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COSMIC

CONSORTIUM FOR SPACE MOBILITY AND IN-SPACE SERVICING, ASSEMBLY AND MANUFACTURING (ISAM) CAPABILITIES

COSMIC CONVERGENCE 2024 SUMMARY

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1. SUMMARY

On May 15-16, 2024, the **Consortium for Space Mobility and ISAM Capabilities (COSMIC)** convened 170 in-person member attendees and 140 virtual member attendees for COSMIC Convergence, COSMIC's only in-person event of the year. To continue to build momentum toward making in-space servicing, assembly, and manufacturing (ISAM) a routine part of space architectures and missions, COSMIC Convergence inspired, integrated, and invigorated its members through a combination of keynote talks, flash talks, discussions about COSMIC objectives and products, and collaborative activities.

2. THE STATE OF COSMIC

COSMIC is governed by a Steering Committee, which consists of term-serving members selected from U.S. government, industry, and academia. The Steering Committee provides strategic guidance to the Consortium Management Entity (i.e., The Aerospace Corporation) regarding implementation, goals, and priorities of the entire U.S. ISAM community. It represents

a broad cross-section of member interests and includes a mix of participants with different expertise, experience, and motivations that play a specific role of ensuring all stakeholder needs are addressed equally.

The Steering Committee met at Convergence to explore topics critical to the future of ISAM and COSMIC, including formalizing cross-caucus communication, working to differentiate COSMIC from other stakeholder groups addressing ISAM issues, and helping the U.S. ISAM community navigate policies for servicing international systems. Committee Chair **Bo Naasz, NASA Senior Technical Lead for ISAM and RPOC System Capabilities,** delivered a State of COSMIC address, which included a review of the COSMIC Operating Plan, a snapshot of U.S. client preparedness for in-space capture and refueling, and a midyear stoplight chart assessment of progress against four key COSMIC objectives as defined in the COSMIC Operating Plan:

1. **Multi-Channel Communications:** provide forums and tools to enable government, industry, and academia to share information, discuss opportunities, and address concerns.
2. **ISAM Capabilities**: encourage technologies that enable and enhance a thriving ISAM community.
3. **Ecosystem Economics:** promote U.S. leadership in ISAM technologies and capabilities that change the business model away from single-use space assets to sustainable operations for crewed and uncrewed space missions.
4. **Mission Applications:** encourage and guide missions to use ISAM capabilities as part of commercial and government program lifecycles.

3. PLENARIES

Dr. Clare Martin
Astroscale U.S.

Dr. Clare Martin, Executive Vice President, Astroscale U.S., provided the Day 1 Convergence keynote remarks. She is a founding COSMIC member who joined Astroscale U.S. in August 2019 as Executive Vice President. In her keynote address, "The View is Incredible from Here: Why ISAM is the Future of Space," Dr. Martin drew a connecting line from legacy in-space servicing achievements through current ISAM successes—including Astroscale's own recent progress in its ADRAS-J mission with Japan, which produced in April 2024 the first publicly released image of space debris captured through rendezvous and proximity operations (RPO)—along a pathway to making on-orbit servicing routine by 2030.

Dr. Jinni Meehan
White House Office of
Science & Technology Policy

On Day 2, Convergence participants were joined virtually by keynote speaker **Dr. Jinni Meehan, Assistant Director for Space Policy, Office of Science and Technology Policy (OSTP),** who assumed her position in February 2024. Dr. Meehan provided COSMIC members with a briefing that detailed OSTP's overarching mission, the six strategic objectives defined in the April 2022 ISAM National Strategy, and the 28 implementation actions defined in the December 2022 National ISAM Implementation Plan. Dr. Meehan noted several benefits of fulfilling the national imperative to developing mature ISAM capabilities. ISAM, she said, could "enable the American innovation to capture" a future market estimated at nearly $1 trillion; "provide a framework for space infrastructure within which emerging space companies can thrive"; enhance humanity's untapped economic potential to both "be the foundation of long-term American leadership over international competition" and "enhance opportunities for international cooperation in space." Dr. Meehan underscored key barriers for COSMIC and the ISAM community to embrace, to position the community most effectively within a constrained budget landscape:

1. Improving coordination and collaboration, both in and outside of the U.S. government, to include academia, industry, and international partners;
2. Sending a clear and consistent demand signal to private industry in order to stimulate investment in ISAM technologies and mitigate risk to address investor confidence; and
3. Establish and adopt ISAM standards to help promote growth.

