

Moon to Mars Architecture Segments







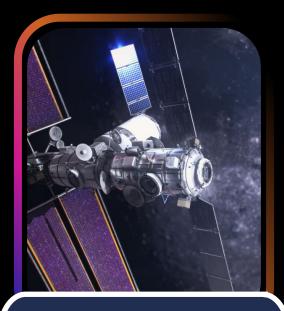
Initial capabilities, systems, and operations necessary to reestablish human presence and initial utilization on and around the Moon.

Return



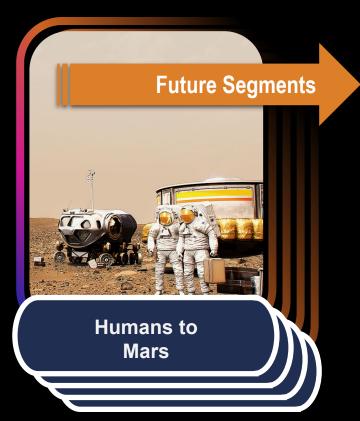
Foundational Exploration

Expansion of lunar capabilities, systems, and operations supporting complex orbital and surface missions to conduct utilization and Mars forward precursor missions.



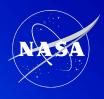
Sustained Lunar Evolution

Enabling capabilities, systems, and operations to support regional and global utilization, economic opportunity, and a steady cadence of human presence on and around the Moon.

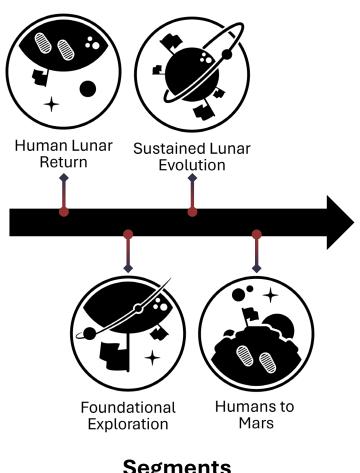


Initial capabilities, systems, and operations necessary to establish human presence and initial utilization on Mars and continued exploration.

Moon to Mars Architecture Segments







Segments

A portion of the architecture that integrates sub-architectures and progressively increases in complexity and objective satisfaction.



and Robotics



Navigation, and Timing Systems



















Sub-Architectures

A group of tightly coupled elements, functions, and capabilities that work together to accomplish one or more objectives.













Human Landing System

Elements

A notional exploration system that enables a set of functions.

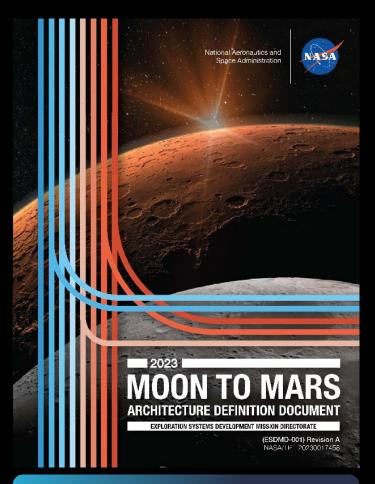




Moon to Mars Architecture Updates













Executive Overview



The exploration of the lunar surface Do au ment (ADD), will require a wide variety and operational poorly access to a range

demands, a substantial gap in lander capa delivery needs, compares those needs will

> Note: Cargo deliveries to Gateway are already instantiated in the Moon to Mars Architecture through the Gataway Logistics Element (GLE), GLEgfirit a witl supply Gataway with critical deliveries that maximize the length of craw stays on Gataway. White use of the Gataway as a logistics cache for lunar exploration could be considered, this paper does not attempt to apeculate on concepts of operation, Instead, it specifically addresses architectural gaps for canto deliveries to the lunar surface. The specific functions fulfilled by GLE may be found in Table

