United Nations
Committee on the Peaceful Uses of Outer Space
Scientific and Technical Subcommittee

On Orbit Servicing, Assembly, & Manufacturing

April 21, 2021

Trudy Kortes
Program Director, Technology Demonstrations
NASA

NASA's On Orbit Servicing, Assembly, & Manufacturing Activity

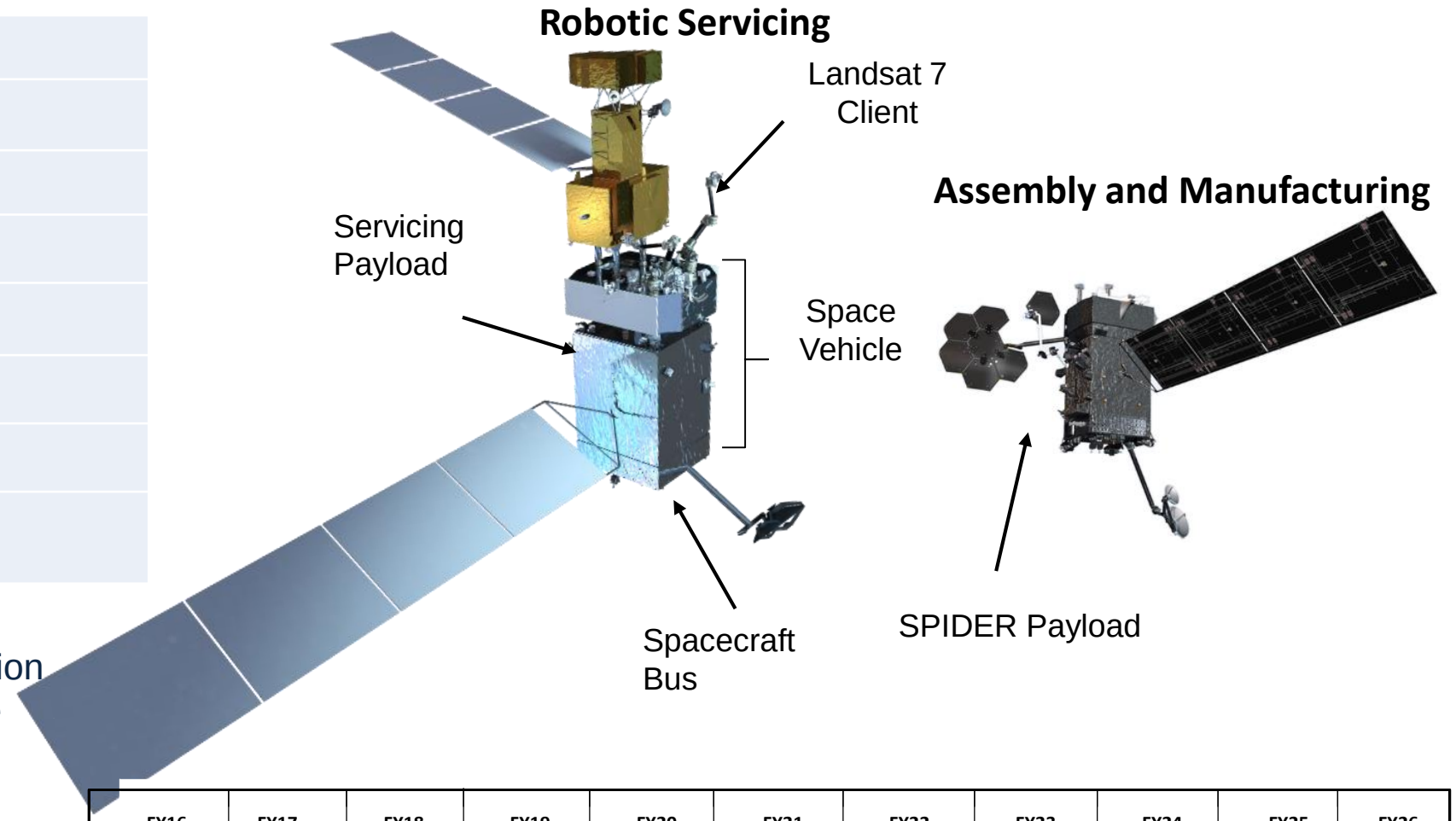
- OSAM is an emerging set of technologies that create the capability to assemble, maintain and repair spacecraft on-orbit, expand the scale of science platforms, manufacture and assemble structures in space, and extend the service life of on-orbit assets.
- NASA is investing in OSAM technologies development and two capability demonstration missions.
- OSAM-1 is a robotic spacecraft equipped with the tools, technologies and techniques needed to extend satellites' lifespans - even if they were not designed to be serviced on orbit.
- OSAM-2 is an in-space demonstration of an extended structure using robotic manipulation.
- OSAM capability has potential applicability to future exploration needs, including the Artemis program.
- OSAM takes into account the LTS Guidelines.

