



Ideas for Infusing OSAM into Nuclear Electric Propulsion Architectures

**Julia Cline¹, John Dorsey¹, David Kang¹,
Bill Doggett¹, and Danette Allen²**

¹Structural Mechanics and Concepts Branch

²Automated Integrated Systems Research Branch

NASA Langley Research Center, Hampton, VA

Nuclear Emerging Technologies
for Space Conference (NETS) 2022
May 9-12, 2022, Cleveland, OH
“Lightning Talk”

This work is supported by NASA's Space Technology Mission Directorate through the Space Nuclear Propulsion project.



OSAM is now ISAM

On-Orbit → In-Space

In-Space

Refers to the suite of capabilities which are used on-orbit, on the surface of celestial bodies, and in transit between these regimes

Servicing

Inspection, life extension, repair, or alteration of a spacecraft after initial launch

Assembly

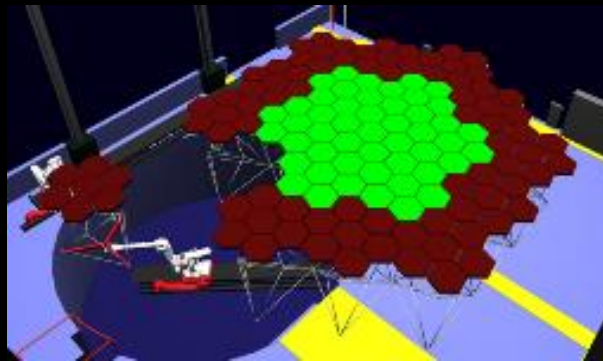
The construction of space systems using pre-manufactured components

Manufacturing

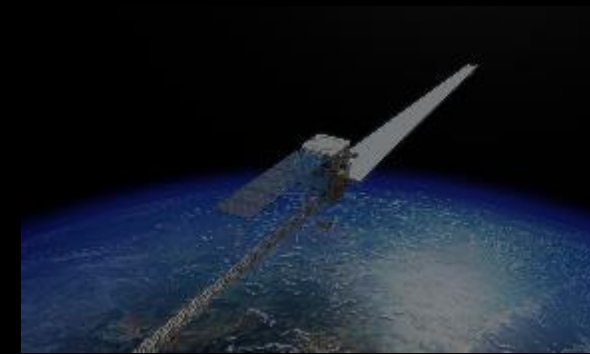
The transformation of raw or recycled materials into components, products, or infrastructure