Cargo Lander Architecture

Lunar surface exploration will require the delivery of assets, equipment, and supplies to the lunar surface.11 While some limited supplies and equipment may be delivered alongside crew on NASA's Human Landing System (HLS), the breadth and scale of logistical needs for deep space exploration

- Delivers non-off, aded and/or off, aded cargo to the lunar surface.
- Provides all services necessary to maintain canto from in-apace transit through Landing on the lunar surface until the cargo is eitherooff, aded from the lander or in an operational state where these services from the lander are no longerneeded, in accordance with cargo lander provider agreements

- Verifies health and functionality obnon-off: aded and for off: aded cargo.
- or other surface as sets are not adgersely affet led by the lander after landing operations.

to the surface. Service interfaces may support the offi, adjing of cargo, compatibility to surface mobility system interactions, and/or providing resources to the cargo, such as power, communications, data, and for ther mail dissipation. Services may be needed from landing to until the cargo is fully operational. including before or after the cargo is off. aded to the surface

Landers and eargo may also need additional, crew-focused lander interfaces such as extravehicular activity (EVA) touch interfaces to support crew interactions. Lastly, given potential crew interaction at or near a lander, landers must have the ability to safe it self after landing so that crew are protected while in a landors' vicinity

White Papers (21 as of June 2024)



Artemis: A Foundation for Deep Space Exploration



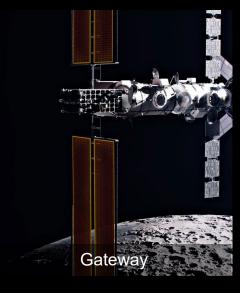






















ARTEMIS I First Mission (Uncrewed Flight Test)



ARTEMIS II

First Crew



ARTEMIS III

First Human Surface Landing







COMPLETE







Artemis II

ARTEMIS FIRSTS:

- Crewed integrated flight test of the Space Launch System (SLS) rocket, Orion spacecraft, and Exploration Ground Systems (EGS) at KSC
- Active Orion Launch Abort System (LAS)
- Demonstration of Orion life support systems
- Proximity operations demonstrations
- Human data collection in transit to and from the Moon, in lunar orbit, and through reentry and splashdown
- Conducting new science and technology demonstrations in orbit

NEW ELEMENTS:

- Orion life support systems
- Launch Complex 39B emergency egress system for crew and new liquid hydrogen system

COMMON ELEMENTS:

- SLS rocket Block 1 configuration
- Orion crew spacecraft
- Mobile Launcher 1

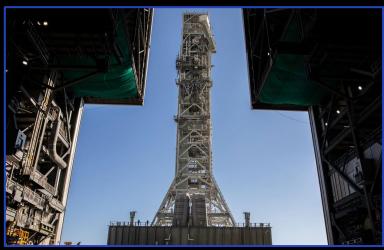
ENSURING CREW SAFETY IS OUR TOP PRIORITY!

Artemis II Progress





Artemis II core stage rollout from Michaud Assembly Facility



ML-1 Preparations for Artemis II



Artemis II Crew Practice Maneuvers Inside Orion Mock-up





Artemis II Core Stage (left) and Launch Vehicle Stage
Adapter (right) at Arrive at Kennedy Space Center



EGS Teams Test Emergency Egress Baskets



Artemis II Crew Field Training in Iceland





Artemis III

ARTEMIS FIRSTS:

- Human landing in South Pole region and return
- Orion to human landing system direct mission including crew docking activity
- Use of Near Rectilinear Halo Orbit (NRHO)
- Four astronauts to lunar orbit
- Two astronauts to lunar surface to collect scientific samples and data
- Conducting new science and technology demonstrations

NEW ELEMENTS:

- Orion full up rendezvous, proximity operations, and docking systems
- Starship human landing system
- Advanced spacesuits and tools to explore the surface and collect samples

COMMON ELEMENTS:

