NASA's In Space Manufacturing Initiatives

"Making Stuff Up As We Go"

In Space EXploring

Future Space 2017
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R.G. Clinton Jr., PhD
Associate Director
Science and Technology Office
NASA Marshall Space Flight Center

In-Space Manufacturing (ISM) Path to Exploration

GROUND-BASED

Earth-Based Platform

- Certification & Inspection Process
- Design Properties Database
- Additive Manufacturing Automation
- Ground-based Technology Maturation & Demonstration
- *AM for Exploration Support Systems (e.g. ECLSS) Design, Development & Test*
- *Additive Construction*
- *Regolith (Feedstock)*

EARTH RELIANT ISS

ISS Test-bed – Transition to Deep Space Gateway

- 3D Print Demo
- Additive Manufacturing Facility
- In-space Recycling
- In-space Metals
- Printable Electronics
- Multi-material Fab Lab
- In-line NDE
- External Manufacturing
- On-demand Parts Catalogue
- Exploration Systems Demonstration and Operational Validation

Space Launch System

PROVING GROUND Cis-lunar

Asteroids

EARTH INDEPENDENT Mars

Planetary Surfaces Platform

- Multi-materials Fab Lab (metals, polymers, automation, printable electronics)
- Food/Medical Grade Polymer Printing & Recycling
- Additive Construction Technologies
- Regolith Materials – Feedstock
- AM Exploration Systems

Text Color Legend

Foundational AM Technologies

AM Capabilities for Exploration Systems

Surface / ISRU Systems

In-space Robotic Manufacturing and Assembly Overview

Concept by Made In Space

Concept by Space Systems/Loral

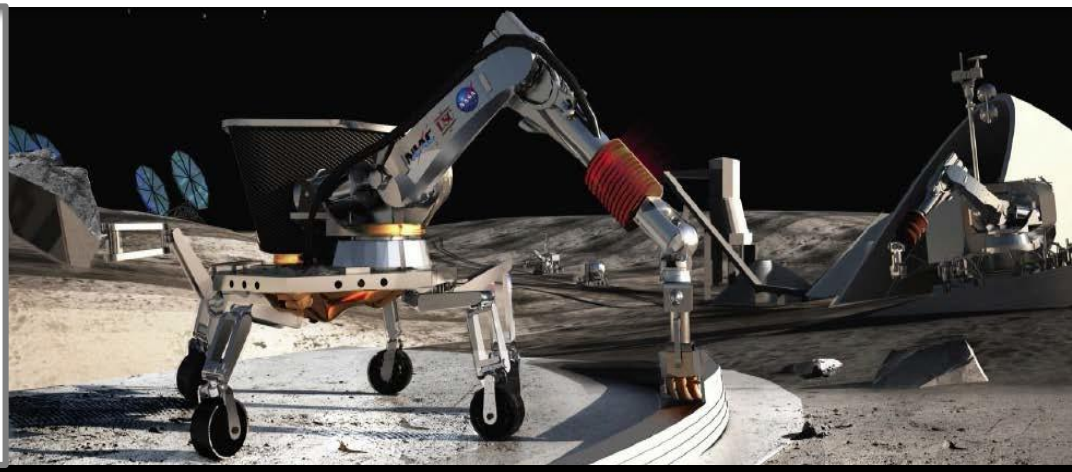
Concept by Orbital ATK

Archinaut	Dragonfly	CIRAS
A Versatile In-Space Precision Manufacturing and Assembly System	On-Orbit Robotic Installation and Reconfiguration of Large Solid Radio Frequency (RF) Reflectors	A Commercial Infrastructure for Robotic Assembly and Services
Tipping Point Objective		
A ground demonstration of additive manufacturing of extended structures and assembly of those structures in a relevant space environment.	A ground demonstration of robotic assembly interfaces and additive manufacture of antenna support structures meeting EHF performance requirements.	A ground demonstration of reversible and repeatable robotic joining methods for mechanical and electrical connections feasible for multiple space assembly geometries.
Team		
Made In Space, Northrop Grumman Corp., Oceaneering Space Systems, Ames Research Center	Space Systems/Loral, Langley Research Center, Ames Research Center, Tethers Unlimited, MDA US & Brampton	Orbital ATK, Glenn Research Center, Langley Research Center, Naval Research Laboratory