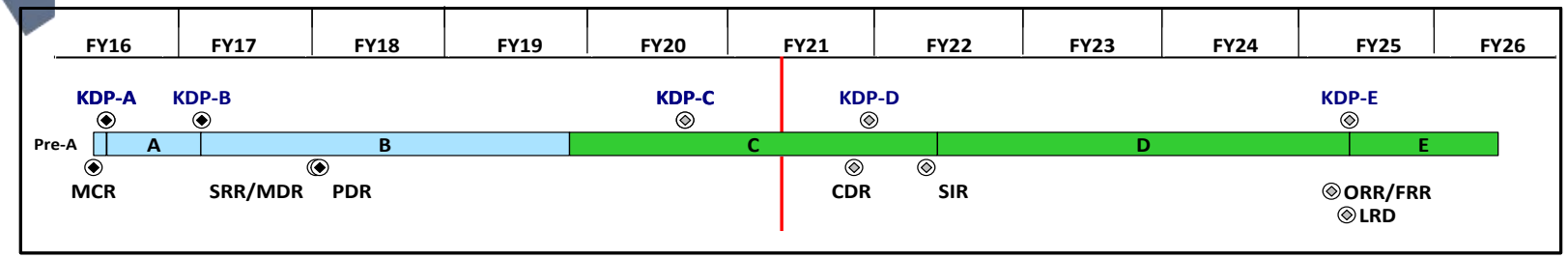
OSAM-1 Mission Overview

Category/Class	Category 1 / Class C
Mission Life	1 year
Launch	2025
Launch Vehicle	Atlas V or Falcon-9
Launch Site	VAFB or KSC
Servicing	Landsat 7
Assembly	Ka Antenna
Manufacturing	Beam

