HEOMD UPDATE

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HUMAN EXPLORATION AND OPERATIONS

Overview

- Insights from the Program Status Assessment
- LEO: ISS, Commercial Crew, and LEO Commercialization
- Artemis Update
- SCaN Commercialization

PSA Key Findings and Assessments

System Engineering

- Current cross-program/Enterprise SE processes do not support necessary decision velocity to achieve the Artemis III timeline to 2024
- Artemis III CONOPS is not yet developed and there is not a detailed plan to manage mission level analysis, increasing risk to the crew and mission success
- The Artemis Program does not have an integrated V&V plan
- Action: Establish an SE&I authority responsible for orchestrating end to end mission analysis for Artemis with clear feedback to the programs

Program Organization

- There is not a single, formal Artemis Program Organization
- Action: Establish Artemis Program Managers for all Phases and necessary support structure

PSA Key Findings and Assessments

Schedule Risk

- The Artemis Phase 1 effort lacks an Integrated Master Schedules (IMS)
- Historically based Schedule Risk Analysis (SRA) for NASA Reference Architecture demonstrates key areas that must be addressed
- Current Agency Baseline Commitment (ABC) for Artemis II (Orion) must be adjusted to reflect anticipated Artemis 1 launch date
- HLS aggressive schedule is the critical path for the Artemis III mission
- **Actions:**
  - Ensure appropriate management reserve is included for HLS to avoid future schedule erosion
  - Focus industry and government resources early
  - Down select early to maximize resources for remaining contractors
  - Consider a Leader/Follower strategy

Apollo LEM Development Lessons

Milestone	LM Date	Apollo LM Comment
RFP	Jul-62	11 firms invited
Proposal Submit	Sep-62	9 responses
Award	Nov-62	1 award
PDR	Sep-63	
CDR	Jan-66	
1st Flight Unit Delivery	Jun-67	
1st Unmanned Flight	Jan-68	LM-1, Apollo 5
1st Manned Flight	Mar-69	LM-3, Apollo 9
1sr Lunar Landing	Jul-69	LM-5, Apollo 11

- **Historically based Schedule Risk Analysis (SRA) for NASA Reference Architecture demonstrates key areas that must be addressed**
  - **Requirements Changes between PDR and CDR caused significant delay**
  - **Development of new technologies extended overall development**
- **Artemis Lessons**
  - **Focus on requirements from the outset**
  - **Limit New technology development to the maximum extent**

