CONSORTIUM FOR SPACE MOBILITY
AND ISAM CAPABILITIES

COSMIC Capstone Challenge (C3) Mentor On-Boarding

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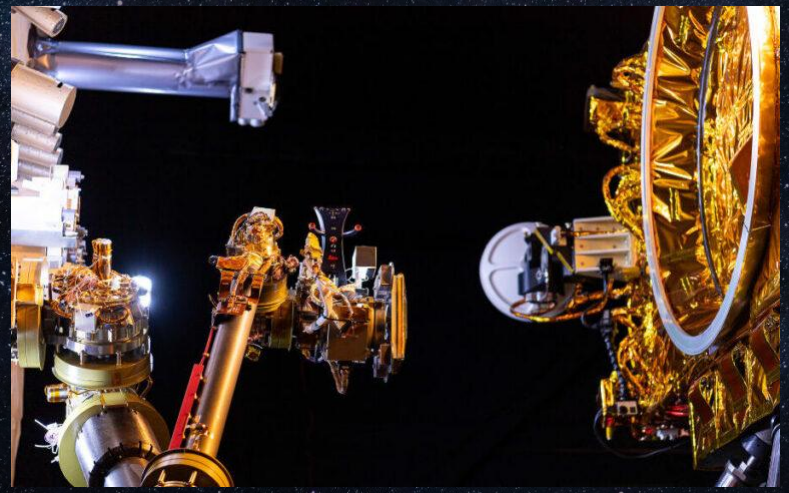
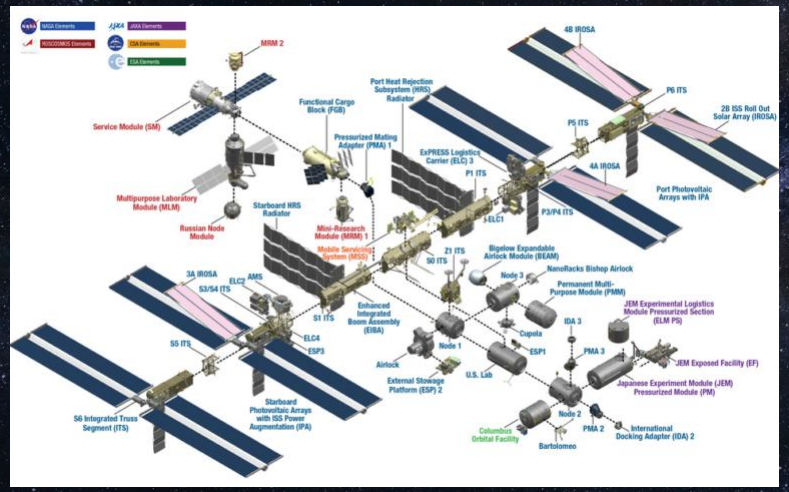
C3 Mentor On-Boarding Agenda

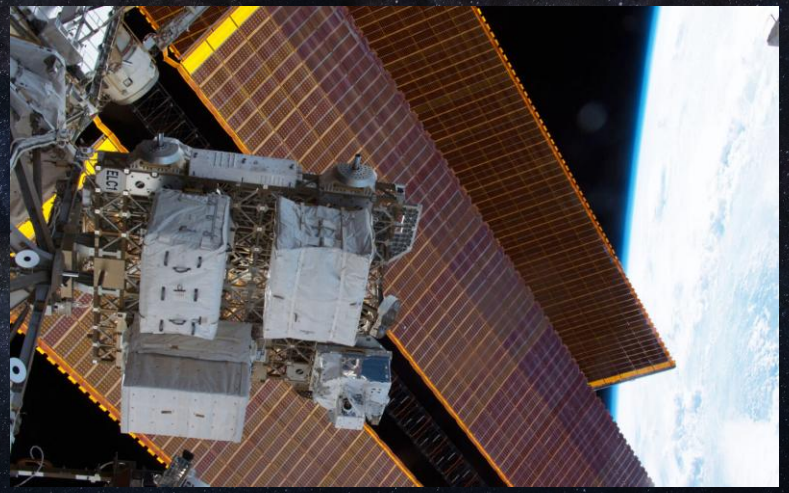
- Gather and Review Meeting Agenda
- Introduction to COSMIC and the Workforce Development Focus Area
- Overview of the COSMIC Capstone Challenge (C3)
- Review of Mentor Responsibilities
- Perspectives from Past & Current Mentors
- Participant Q&A
- Wrap-up

What is ISAM?