Dr. Meehan stressed that collaboration within the interagency working group established in the 2022 National ISAM Implementation Plan—as well as within OSTP, where she also has input in the execution of the related National Cislunar Science and Technology Strategy—is continuing to advance the ISAM National Strategy and make progress against the objectives laid out in the Implementation Plan.

4. MEMBER CAUCUSES

One method COSMIC members use to organize themselves is to separate into three caucuses: U.S. government, industry, and academia. These caucuses allow representatives from each market segment to communicate among themselves, identifying topics, products, needs, or ideas that are of particular importance to their market segment. Each member caucus met during Convergence to elect inaugural caucus chairs and to discuss critical path needs for their respective constituencies.

4.1 GOVERNMENT CAUCUS

Ms. Jill McGuire, NASA GSFC
Chair, Government Caucus

The Government Caucus elected its inaugural chair, **Jill McGuire, Associate Director for NASA's Exploration and In-Space Services (ExIS) Projects Division**. In her role, Ms. McGuire carries on NASA's 30-year legacy of satellite servicing and repair by developing new technologies for future programs. She has worked at NASA Goddard Space Flight Center since January 1992 and began working in satellite servicing in 1998 when she began supporting the Hubble Space Telescope (HST) Development Project.

The caucus also received flash talks from **Dr. Seth Lacy, U.S. Air Force Research Lab (AFRL) Senior Scientist for Space Mobility and Precision Maneuver,** regarding AFRL's ISAM/Space Access, Mobility, and Logistics (SAML) test and research infrastructure, and from Mr. Naasz, who discussed the recently completed NASA Technology Shortfall Prioritization Survey which was published in April 2024. Finally, the caucus discussed the challenges facing the ISAM/SAML community resulting from recent mixed messages coming from senior government leaders regarding the demand signal for operational ISAM capabilities.

4.2 INDUSTRY CAUCUS

Ghonhee Lee
Katalyst Space Technologies
Chair, Industry Caucus

The Industry Caucus elected its inaugural chair, **Ghonhee Lee, CEO of Katalyst Space Technologies.** He leads Katalyst's efforts to bring in-space upgrade products to market, leverage ISAM technologies to retrofit existing satellites with new capabilities post-launch, and design business models fit for the new space age. Katalyst has secured seed equity financing, AFWERX SBIRs & TACFIs, and non-SBIR funding from the United States Government. Prior to starting Katalyst, Mr. Lee worked as a guidance, navigation, and control (GNC) engineer on development and flight efforts for U.S Navy and Security Cooperation Organization programs.

The Industry Caucus discussed how to improve engagement between its own members and how to gather information needed to communicate more effectively across the other COSMIC caucuses. Participants also explored areas where industry can lead the ISAM/SAML community in a push toward making ISAM capabilities routine in space missions, such as self-identifying areas needing development or establishing demand signals natively within the commercial sector.

4.3 ACADEMIA CAUCUS

Dr. Seetha Raghavan, Embry-Riddle Aeronautical University
Chair, Academia Caucus

The Academia Caucus elected its inaugural chair, **Dr. Seetha Raghavan, Professor and Associate Dean of Research and Graduate Studies of the College of Engineering at Embry-Riddle Aeronautical University**. Dr. Raghavan served as a faculty member for 14 years at the University of Central Florida, most recently as Director of the Aerospace Engineering Graduate Program. She was instrumental in leading the development of the Ph.D. program in Aerospace Engineering to its successful launch in 2019 and leading the program to a growth in enrollment to 60 doctoral students with 20 AE doctoral degrees awarded by the end of her tenure. Over the last 20 years, her research has contributed to knowledge for future aerospace materials and structures, while initiating international collaboration and bringing fundamental research to industry.