Servicing



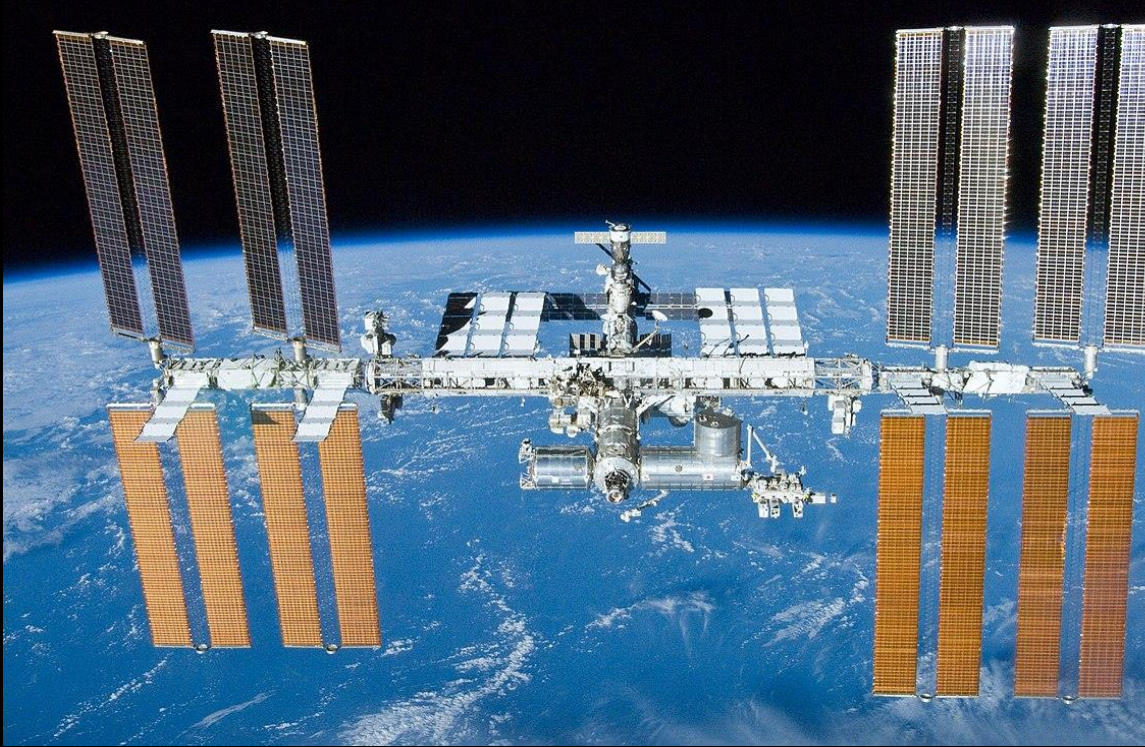
Assembly



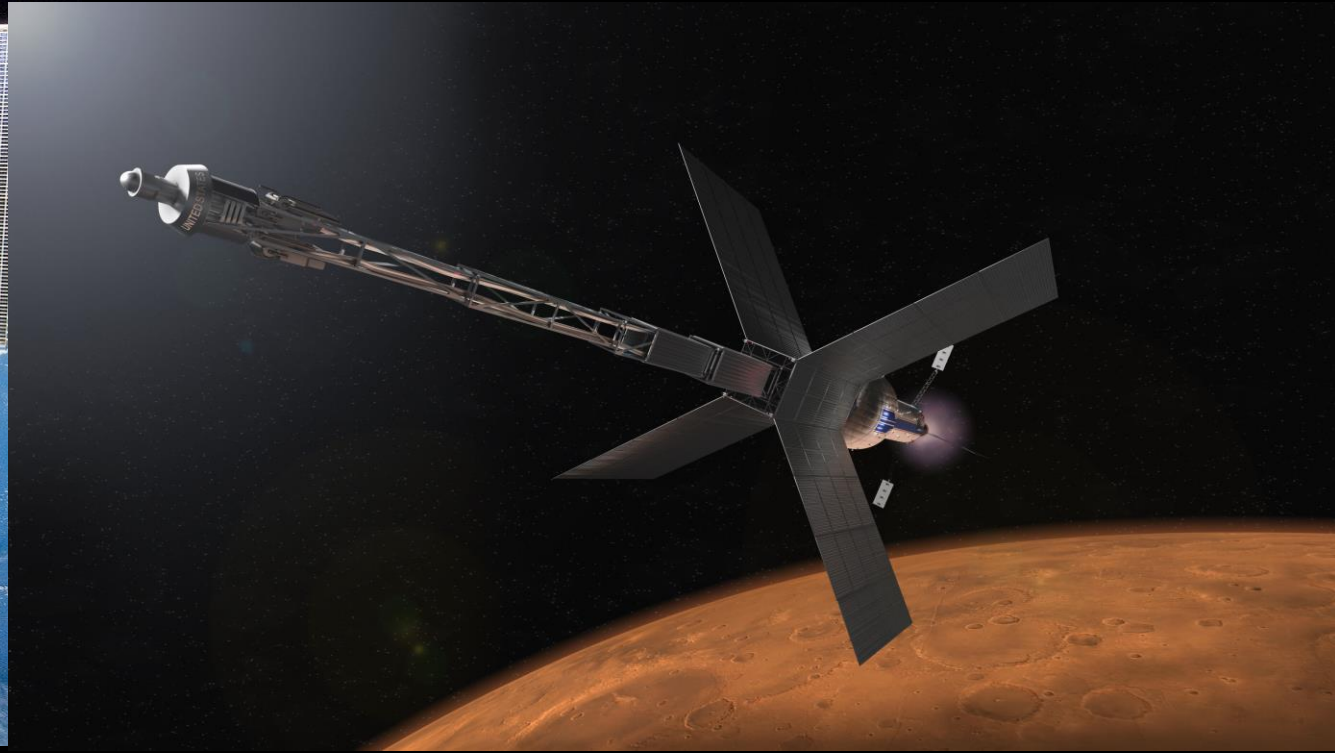
Manufacturing



Nuclear Electric Propulsion (NEP) vehicles are the same size magnitude as the ISS