- Design of modular, serviceable, upgradeable, and evolvable systems
- Assembly of simple to complex space systems
- Manufacturing in space using Earth- and locally-sourced materials

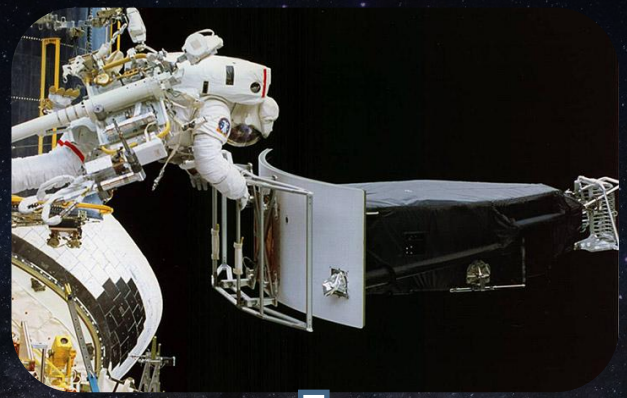






Why Now?

ISAM National Strategy and Implementation Plan



Foster an ecosystem to leverage ISAM capabilities

- Support and stimulate USG, academic, and commercial ISAM capability development
- Consistent with US Space Priorities Framework (Dec 2021)

Strategic goals

1. Advance ISAM research & development
2. Prioritize expanding scalable ISAM infrastructure
3. Accelerate the emerging ISAM commercial industry
4. Promote international collaboration and cooperation
5. Prioritize environmental sustainability
6. Inspire a diverse future space workforce

COSMIC: A Nationwide Alliance for ISAM

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- Vision:
  - Create a nationwide alliance that enables the U.S. space community to provide global leadership in ISAM.
- Mission:
  - Making ISAM a routine part of space architectures and mission lifecycles.

Goals and Objectives

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Capability Development

Develop, mature, and demonstrate ISAM technologies that enable and enhance mission utility.

- *Promote coordinated development and demonstration of new ISAM technologies*
- *Provide access to digital, ground, and space test opportunities and infrastructure to transform technologies into fielded capabilities*
- *Incubate and advocate promising technologies with applications to new ISAM markets*

Ecosystem Economics

Promote U.S. leadership in ISAM technologies and capabilities that change the business model away from single-use space assets.

- *Facilitate transfer of ISAM technologies to commercial market*
- *Encourage collaboration among industry and government members*
- *Support organizations in the development of open standards and norms*
- *Navigate the ISAM legal and regulatory perspectives*

Mission Applications

Encourage and guide missions to use ISAM capabilities as part of commercial and government program lifecycles.

- *Collaborate to define future missions and architectures that require or benefit from ISAM capabilities (“guide stars”)*
- *Influence the incorporation of ISAM into government and commercial space activities*
- *Maintain knowledge of available ISAM capabilities, ongoing activities, and existing facilities, and communicate this information to mission developers*
- *Prioritize environmental sustainability*

A nationwide alliance working collaboratively to make ISAM a routine part of the space mission lifecycle

Organization

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Steering Committee
(USG + Industry* + Academia)

Consortium Management Entity
Phase 1: Execute day-to-day operations of the Consortium according to strategic guidance from the Steering Committee
Phase 2: Integration across focus areas

USG Caucus
Support USG products, e.g. prioritization, solicitations, and roadmapping

Industry Caucus*

Academia Caucus

Research & Technology (RT)

1. Basic Research (w/ Academia)
2. Applied Technology (gov't and industry)
3. R&D Subgroups (by discipline and/or ISAM function, e.g. robotics, RPO, capture, refueling, autonomy, etc.

Demonstration Infrastructure (DI)

1. Digital and simulation systems
2. Ground test facilities and systems
3. Flight testbeds for ISAM technologies / capabilities

Missions & Ecosystems (ME)

1. Business models, economic benefits, programmatic versatility
2. Current missions enhanced by ISAM (business case, lifecycle value)
3. Future missions enabled by ISAM

Policy & Regulation (PR)

1. Remove speed bumps to widespread adoption
2. Various activities (w/ CONFERS)
3. Support for others who develop standards

Workforce Development (WD)

1. Increase opportunities to include ISAM in education
2. Build a skilled labor workforce to support ISAM
3. Expand opportunities to attract students to tackle ISAM challenges

* Includes ties to CONFERS

COSMIC Workforce Development Focus Area (WDFA)

- "To achieve the goals outlined in the ISAM National Strategy, the future space workforce must be diverse and be ready to tackle some of the most challenging space problems."

- "Education and workforce training programs must **prepare and inspire the next generation** of space scientists, engineers, and technologists to advance ISAM capabilities."
  - "Expand opportunities at the high school, undergraduate, graduate, and post-doctoral level to attract students from multiple disciplines – engineering, science, technology, policy, law, etc. – to tackle ISAM challenges through **learning activities**, awards and grants, internships, **research opportunities**, and other incentives to inspire a diverse workforce."