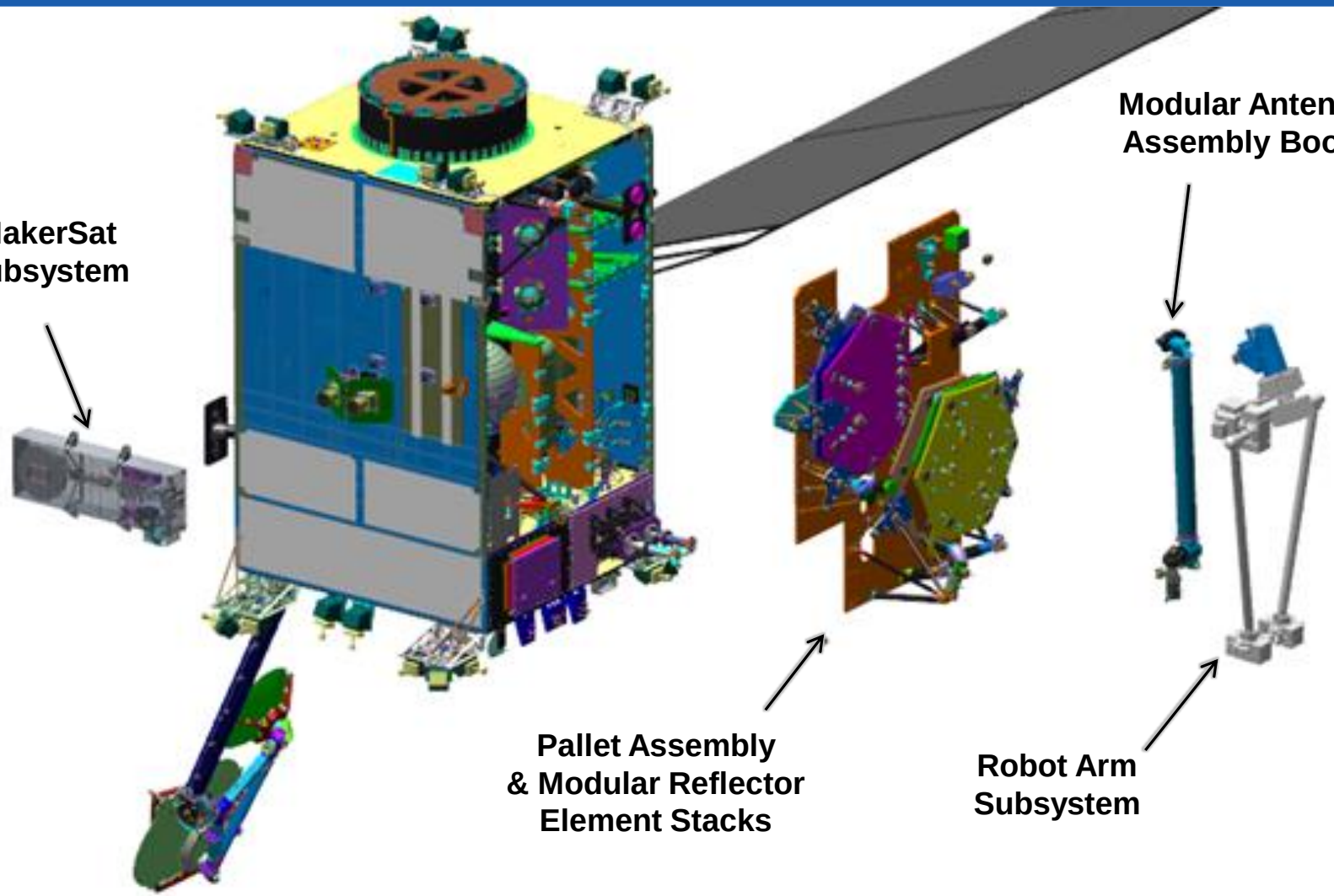
OSAM-1 will demonstrate

- Autonomous rendezvous and inspection
- Autonomous capture of client satellite
- Tele-operated robotic servicing
- Refueling of client satellite
- Relocation of client satellite
- Release and safely depart from client
- On-orbit assembly of an antenna
- On-orbit manufacturing of a beam





Space Infrastructure Dexterous Robot (SPIDER) Payload Overview



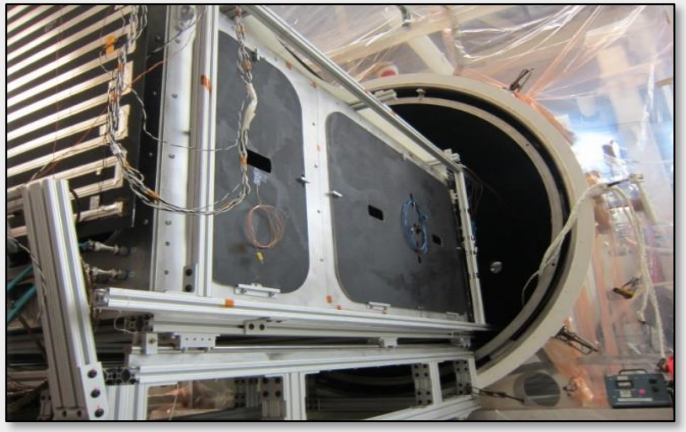
SPIDER will demonstrate:

- Assembly / disassembly of 3m Ka quality reflector antenna in-space utilizing a lite weight robot arm
- Dexterous robotic system operating under supervised autonomy
- Manufacturing and characterization of a 10m long, thermally stable, precision structural beam
- Removal and re-installation of beam manufacturing unit

OSAM-2 (Archinaut) Mission Overview

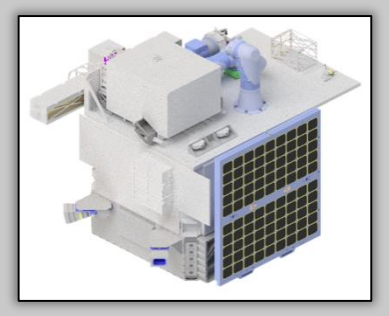
Phase I: Development

- Extended Structure Additive Manufacturing Machine (ESAMM) successfully tested in 2017
- Ground Based Manufacturing & Assembly System Hardware (GBMASH) successfully tested in 2018