Additive Construction Projects Leveraging CommonTechnologies

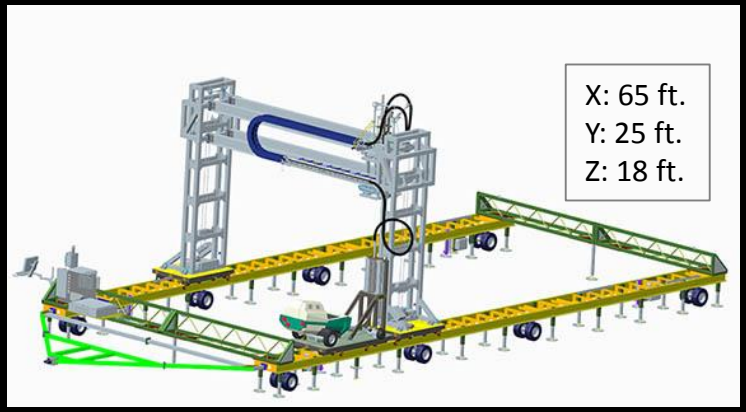
US Army Corps of Engineers
Engineer Research and Development Center

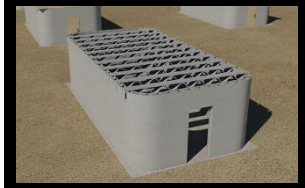
Additive Construction with Mobile Emplacement (ACME) NASA



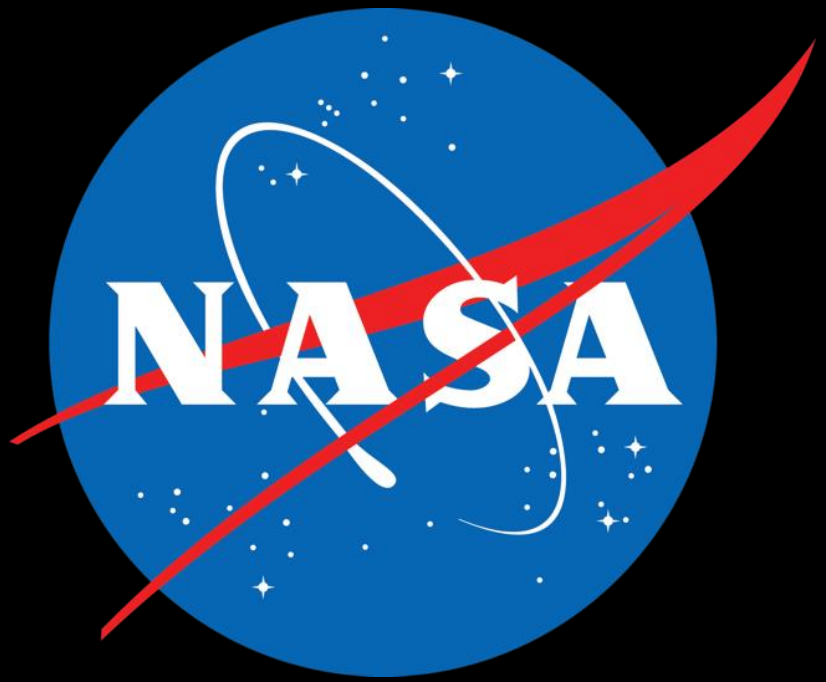
Shared Vision: Capability to print custom-designed expeditionary structures on-demand, in the field, using locally available materials.