LEO: ISS, Commercial Crew, and LEO Commercialization

Expedition 63 Crew

SpaceX Crewed Dragon

Boeing Starliner

LEO Commercial Services


Space X C1 Launch
December 8, 2010


SpaceX C2+ Launch
May 22, 2012


Orbital A-ONE Launch
April 21, 2013


Orbital ORB-D1 Launch
September 18, 2013



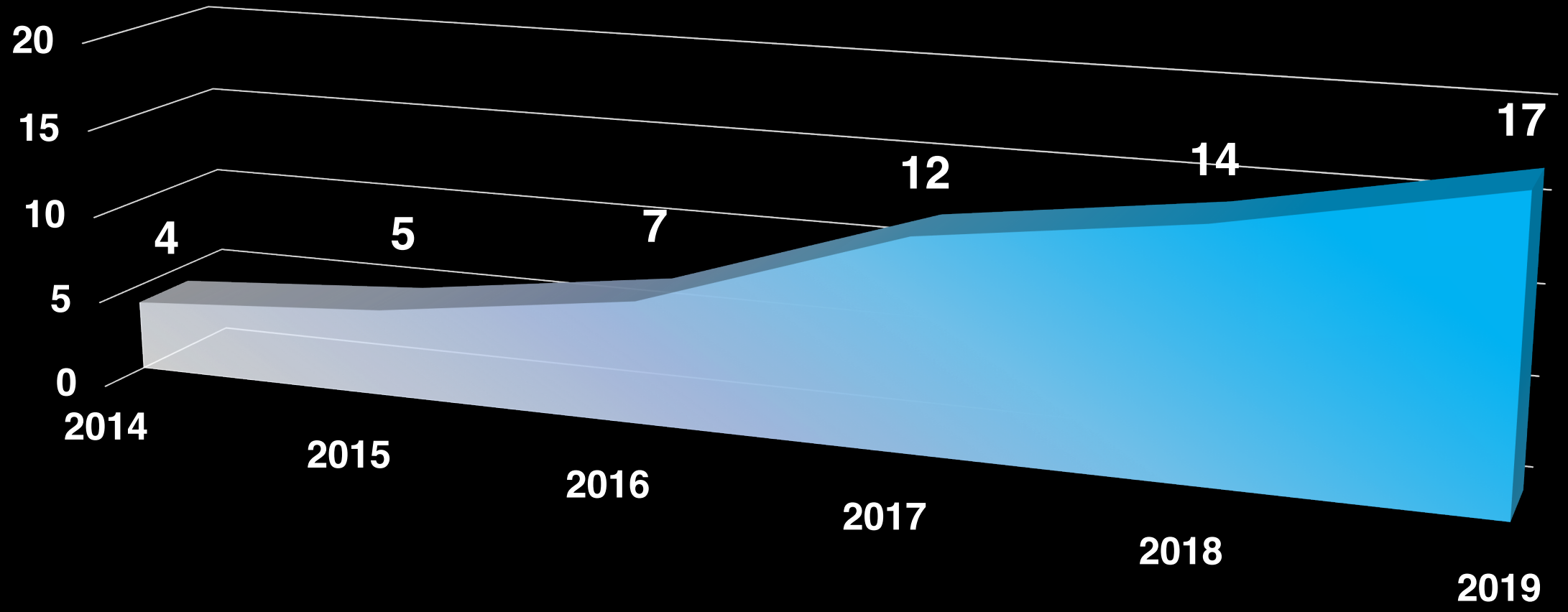




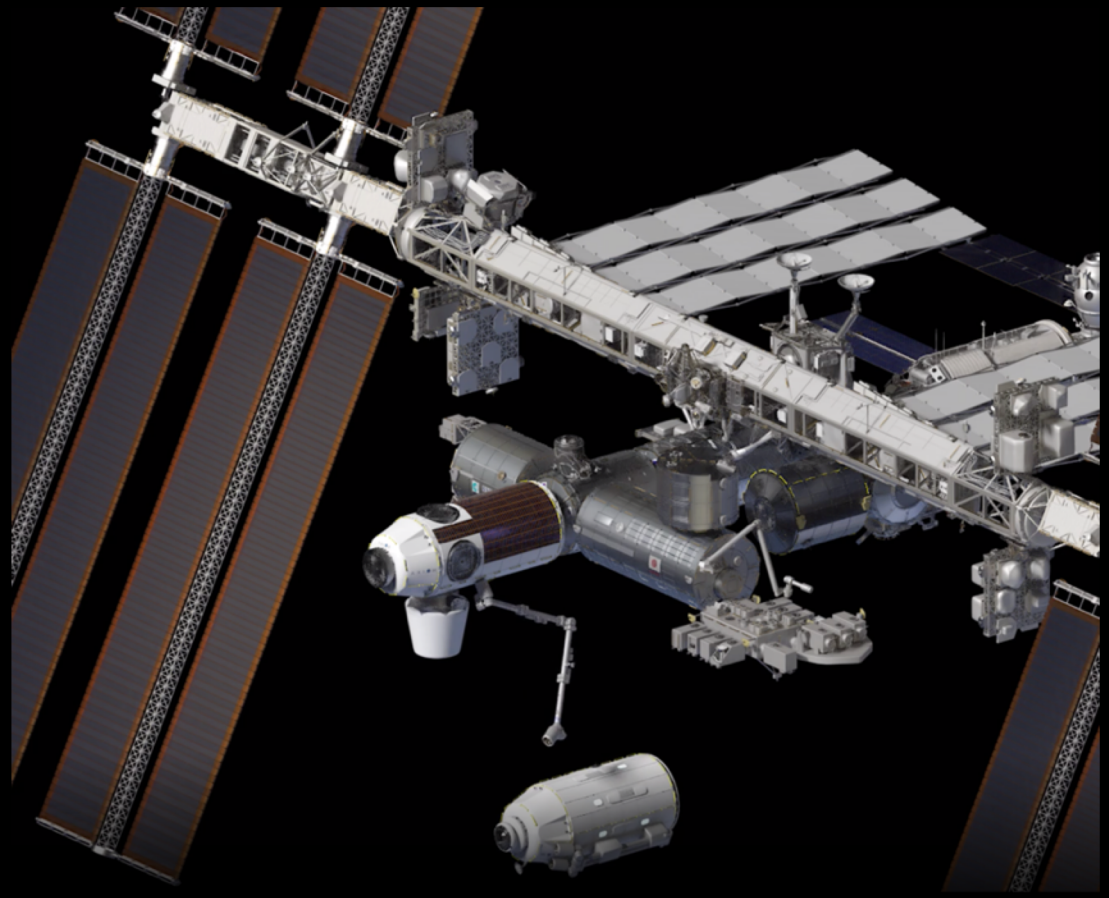
CARGO

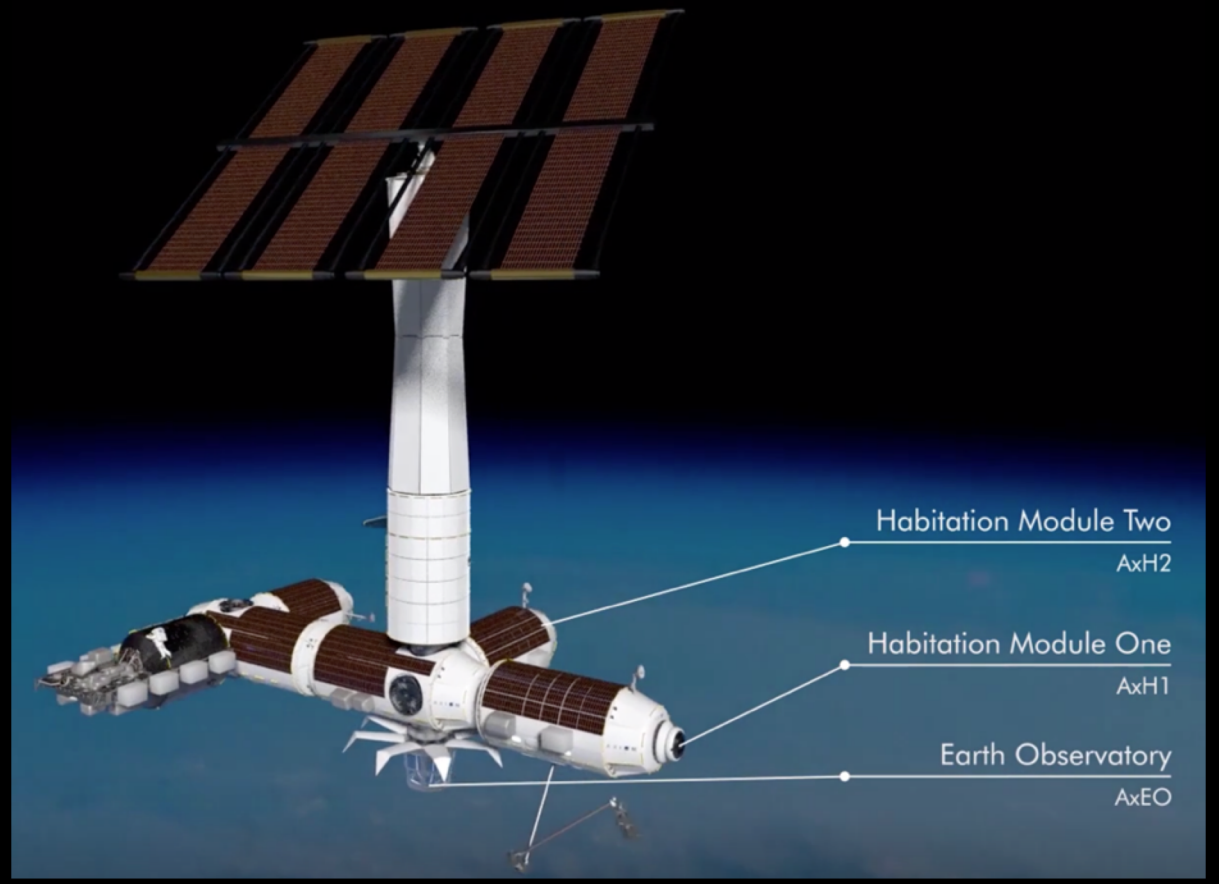
CREW

In-Orbit Commercial Facilities on the International Space Station (ISS)