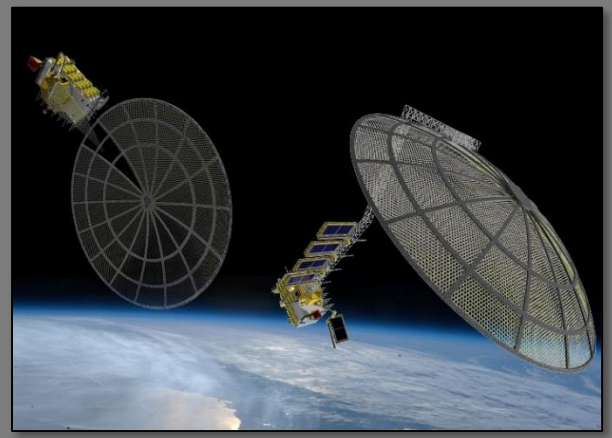
Phase II: Demonstration

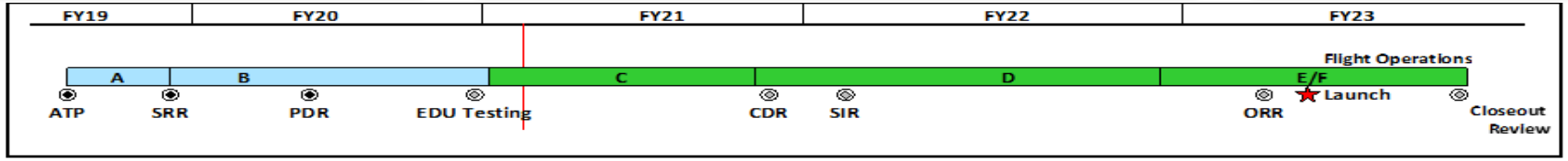
- OSAM-2 (Archinaut One): In-space demo of extended structure, robotic manipulation
- Focus on demonstrating capabilities relevant to commercial and government missions
- 4-year flight demo mission funded by NASA Space Technology Mission Directorate



Phase III Goal: Commercialization

- Deployment of commercial products in space
- Extended structure AM, robotic assembly, and in-situ inspection capabilities applied to commercial and government missions
- Deployment funded by customers





On-Orbit Servicing Applications to Sustained Human Presence Beyond LEO

Key Technologies

- Rendezvous & Proximity Operations
- Advanced Avionics
- Specialized Tools
- Fluid Transfer
- Dexterous Robotics
- Cooperative Service Aids

- **Refuelable spacecraft**
  - Autonomous refueling will inform future refueling technologies required for fully reusable lunar landers and the Mars Transportation architecture.
  - Providing valves, fluid transfer systems, refueling vehicles or propellant depots spacecraft can visit
- **Human habitat maintenance aboard spacecraft**
  - Oxygen replenishment
  - Cooling system maintenance
- **Ability to conduct unplanned repair in face of unforeseen circumstances**
  - Providing robotics, tools and RPO systems, maintenance vehicle
- **Ability to conduct planned maintenance of subsystems**
  - Providing robotics, tools, maintenance vehicle

Assembly & Manufacturing Applications to Sustained Human Presence Beyond LEO

- **Augmentation of Human Exploration capabilities**

  - Assembly and Manufacturing technologies can evolve to contribute to lunar sustainability for assembly of potential future lunar surface structures
  - Enables larger space payloads, overcoming the launch vehicle fairing volume constraint
  - Payloads no longer necessarily need to be qualified to survive launch loads and environments
  - Robot assembly and supervised autonomy technologies augment exploration capabilities, overcoming human safety factors of transferring and integrating hardware
  - Allows greatly simplified integration and the ability to repurpose, upgrade, or reconfigure assets beyond LEO

These capabilities will contribute to the NASA Artemis program by providing more sustainable, affordable and resilient spaceflight near Earth, the Moon and deep into the solar system through in-space servicing and assembly.