The COSMIC Capstone Challenge (C3)

Review the C3 Information Packet

The Challenge:

- National student competition aimed at developing novel ISAM concepts
- The COSMIC Capstone Challenge is presented to college students who are invited to develop conceptual missions & designs for spacecraft operations in orbit or on the lunar surface.

The Vision:

- Leverage the COSMIC network to connect students and universities to organizations and commercial companies which would collaborate with student teams to adopt these ideas and fund them for internal development, strengthening the ISAM talent pipeline

Review the C3 Information Packet!!!

- It's neither long nor dense, yet covers key material that won't be discussed today

LinkedIn Group: https://www.linkedin.com/groups/14485139/

C3 in Context

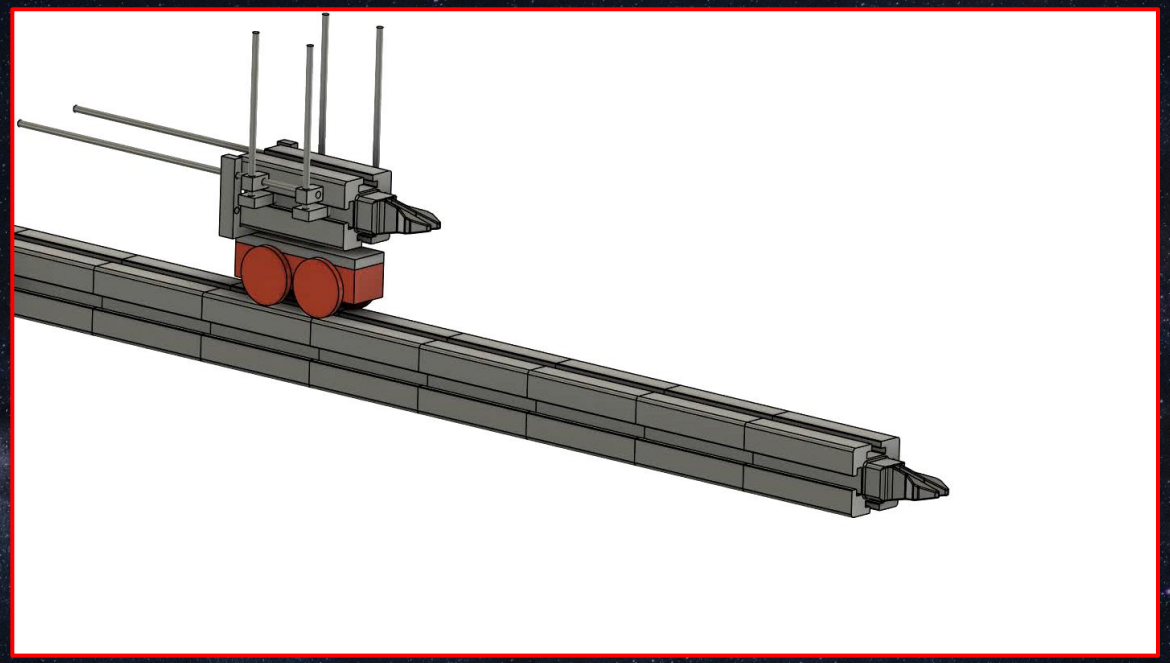
Tech Development Roadmap Tie-In for Track 1

- Technology development roadmap began at Aerospace in Spring 2022 by developing a concept for an orbital satellite factory that could be put into service within 10 years
- Purpose of the goal was to motivate a focus on technologies that seemed viable in mid-term
- Roadmap identified key technologies, which are demonstrated at increasing complexity on orbit
- C3 plays a crucial role in developing orbital experiments that enable functional missions next decade

- 2022-2025 Roadmap development
- 2022-2030 Advance key technology in the lab for orbital experiments
- 2023-2026 Develop & design five 12U-sized orbital experiments as hosted payloads through STP
- **2023-2026 Students in COSMIC Capstone Challenge conceptually design complex orbital experiments**
- 2026-2028 Integration, launch and execution of orbital experiments
- **2029-2031 Larger (ESPA-class), integrated orbital experiments inspired by Design Challenge**
- 2031 Enable government agencies to create request-for-proposal for orbital manufacturing

The Challenge Focuses on Conceptual Design

- Without requiring a prototype, engineering drawings and animations become essential for communicating the conceptual design
- While conceptual design is not focused on analysis, engineering assessments are a crucial part of the process
  - Trade studies
  - Feasibility
  - Size, weight, and power (SWAP) requirements
  - Utility
  - Novelty



Self-assembling modular network for transporting manufacturing, assembly, inspection and servicing tools around a satellite

