to Deep Space and Mars System
- Sustainable Human Missions to Mars Surface
SLS Mission Capabilities

Space Habitat
Asteroid Rendezvous
Deep Space Telescope
GEO Servicing
Solar Probe
Mars Sample Return
Mars Cargo Lander
Humans to Mars
Europa Clipper
Enceladus Return
Uranus Spacecraft
Interstellar
SLS Benefits for Science Missions

◆ SLS Being Developed to Enable Exploration
  • Volume and mass capability/margin required for complex deep-space human mission
    - Increased design simplicity
    - Fewer origami-type payload designs needed to fit in the fairing
    - Simplifies on-orbit operations
    - Reduced risks and hazards

◆ SLS investment can be leveraged for other missions requiring large volume or mass, or reduced trip times
  • Deep Space Exploration
  • Planetary Landers
  • Human Habitats
  • Great Observatories
  • Space Solar Power
  • Outer Planet Missions
  • National Security Space Payloads
Manufacture and Testing Underway
Summary

◆ **SLS provides capability for human exploration missions.**
  • 70 t configuration enables EM-1 and EM-2 flight tests.
  • Evolved configurations enable missions including humans to Mars.

◆ **SLS offers unrivaled benefits for a variety of missions.**
  • 70 t provides greater mass lift than any contemporary launch vehicle; 130 t offers greater lift than any launch vehicle ever.
  • With 8.4m and 10m fairings, SLS will offer greater volume lift capability than any other vehicle.
  • Initial ICPS configuration and future evolution will offer high C3 for beyond-Earth missions.

◆ **SLS is currently on schedule for first launch in December 2017.**
  • Preliminary design completed in July 2013; SLS is now in implementation.
  • Manufacture and testing are currently underway.
  • Hardware now exists representing all SLS elements.