Automated Construction of Expeditionary Structures (ACES) Construction Engineering Research Laboratory - Engineer Research and Development Center (CERL – ERDC)

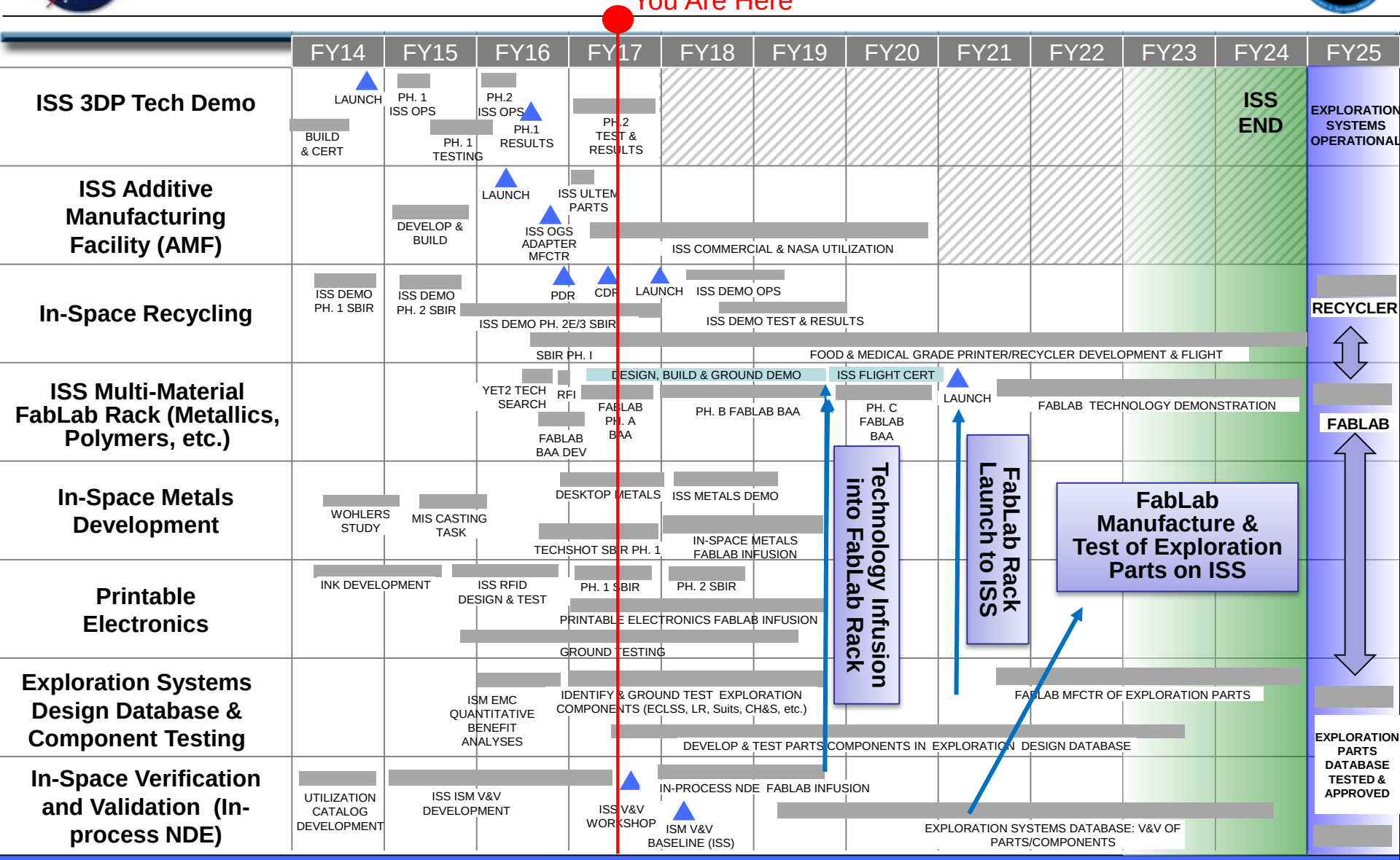




B-hut
(guard shack)
16’ x 32’ x 10’