International Space Station (ISS)



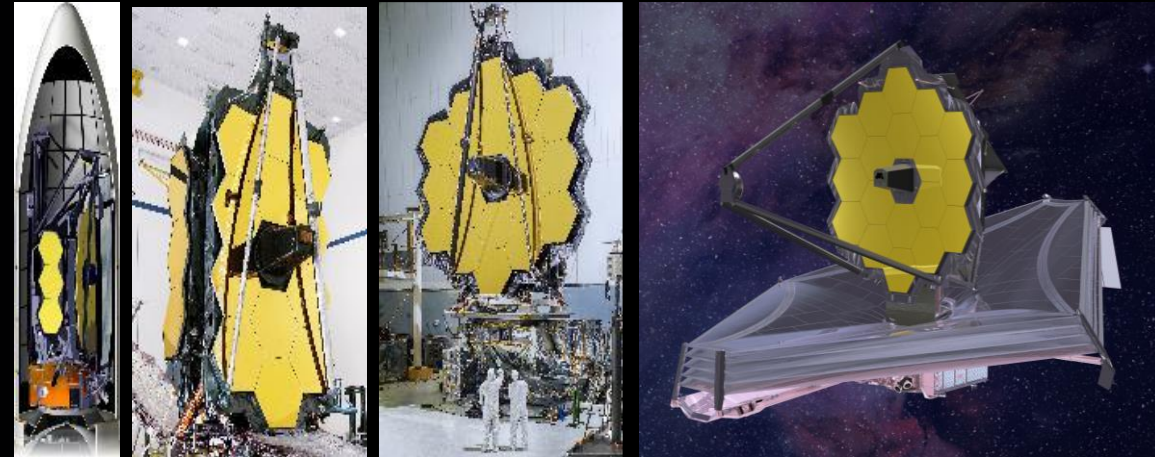
NEP vehicle concept

Persistent asset:

- 1) Large structural area
- 2) Comprised of several components
- 3) Long lifetime/mission duration
- 4) Benefits from multiple visits for servicing, upgrades



How to achieve large structures on orbit?