Axiom Space Selected for ISS Commercial Port





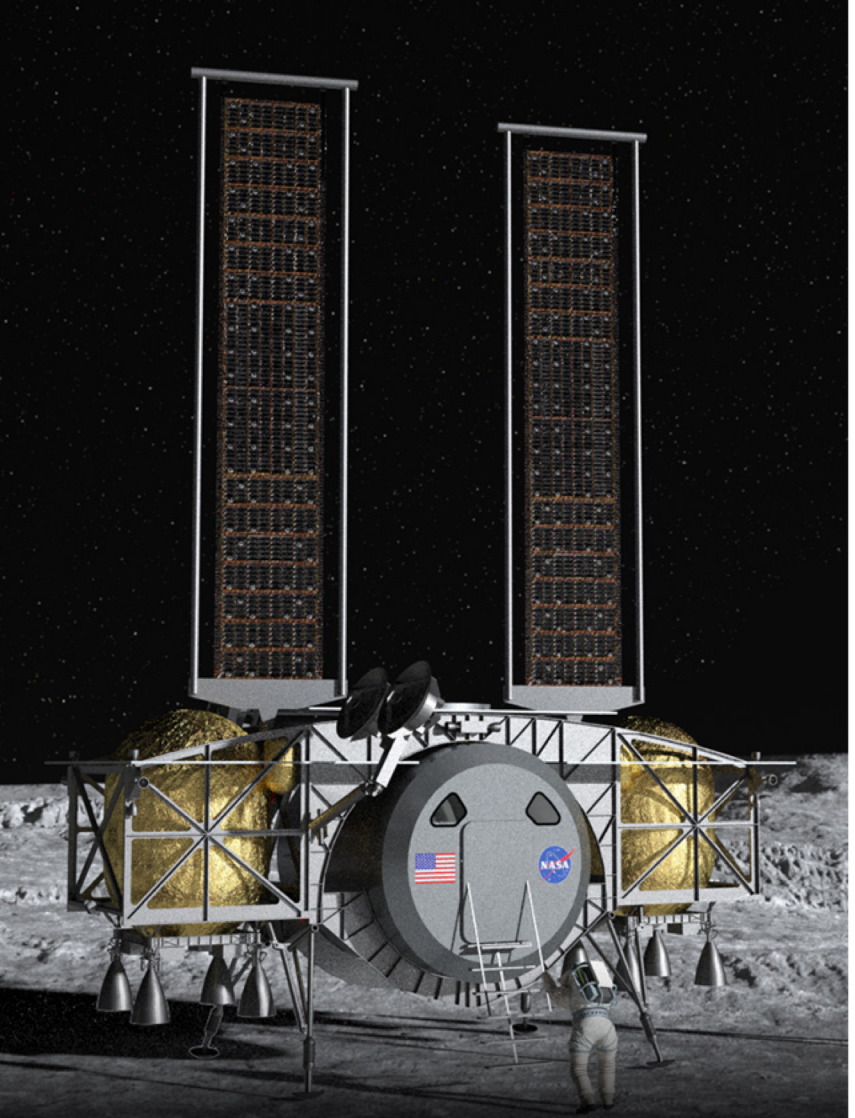

Artemis Updates

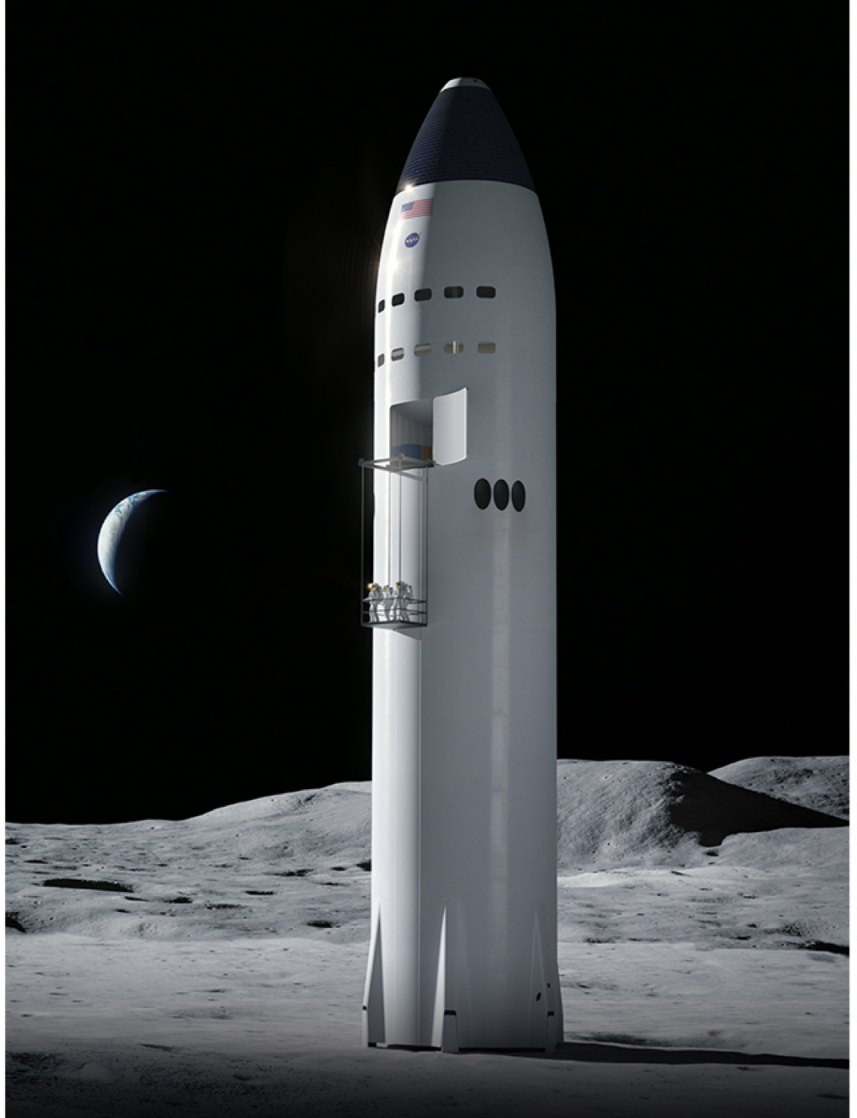

SLS at the
B-2 Test Stand

Orion Returning to KSC