Open discussion at the Academia Caucus focused on membership challenges and opportunities, reviewed and prioritized academic needs, and discussed the vision, mission, and actions for the caucus.

5. FOCUS AREAS

COSMIC harnesses the creativity, energy, and resources of the nation to ensure the United States is at the forefront of ISAM capabilities. COSMIC includes five Focus Areas, each of which includes interested members of COSMIC's general membership from all three caucuses. Together, Focus Area attendees are responsible for creating a community that enables sharing of information between all consortium members. Each group gathers information, facilitates the creation of consortium products, and provides configuration management of the products after they are approved. COSMIC's Focus Areas are **Research & Technology (RT)**, **Demonstration Infrastructure (DI)**, **Missions & Ecosystems (ME)**, **Policy & Regulation (PR)**, and **Workforce Development (WD)** as shown in the figure below. Convergence afforded each focus group opportunities to discuss and advance work products in a collaborative setting.

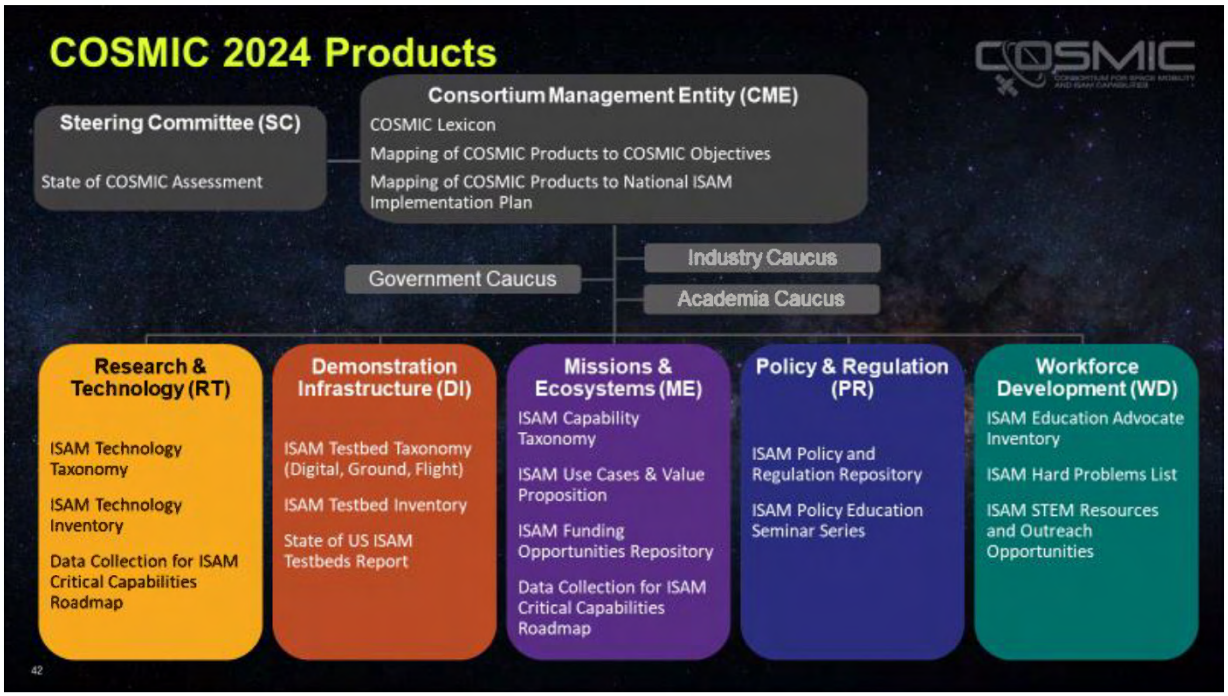

Figure 1 COSMIC 2024 Focus Area Products

5.1 RESEARCH AND TECHNOLOGY (RT)

The RT breakout session at COSMIC Convergence emphasized manufacturing-related needs and advances in government, academia, and industry through four flash talks from COSMIC members working on in-space manufacturing. Briefs were provided by Zachary Courtright (NASA MSFC), Tim Poe (NASA MSFC), Keng Hsu (University of Arizona), and Elozor Plotke (for USSF/SSC).