- SLS rocket Block 1 configuration
- Orion crew spacecraft
- Mobile Launcher 1



Artemis III Progress







Interim cryogenic propulsion stage complete final testing and checkout



SpaceX's Starship Flight Test Four



Spacesuit Test of Starship HLS



Andre Douglas (Artemis II backup astronaut), right, and Kate Rubins participate in JETT 5



Core stage liquid oxygen tank at Vertical **Assembly Center at Michoud**



Artemis III Core Stage Engine Section



VAB High Bay 2 Optimizing for SLS



European Service Module 3 joined with Crew Module Adapter





Artemis IV

ARTEMIS FIRSTS:

- Crewed mission to Gateway space station
- Launch, delivery, and integration of a space station module in lunar orbit
- Crew transfer from Orion to human landing system (HLS) via Gateway
- Deep Space Logistics flight to Gateway
- Conducting science and demonstrating technology in orbit and on the surface

NEW ELEMENTS:

- Space Launch System rocket Block 1B configuration Mobile Launcher 2 with supporting ground systems
- SpaceX Sustaining Starship HLS
- Gateway modules: Power and Propulsion Element and Habitation and Logistics Outpost (pre-staged in orbit); International Habitat (launched on SLS Block 1B alongside the crew aboard Orion); Deep Space Logistics

COMMON ELEMENTS:

- Common SLS elements
- Orion crew spacecraft
- Spacesuits and support systems



Artemis IV Progress





Mobile Launcher 2 'Jack and Set' maneuver



ML2 Tower Segment as of August 30



Artemis IV Core Stage Engine Section



Liquid hydrogen tank for core stage in progress



Universal stage adapter structural qualification article panels aligned and loaded on Vertical Assembly Tool

Artemis IV:
PPE/HALO
Launch and Pre-staging

MISSION SUMMARY:

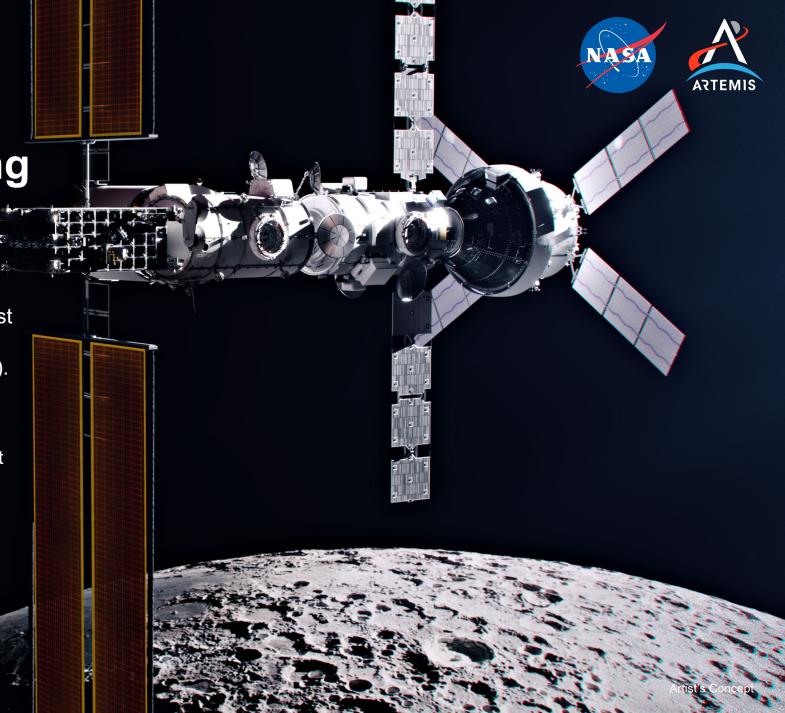
In preparation for the launch of the Artemis IV crew aboard Orion with Gateway's International Habitat module on SLS, NASA will launch the first elements of the Gateway lunar space station to the selected Near Rectilinear Halo Orbit (NRHO).