Mobile Launcher Roll Out

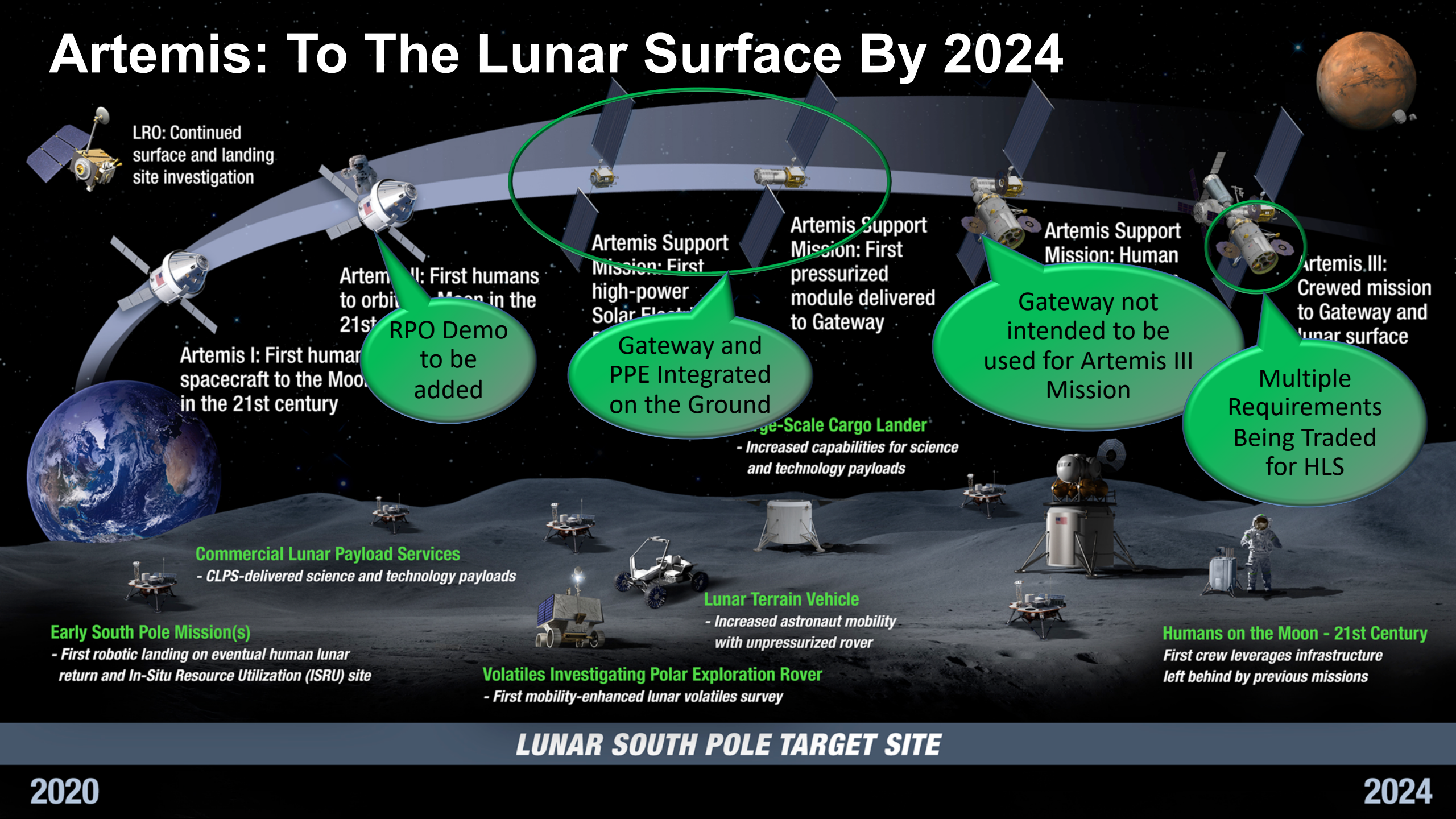
Preparing for Recovery at Sea


Dynetics
A Leidos Company

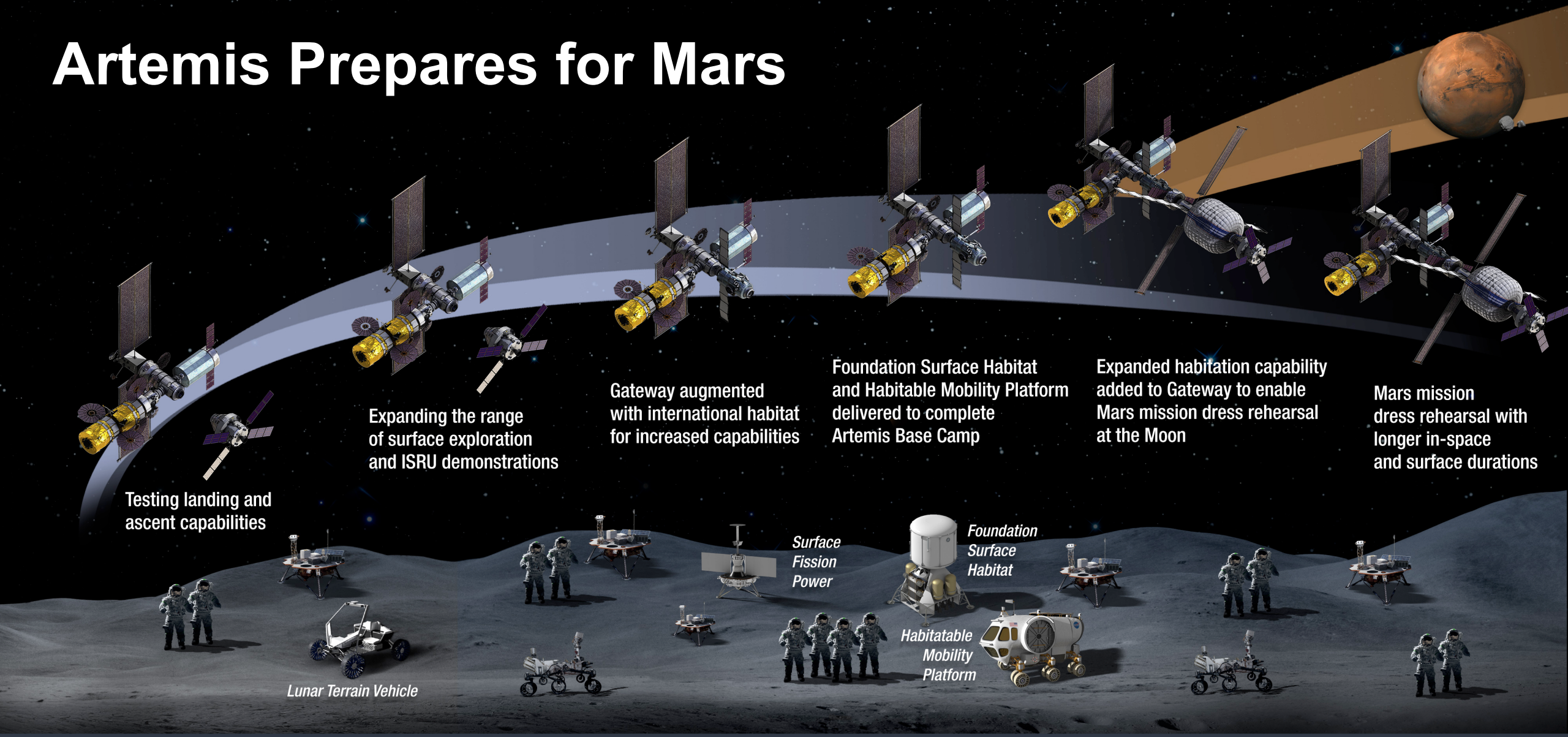

SPACEX