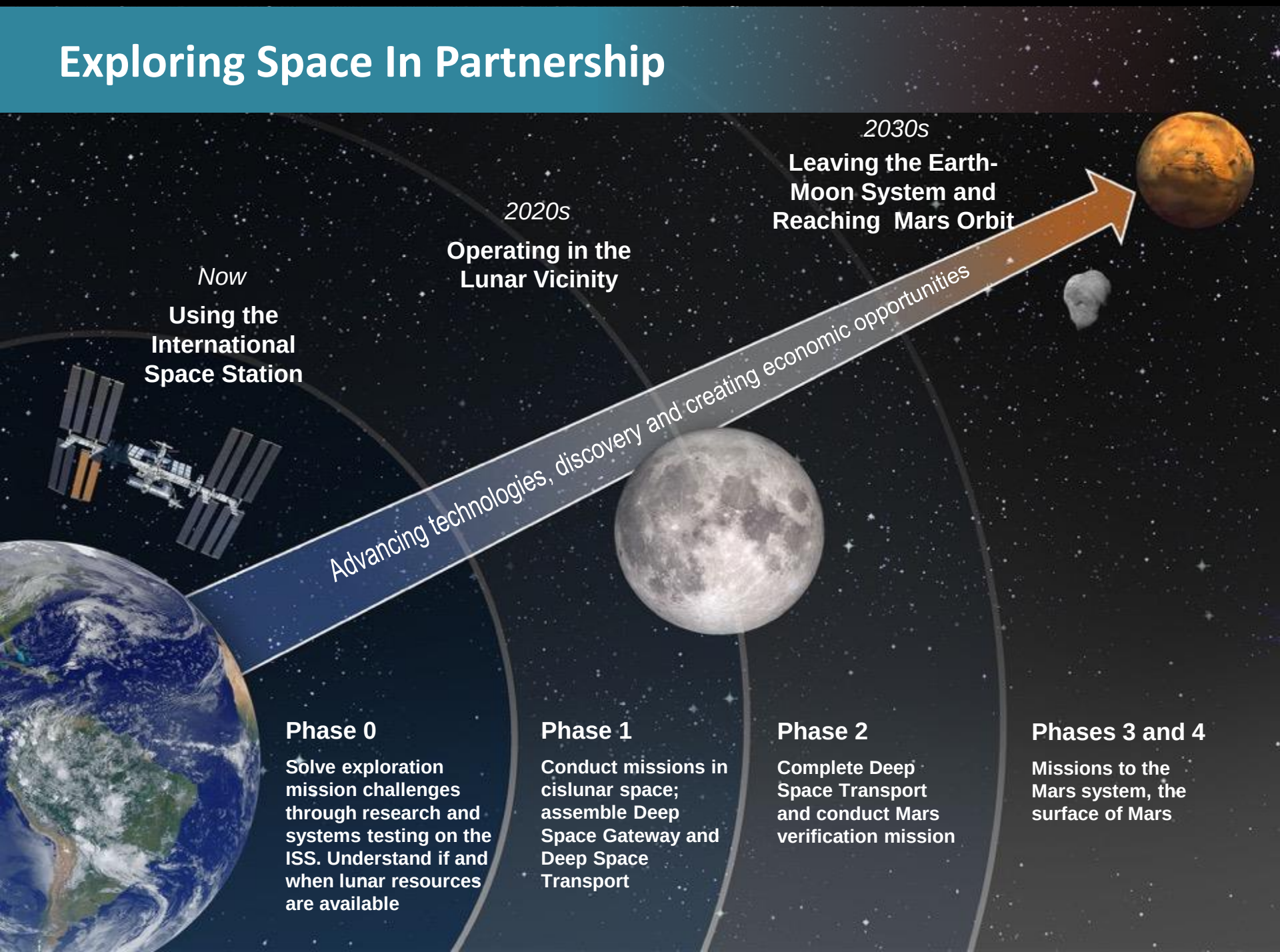

NASA

In-Space Manufacturing (ISM) Program Timeline

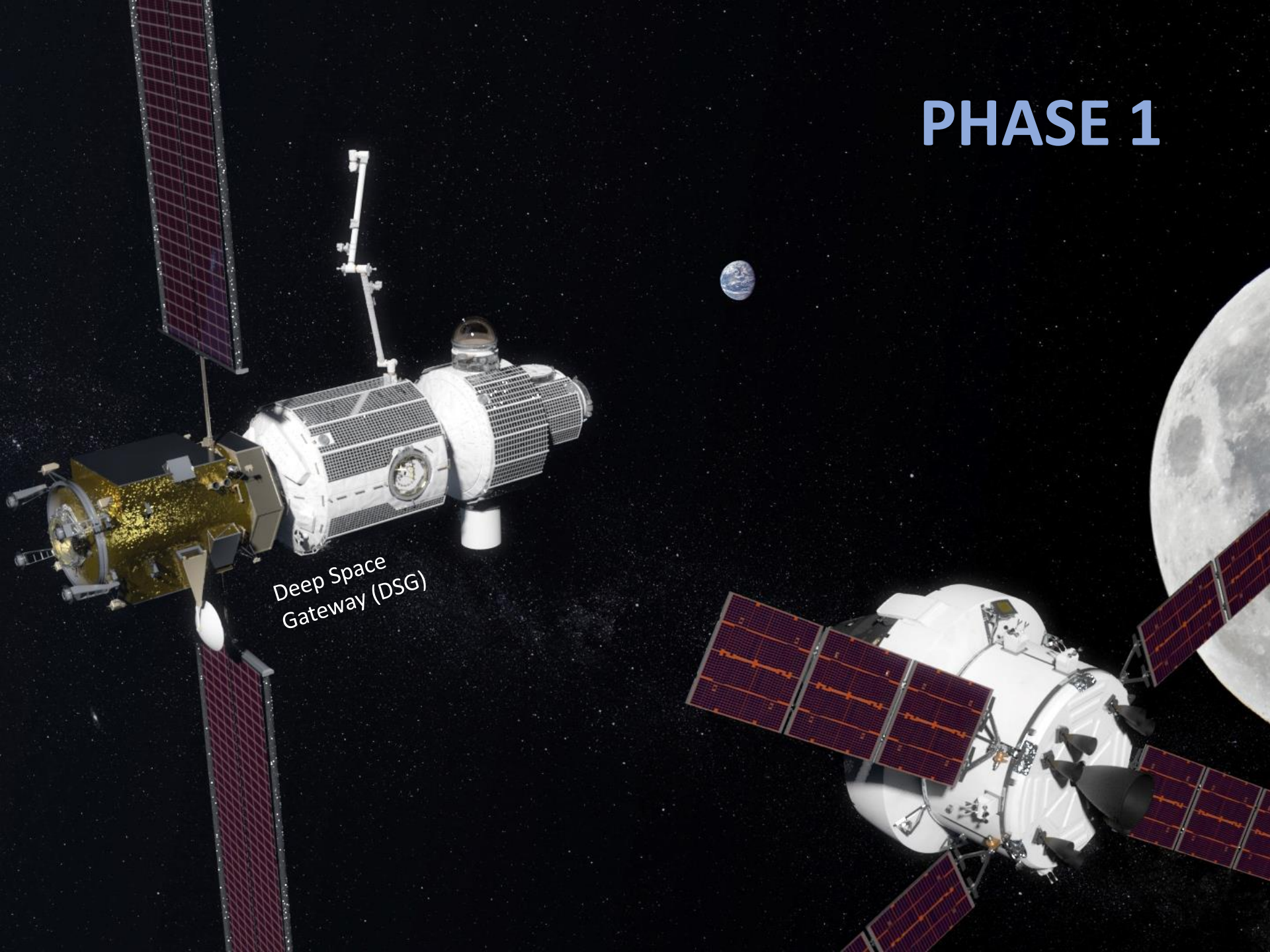


