Kenneth Bowersox, Associate Administrator (Acting) for Human Exploration and Operations, NASA

0900 EDT

TO SUBMIT QUESTIONS:

Go to: https://www.sli.do/
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KEN BOWERSOX
Associate Administrator, acting
Human Exploration and Operations Mission Directorate
NASA Headquarters, Washington, D.C.
Space Policy Directive 1: To The Moon, Then Mars

“Lead an innovative and sustainable program of exploration with commercial and international partners to enable human expansion across the solar system and to bring back to Earth new knowledge and opportunities. Beginning with missions beyond low-Earth orbit, the United States will lead the return of humans to the Moon for long-term exploration and utilization, followed by human missions to Mars and other destinations...”
WHY THE MOON?

Learning and developing the skills necessary to take humans beyond the Earth-Moon system

Developing hardware and sustainable systems for human exploration

Building an open infrastructure that will allow human exploration beyond the Earth and Moon

Solving the problems necessary for crews to become Earth independent provides a knowledge that allows us to improve life on the Earth

Understanding if lunar resources can be used for exploration
The International Space Station

A catalyst for global cooperation and economic growth in the world creating jobs, opportunity, and a strong relationship between America and its international partners.
ISS: where crew continuously lives and works in space, enhancing all aspects of our lives here on Earth

The official Expedition 61 crew portrait
(from left): NASA astronaut Andrew Morgan, Roscosmos cosmonaut Alexander Skvortsov, astronaut Luca Parmitano of ESA (European Space Agency), Roscosmos cosmonaut Oleg Skripochka, and NASA astronauts Jessica Meir and Christina Koch.
International Interoperability Standards
Preparing for deep space exploration

Draft Deep Space
Interoperability System Standards
Posted for feedback on March 1, 2018

- Avionics
- Communication Systems
- Environmental Control and Life Support
- Power
- Rendezvous
- Robotics
- Thermal

www.InternationalDeepSpaceStandards.com
Open Architecture Creates Opportunity

**ISS as a Model**

**COMMERCIAL CARGO & CREW**
- Cygnus (Northrop Grumman)
- Dragon (SpaceX)
- Dream Chaser (SNC)

**INTERNATIONAL**
- Soyuz & Progress (Roscosmos)
- H-II Transfer Vehicle (JAXA)
- Orion/European Service Module (ESA)

**Gateway**
- Multiple providers expected in lunar orbit and on the surface

**Lunar Surface**
Sustainable and Efficient Human Exploration
Evolving Environmental Control and Life Support Systems (ECLSS)

Evolution of ECLSS
ISS to Exploration
International Space Station (ISS)

Surface Systems Ground Test

Continue ECLSS Testbed in Low-Earth Orbit (LEO)
Notional Commercial Platform

Lunar Surface Short Duration and Regenerative ECLSS

Infuse Exploration ECLSS as Applicable
Gateway

Infuse Exploration ECLSS into Mars Transport and Surface
Mars-class Transportation

Mars Surface Regenerative ECLSS
Achieving 2024 – A Parallel Path to Success

Artemis will see government and commercial systems moving in parallel to complete the architecture and deliver crew.

**Artemis 1**
First flight test of SLS and Orion as an integrated system

**Artemis 2**
First flight of crew to the Moon aboard SLS and Orion

**Artemis 3**
First crew to the lunar surface; Logistics delivered for 2024 surface mission

Between now and 2024, U.S. industry delivers the launches and human landing system necessary for a faster return to the Moon and sustainability through Gateway.

**CREW**
NASA Programs SLS and Orion

**Artemis Programs**
- **CREW**
  - NASA Programs SLS and Orion
  - Commercially Provided Elements
  - Human Landing System
- **PPE**
  - Power and Propulsion Element arrives at NRHO via commercial rocket
  - Pressurized Module
    - Small area for crew to check out systems prior to lunar transfer and decent
  - Up to three commercial rocket launches, depending on distribution of the Transfer, Descent, and Ascent functions.
- **CARGO**
  - Commercially Provided Elements

**Commercially Provided Elements**
- **CREW**
  - NASA Programs SLS and Orion
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**Human Landing System**
- **Transfer**
  - Transfers lander from Gateway to low lunar orbit
- **Descent**
  - Descends from Transfer Vehicle to lunar surface
- **Ascent**
  - Ascends from lunar surface to Gateway
Artemis Phase 1: Path to The Lunar Surface

Artemis I: First human spacecraft to the Moon in the 21st century

Artemis II: First humans to orbit the Moon in the 21st century

Artemis Support Mission: First high-power Solar Electric Propulsion (SEP) system

Artemis Support Mission: First pressurized module delivered to Gateway

Artemis Support Mission: Human Landing System delivered to Gateway

Artemis III: Crewed mission to Gateway and lunar surface

Commercial Lunar Payload Services
- CLPS-delivered science and technology payloads