In addition to the flash talks, the breakout included working sessions on two of the products tasked to RT by the COSMIC Steering Committee. The working sessions included strong participation from virtual attendees, who used a virtual whiteboarding tool to emulate the activities performed by the in-person attendees.

RT attendees began work on the ISAM Technology Taxonomy product by providing comments on their desired modifications to a previous technology taxonomy created by NASA. These comments allowed RT to narrow down its taxonomy to focus more closely on only ISAM-relevant technologies. This input, as well as feedback from the discussion following the working session, will be used to develop version 1.0 of RT's ISAM taxonomy.

The survey tool that will be used to collect data was demonstrated to attendees, so they could provide feedback on community needs for both the database and the querying tool. With these tools, RT will collect data on maturity of various ISAM technologies and how these technologies should be classified using the ISAM taxonomy. Collecting this data will help RT members develop a broader understanding of the technology landscape and critical needs.

Technical leads have been identified that will run RT subgroups to fine-tune the ISAM technology taxonomy, gather technologies for the inventory, and help guide the RT community identify and ingest relevant data from COSMIC members to build on the existing work of the community to produce a full, unified ISAM Technology Inventory.

5.2 DEMONSTRATION INFRASTRUCTURE (DI)

The Demonstration Infrastructure Focus Area breakout at Convergence emphasized sharing information relevant to testing and maturing ISAM technologies, and making collaborative progress on two of the products assigned to DI by the Steering Committee: DI Testbed Taxonomy and Testbed Inventory.

DI breakout attendees were treated to a flash talk from Noah Gladden from Arkisys, who described Arkisys' plans for an in-space testbed for ISAM called The Port. The talk emphasized the motivation, end state vision, and the current status of the project, including digital and ground-based testing of The Port hardware and CONOPS.

At Convergence, leads for each of the Product Tiger Teams briefed an update of progress made to date. Lee Wilson (Radiant Space Systems), Bogdan Udrea (VisSidus Technologies, Inc), and John Lee (Amrok Space) briefed the Testbeds Taxonomy. The DI community provided feedback on the draft Taxonomy and suggestions for Testbed Inventory database schema and content solicitation. For example, the community suggested shaping the testbed inventory survey based on details defined in NASA's ISAM State of Play. While the community believes there's a need to separate the taxonomy definitions when discussing ground, digital, and in-flight testbeds, they identified the need to find points of intersection between these definitions so that a cohesive, connected workflow is displayed when a system moves from digital simulation to ground-based testbed to in-orbit V&V on the in-flight testbed.

Going forward, the Testbed Taxonomy will be finalized and released after internal reviews within the Tiger Teams and by the entire DI membership. The first iteration of the Testbed Inventory will focus on interoperability of the three DI subgroups: digital, ground, and flight. A content solicitation survey will be circulated among COSMIC members to inform this first iteration.

5.3 MISSIONS AND ECOSYSTEMS (ME)

During its breakout at Convergence, ME Focus Area attendees workshopped and scoped four working products: an ISAM Capability Taxonomy, an ISAM Funding Opportunities Repository, a Data Collection for ISAM Critical Capabilities Roadmap, and a High-Value Use Cases and Value Propositions product. In the months leading up to Convergence, leads were identified for two of the four products, and all four product concepts were scoped, with ideal delivery mediums identified and some sources of information pinpointed.

To help Convergence attendees expand their thinking around the future of both ISAM and the space ecosystem as a whole, ME attendees participated in an interactive Blue Sky Foresighting exercise to support development of the High-Value Use Cases and Value Propositions product. As part of the exercise, attendees explored four archetypical future scenarios surrounding sociopolitical, technological, and financial priorities based on evolving world events. Analysis of these scenarios postulated the need for development of ISAM capabilities in those futures, and will inform ME use cases and their value propositions.