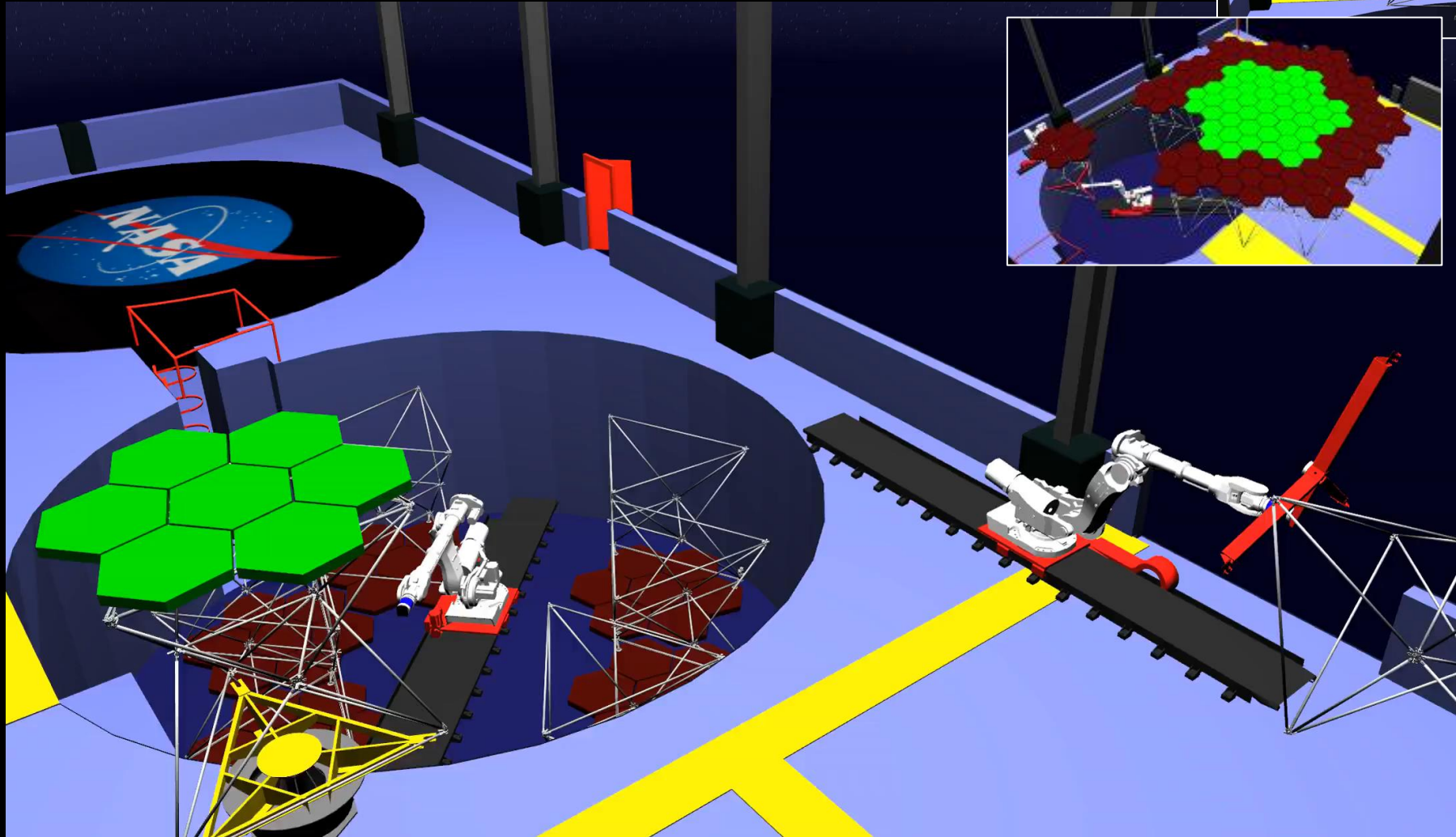
ISS

Berth or dock monolithic modules; some deployables

James Webb Space Telescope

Fold to fit inside payload fairing for launch and deploy unaided once on orbit

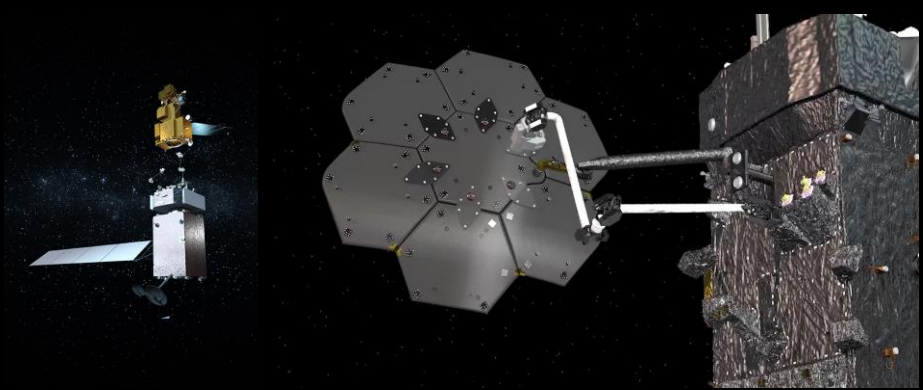
An ISAM approach embraces.....



- Autonomous robotic agents
- Component modularity
- Maintenance
- Repairs
- Replacements
- Upgrades



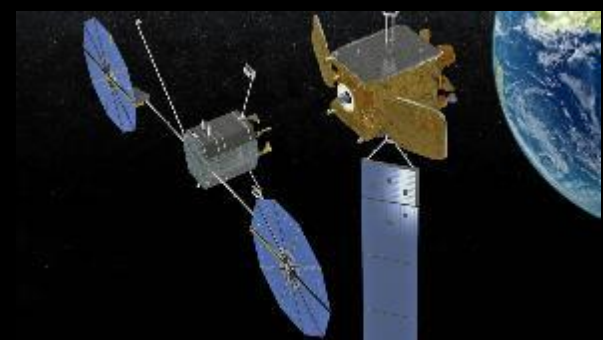
Commercial industry is making significant advancements *right now* that can be leveraged for future spacecraft