Early South Pole Mission(s)
- First robotic landing on eventual human lunar return and In-Situ Resource Utilization (ISRU) site
- First ground truth of polar crater volatiles

Large-Scale Cargo Lander
- Increased capabilities for science and technology payloads

Humans on the Moon - 21st Century
First crew leverages infrastructure left behind by previous missions

LUNAR SOUTH POLE TARGET SITE

2020

2024
Gateway is Essential for 2024 Landing

- Initial Gateway focuses on the minimum systems required to support a 2024 human lunar landing while also supporting Phase 2
- Provides command center and aggregation point for 2024 human landing
- Establishes strategic presence around the Moon – US in the leadership role
- Creates resilience and robustness in the lunar architecture
- Open architecture and interoperability standards provides building blocks for partnerships and future expansion
Mars
Vistas of opportunity and discovery

Earth
Let’s go. *The time is now.*

We have the capability

We have the purpose

We have the charge

We have the responsibility
Panel: Moon, Mars and Beyond: The Servicing Industry's Role in Future Exploration

0930 – 1030 EDT

Moderator: Ian Christensen, CONFERS Secretariat

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Bob Curbeam
Northrop Grumman Innovation Systems
On-Orbit Servicing for Exploration

2 October 2019

Robert Curbeam
VP – Strategy and BD

Northrop Grumman Innovation Systems

This document does not contain technical data as defined in the ITAR, 22 CFR 120.10; or technology as defined under the EAR (15 CFR 730-774).
Mission Extension Vehicle Overview

CURRENT STATUS
- Space Logistics, LLC - A Northrop Grumman Strategic Venture
- MEV-1
  - 5 Year Service Contract – Intelsat
  - Launch Period: October 2019; ILS
  - FCC and NOAA Licenses Issued
  - L+1 Insurance Placed
- MEV-2
  - 5 Year Service Contract – Intelsat
  - Launch Period: Early 2020; Ariane
  - Build to Print of MEV-1

Service Offerings
- Station Keeping
- Incline Reductions
- Relocations
- Inspections

Value Proposition
- Defer Capex
- Start New Orbital Roles
- Capitalize On Old Assets
- Anomaly Attribution

MEV Docked Life Extension
Making Commercial Satellite Servicing a Reality in 2019
On-Orbit Servicing Roadmap

A Fleet of Commercial Servicing Vehicles

- Station Keeping
- Attitude control
- Incline Reductions
- Relocations
- Inspections

- Life Extension
- Hosted P/L Install
- Simple Repairs
- Inspections
- Capture Non-std S/C

Enhanced Robotics Capabilities For:
- Assembly
- Repair
- Capture Of Derelict Satellites/Objects
Mark pages according to the proprietary level of information as described in Company Procedure J103 (or remove).
Al Tadros, Vice President
Space Infrastructure and Civil Space, Maxar Technologies
Daniel Noelke
German Aerospace Center (DLR)
The EU Strategic Research Cluster

Space Robotics Technologies

Daniel Noelke (DLR)
EU PERASPERA PSA Delegate

GSSF 2019, Washington, D.C., USA
H2020 SRC *Space Robotics Technologies*

• Develop an integrated master plan/roadmap of activities for a Strategic Research Cluster (SRC) in Space Robotics Technology

• SRC shall deliver key enabling technologies and demonstrate autonomous robotic systems at a significant scale (2024/2025) as key elements for on-orbit satellite servicing and planetary exploration

• General goals:
  - Strengthen industry and institutions
  - Explore & Enable business in Space
  - Setting technology standards for commercialization of space
  - Economical, competitive, sustainable space missions & applications as well as infrastructure for the next decades
  - Exploit synergies with terrestrial applications
What we are aiming at?

“An holistic approach that guides towards a sustainable, highly-automated, flexible and economical viable space infrastructure, enhancing manifold commercial opportunities in space and on earth.”

An AppStore philosophy for space applications:
Creation of new functions by generating building block chains
Thank you for your attention!
CONFERS Spotlight Talk: Brian Weeden, CONFERS Executive Director

1030 – 1045 EDT
Morning Coffee Break

Sessions Resume at 1115 EDT
Issues Forum: Sustainability and Commercial On-Orbit Servicing

1115 – 1215 EDT

- Moderator: Brian Weeden, CONFERS Executive Director
- Joe Anderson, Vice President, Operations and Business Development, SpaceLogistics, LLC.
- Theresa Hitchens, Breaking Defense
- Matthew Shouppe - Director of Commercial Space, LeoLabs
- Charity Weeden - Vice President, Global Space Policy, Astroscale

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CONFERS Townhall and Concluding Remarks

1215 – 1300 EDT

- Brian Weeden, CONFERS Executive Director
- CONFERS Executive Committee Members

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