Design Tracks for C3

- There are 6 design tracks that teams can participate in:
  - Track 1 Challenge: **Orbital Manufacturing and Assembly** (C3-Manufacturing)
    - Design a payload to be hosted aboard Arkisys's Bosuns Locker that would demonstrate a chain of 3 or more operations providing a capability important for orbital manufacturing or assembly.
  - Track 2 Challenge: **Lunar Operations** (C3-Lunar)
    - Design a payload to be delivered by Astrobotic's Griffin lander that can prepare the lunar surface for a Fission Surface Power reactor with humans residing within 1km. Prototype required.
  - Track 3 Challenge: **Orbital Servicing** (C3-Servicing)
    - Using Northrop Grumman's Mission Robotic Vehicle (MRV) and Mission Extension Pod (MEP) as a fixed servicer capability, design and analyze candidate on-orbit attachable components (OACs) that the MRV could use to alter a client spacecraft already on-orbit in geostationary orbit (GEO) or cislunar space.
  - Track 4 Challenge: **In-Space Construction** (C3-Construction)
    - Design orbital or surface infrastructure element(s) and outline the mission describing its construction using autonomous robotic assembly technologies. Teams should leverage previous work in modular building blocks and "builder robots" as referenced; teams may choose NASA's Project ARMADAS or other types of building blocks and robotic systems to address their mission needs.
  - Track 5 Challenge: **In-Space for Earth** (C3-Return)
    - Design a manufacturing payload hosted by Dispatch's Free Flyer 1 reentry vehicle to produce materials in space with properties that are impossible to achieve on Earth.
  - Track 6 Challenge: **Architecture of Autonomous Space Clusters** (C3-Cluster)
    - Develop an architecture and key elements that would enable a cluster of vehicles that would autonomously perform important functions in orbit or on the lunar surface (U.S. persons only).

The 2026-27 COSMIC Capstone Challenge

Mentoring-based approach

- Provide guidance to student teams and advise them in setting professional expectations and viewing the mission lifecycle holistically
- Drawn from across COSMIC membership to provide expertise and diversity of perspective
- Mentors will meet with students at least biweekly to support students and answer questions
- Students will mainly be focused upon addressing key milestones and completing coursework

Showcase events

- An informal midpoint showcase is planned for December to get informal feedback
- Industry professionals will judge during the 30-minute outbrief in mid-April at the C3 Final Showcase
  - There will be an in-person option at The Aerospace Corporation in Los Angeles
  - Other COSMIC member organizations are invited to host presentations on-site

Timeline for Academic Year 2025-2026

All days are week of unless noted otherwise, based a 2-semester Capstone

• Early August	C3 launches & registration opens
• September 9	Separate on-boarding briefs for professors, mentors & students
• September 11	Team registration deadline
• September 21	Begin distinct weekly office hours for professors, mentors & students
• September 21	Recommend teams have selected Program Manager
• October 14	Select operations to form the foundation of the target capability
• October 17	Submission of Mission Statement
• November 15	Present internal Systems Requirements Review (SRR)
• December 7-11	Midpoint showcase/ “Pitch” Presentation (5-minute flash talks open to all)
• January 13	Complete trade studies
• March 3	Complete Internal Conceptual Design Review
• April 1	Develop plan to reach Preliminary Design Review
• April 12-14	Presentation & judging at C3 Final Showcase (Virtual & on-site in El Segundo)
• Late May	Recommended time to submit paper or abstract to technical conference or journal

The Mentor's Role

Students, advisors (professors/ teachers), mentors and organizers each have different roles

- For many, this is the students' first experience dealing with industry professionals
  - Offering program management guidance can be just as important as technical guidance
  - We recommend treating the students as you would a junior engineer
- Expect the students to act professionally and guide them on how to do so
  - If students are ill-prepared for meetings, announce last-minute cancelations, or are unresponsive offer correction
  - Communicate with advisors if the students consistently fall short of expectations or are going off track
- If beyond your expertise, serve as a nexus to connect students with other resources
  - Identify references
  - Suggest contacts inside or outside your organization– professionals are often receptive to student queries
- Direct students to their professors or C3 organizers as needed

The Mentor's Role

Students, advisors (professors/ teachers), mentors and organizers each have different roles

- Mentors may suggest direction, but should not dictate them
  - For some projects, it may be appropriate for the mentor to specify the direction as long as the professor is on board
- Classroom priorities take precedence over C3 goals
- Grading and evaluation is **not** the mentor's role
  - Mentor's role is to provide guidance and expertise
  - You are not expected to evaluate students against each other
  - Mentors should offer feedback about how teams did broadly and may offer more detailed feedback
- Most of all, mentors should guide the students towards success
  - It's OK to point out dead ends

Mentor Perspective

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Next Step & Questions

- All student teams should register at: https://forms.gle/gvanwxr988ANpTKv8
  - This allows us to track the teams and communicate directly with the students

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Next Step & Questions

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Questions?

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