HUMAN LANDING SYSTEM
NATIONAL TEAM
BLUE ORIGIN
LOCKHEED MARTIN
NORTHROP GRUMMAN
DRAPER

Artemis: To The Lunar Surface By 2024



Artemis Prepares for Mars



SUSTAINABLE LUNAR ORBIT STAGING CAPABILITY AND SURFACE EXPLORATION

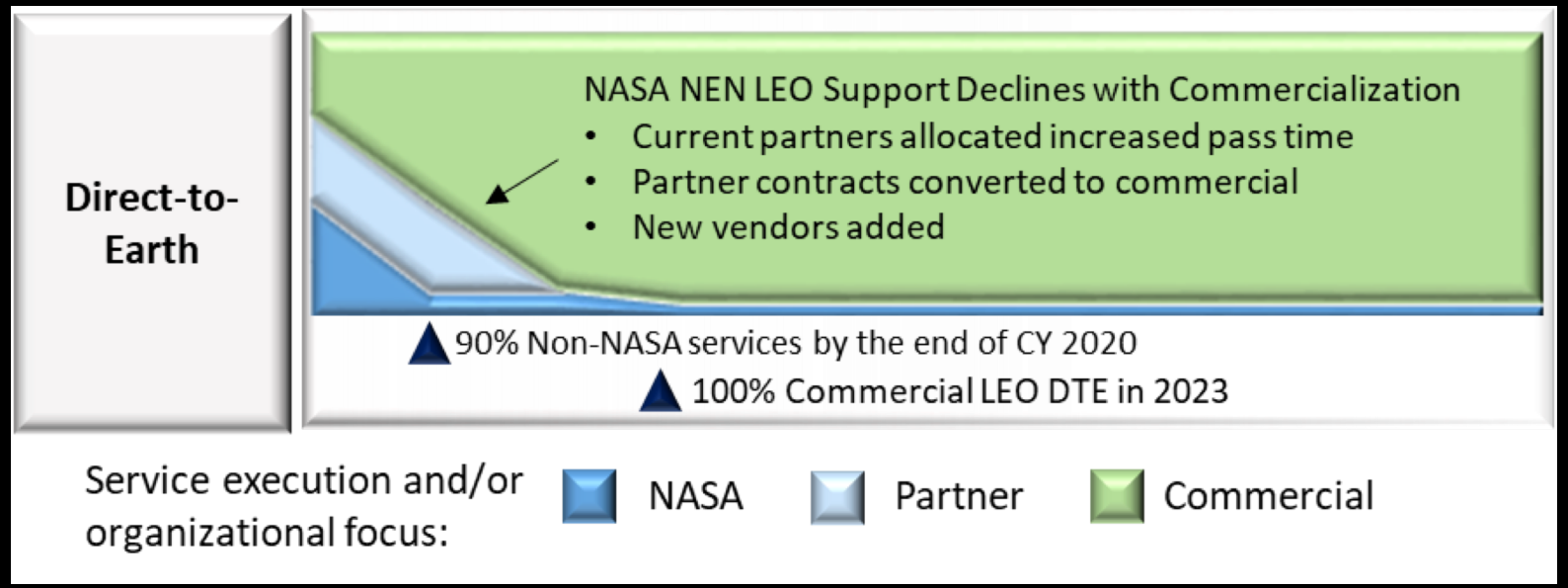
MULTIPLE SCIENCE AND CARGO PAYLOADS | INTERNATIONAL PARTNERSHIP OPPORTUNITIES | TECHNOLOGY AND OPERATIONS DEMONSTRATIONS FOR MARS