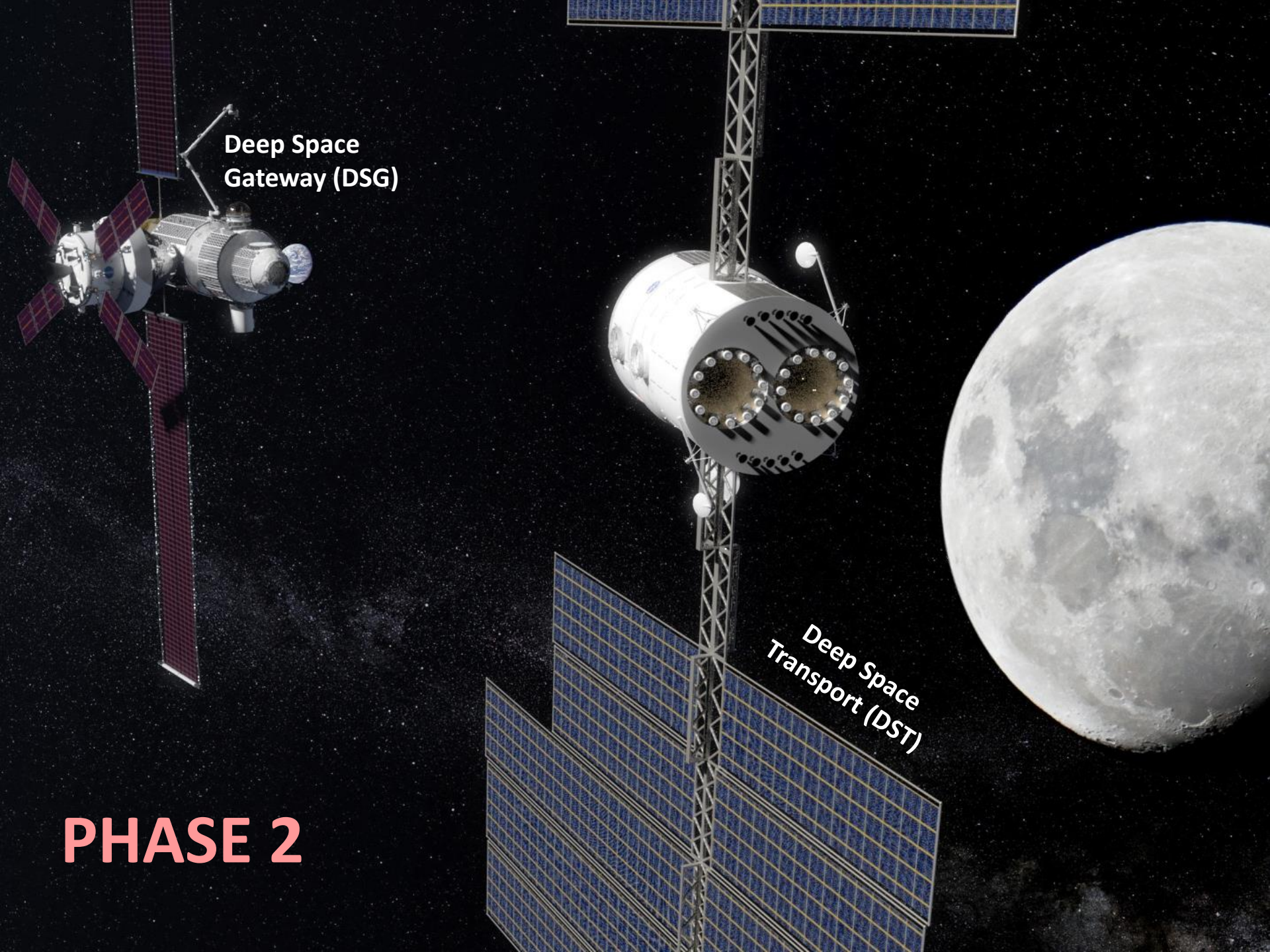
ISM enables the 'Design for Maintainability' approach Required for Sustainable Exploration missions.

Exploring Space In Partnership



PHASE 1




Deep Space
Gateway (DSG)
Deep Space
Transport (DST)
PHASE 2