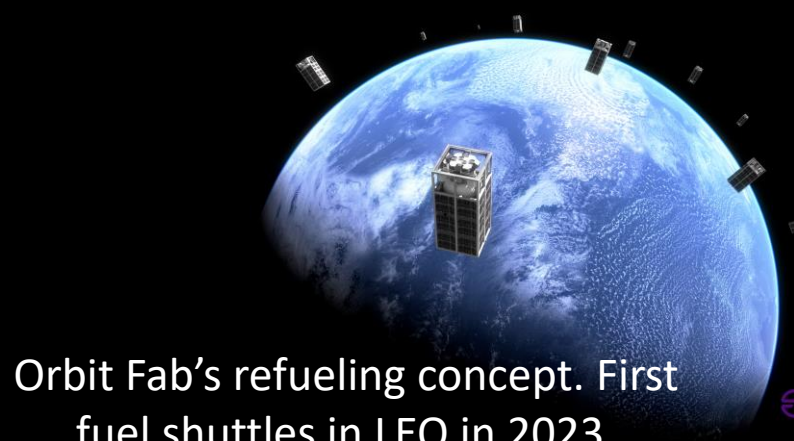
OSAM-1 mission to service a satellite and assemble an antenna in-space. Launch ~2024



OSAM-2 will manufacture a beam and assemble solar arrays. Launch ~ 2023.



Northrop Grumman Mission Extension Vehicle (MEV) provides mission extension and relocation services. Launched in 2020, 2021.



Orbit Fab's refueling concept. First fuel shuttles in LEO in 2023.



Orbit Fab to refuel Astroscale LEXI. Estimated in ~2026.

... these are just a few examples, and the list goes on....



Benefits of an ISAM approach to NEP

Greater flexibility in choice of launch vehicle

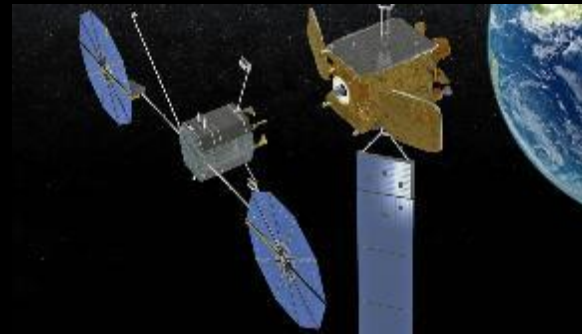
- Scheduling/availability
- Cost



Reduced complexity from origami-style deployable structures to efficiently packaged modular elements

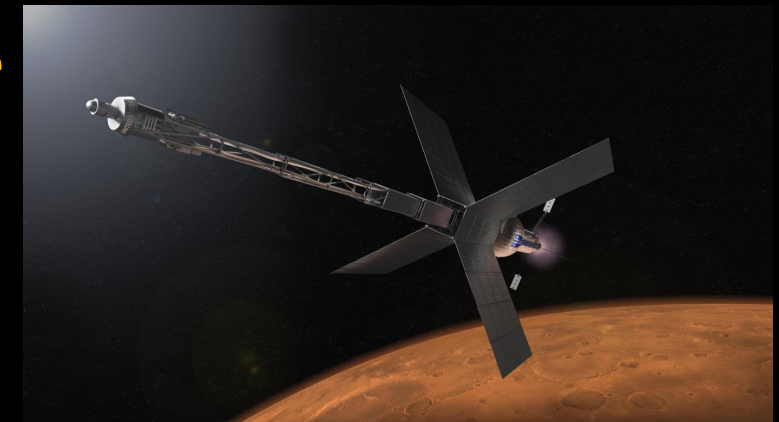


Berth large modules using long-reach robotic agents



Use orbital transfer (current commercial capability) to transfer all components to assembly orbit

Promotes reusability because the ability to repair, replace, and upgrade components is built into the architecture from the onset





Thank you for your attention! Any questions?

For more information on ISAM and persistent assets:

Doggett, et al. "Persistent Assets in Zero-G and on Planetary Surfaces: Enabled by Modular Technology and Robotic Operations," AIAA 20018-5305 (2018), <https://doi.org/10.2514/6.2018-5305>

"In-Space Servicing, Assembly and Manufacturing National Strategy" released in April 2022 by the National Science and Technology Council

Julia Cline, PhD, julia.e.cline@nasa.gov

Structural Mechanics and Concepts Branch

NASA Langley Research Center, Hampton, VA