SCaN: Space Communications Commercialization

Near Earth Network (NEN) Commercialization

100% Commercialization of Near Earth Direct-to-Earth Services by 2023

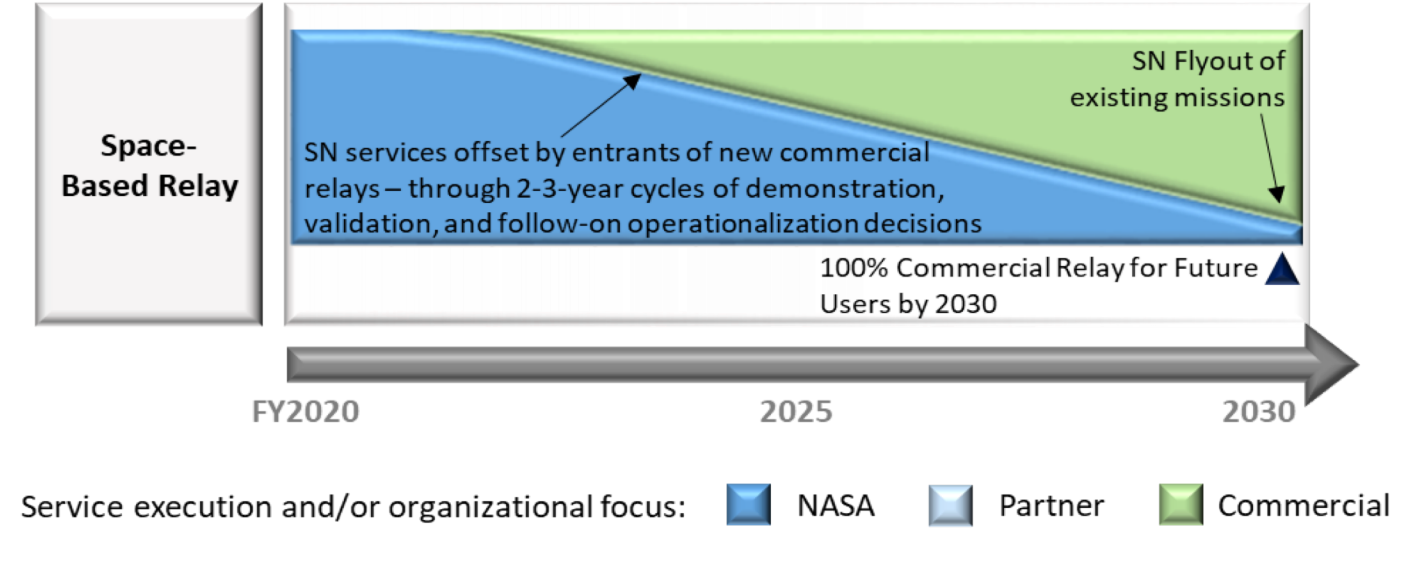
- Near-term increase in services provisioned by current commercial & partner ground sites:
  90% non-NASA service by the end of CY20
- 2023 target applies to existing and new missions
- Infuse new vendors drawing on vibrant and growing market



Space Network (SN) Commercialization

100% Commercialization for Space-Based Relay Services by 2030

- Direct to Earth service will be maximized but some user requirements will only be met with relay capability
- NASA will no longer build/deploy Tracking and Data Relay Satellites; rather capitalize on growing commercial space activity
- Time required to gradually transition future NASA users to the new paradigm




NASA
NASA
QUESTIONS?