5.4 POLICY AND REGULATION (PR)

The Policy and Regulation breakout session began with two regulatory flash talks and Q&A discussions. The first speaker, Steven A. Rowings of the law firm of Akin Gump, provided an overview of the U.S. regulation of private space ISAM activities, including licensing requirements from the FAA, FCC, and NOAA. A complementary talk from Patrick Webre, Deputy Chief of the Federal Communications Commission's Space Bureau, followed on "FCC Updates: The Space Bureau and ISAM Licensing Proceeding." The remainder of the meeting was devoted to development of PR's two products: the Regulatory Repository and the Policy Education Seminar Series. Each product was discussed and largely completed in the meeting. Product lead Jay Mills from the law firm Hogan Lovells introduced the latest version of the U.S. ISAM Regulatory Repository, which has been developed and revised over the course of several monthly meetings. The text was deemed stable, complete, and ready for sharing with and use by the COSMIC membership. This Repository will be updated on a quarterly basis; future updates will consider whether technical standards should be included and in what file format the Repository should be maintained.

Jennifer McClellan from Astroscale U.S. led the discussion on the second product, the Seminar Series. Building off past PR Focus Area discussions, the group deliberated on the topics for the three seminars to be planned for the second half of 2024. Starting from the topics selected at the previous PR monthly meeting, the group broke into small table discussions (including a virtual table) and shared ideas for the topics, ultimately selecting three final seminar topics:

1. Update on ISAM Priorities and Strategy

2. Evolving Regulatory Needs for Federal and Commercial ISAM Missions
3. Overarching International Law Considerations and Implications to US ISAM.

The group will continue to work by correspondence to suggest and recruit speakers. The Seminar Series, which will provide COSMIC members regular opportunities to present on relevant topics, will commence later this year. All COSMIC members will be welcome to attend, and proceedings will be recorded.

5.5 WORKFORCE DEVELOPMENT (WD)

The Workforce Development Focus Area breakout at COSMIC Convergence featured discussions about how to inspire the future ISAM workforce and the COSMIC Capstone Challenge (C3). Attendees also participated in activities to curate a list of challenging topics in ISAM for future capstone challenges, and developing strategies related to ISAM in the curriculum and in challenges and capstones. Through these activities, the WD community identified potential challenges, roadblocks, and opportunities within academia, industry, and government related to infusing ISAM content into education and facilitating workforce development initiatives.

Attendees proposed ideas for infusion opportunities for ISAM education and brainstormed about topics for student capstone projects. Based on the discussion, WD will continue collecting and finalizing student capstone project ideas, recruiting volunteers to contribute to product development, and reaching out to the COSMIC community to recruit students, mentors, and judges for C3.

6. NEXT STEPS

The 2024 COSMIC Convergence served to inspire, integrate, and invigorate our community in its pursuit of the national goals of making ISAM technologies and operations routine parts of space missions, to help extend U.S. leadership in space. Going forward, COSMIC members will continue to convene at monthly Focus Area meetings to advance work on their respective 2024 products, as well as the next quarterly Caucus meetings in August and September. The next General Membership Meeting will be held fully online on Wednesday, December 4, 2024, where members will showcase products and achievements and conduct a 2024 ISAM Year in Review.

Going forward, COSMIC will hold two General Membership Meetings each year: one in-person Convergence mid-year, and one virtual meeting at the end of the year. While work continues on completing novel ISAM products throughout the rest of 2024, the COSMIC community is already generating ideas for future products in 2025 and beyond. COSMIC provides a venue and community that fosters creativity, innovation, and information-sharing for the benefit of the entire U.S. ISAM community.

We strongly encourage any ISAM stakeholder who is not already a member to contact us at Membership-COSMIC@aero.org, for more information about COSMIC, how to join, and for opportunities to contribute to this important effort at a crossroads moment for ISAM and U.S. space.