ARTEMIS FIRSTS:

- Human habitat designed for lunar orbit
- Solar electric propulsion powered human spacecraft

NEW ELEMENTS:

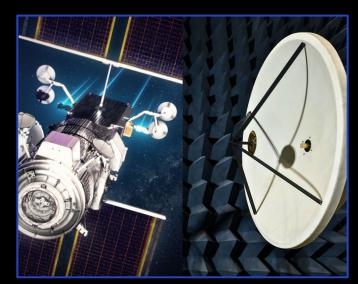
- Power and Propulsion Element (PPE)
- Habitation and Logistics Outpost (HALO)
- Science payloads to study radiation:
 - HERMES (NASA)
 - ERSA (ESA)
 - IDA (ESA, JAXA)



Gateway Progress



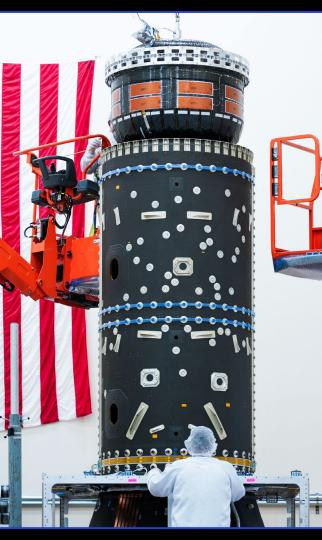




Field Tests for Gateway Communications



Canada began work on Canadarm3 robotic arm June 27



Maxar technicians installed xenon tanks into Power and Propulsion Element (PPE) central cylinder for Gateway



Gateway Habitation and Logistics Outpost (HALO) undergoes stress testing at Thales Alenia Space facility on June 10



NASA astronaut Nicole Mann participates in virtual reality testing of Gateway



Artemis V





ARTEMIS FIRSTS:

- Use of the lunar terrain vehicle (LTV) rover by crew to access more of the lunar surface and collect diverse scientific samples
- Use of second lunar lander design
- Use of new RS-25 engines
- Conducting new science and demonstrating technology in orbit and on the surface

NEW ELEMENTS:

- Blue Moon human landing system
- LTV unpressurized rover with scientific instruments
- Gateway modules: ESPRIT Refueling Module (European System Providing Refueling Infrastructure and Telecommunications), Canadarm3 robotic arm

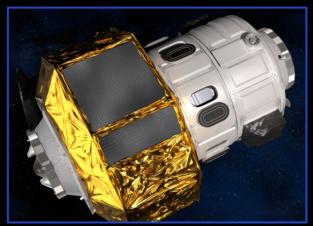
COMMON ELEMENTS:

- Space Launch System rocket Block 1B configuration
- Orion crew spacecraft
- Mobile Launcher 2 with supporting ground systems
- Spacesuits and support systems

Artemis V and Beyond



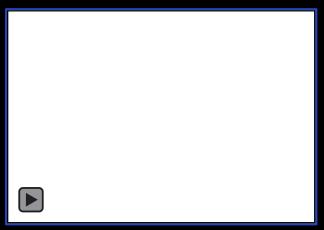




ESA Lunar View Refueling Module will transport cargo and provide storage, fuel



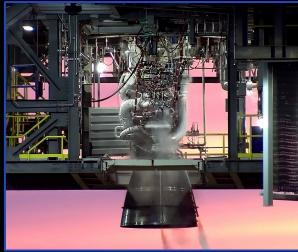
Japan Pressurized Rover



Trial BOLE Composite Case Winding



Artist concept of Blue Origin's Blue Moon human landing system



BE-7 Engine for Blue Moon Landers



Blue Origin's Marine Landing Platform



Artist's concept of Intuitive Machines' Moon RACER LTV. Credit: Intuitive Machines



Artist's concept of Lunar Outpost's Lunar Dawn LTV. Credit: Lunar Outpost



Artist's concept of Venturi Astrolab's FLEX LTV. Credit: Astrolab





We came in peace.



We return for all humanity.





Q&A