Let's talk **Space Traffic Coordination**

#SpaceTrafficCoordination

Office of Space Commerce
National Oceanic and Atmospheric Administration
U.S. Department of Commerce

Introduction:

Space Debris By the Numbers

Space may be infinite, but Earth's orbits are not. They are becoming congested with satellites and hazardous debris, increasing the risk of space collisions that generate even more debris. Since 1957, humankind has launched well over 17,000 objects into space—with over half of them launched in the past 6 years! (Source: United Nations Office for Outer Space Affairs (UNOOSA)).

Today the United States Department of Defense is tracking over 45,200 space objects, including 10,200 active satellites and 18,800 pieces of debris. Some experts estimate there may be a million pieces too small to track with current technology.

The advent of proliferated LEO (pLEO) constellations has intensified the urgency for accurate, actionable space situational awareness (SSA) information and space traffic coordination (STC) services. Soon, multiple pLEO constellations—each with thousands of satellites—will try to coexist without colliding.

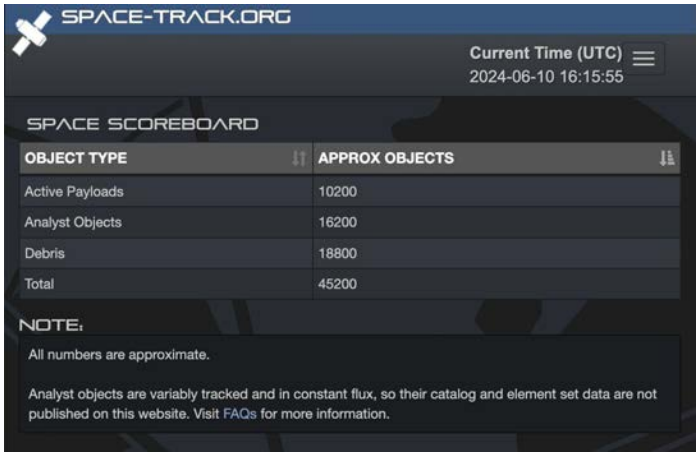
The 2009 Iridium-Cosmos Collision & Space-Track.org

The 2009 collision between an Iridium satellite and a defunct Russian Cosmos satellite served as a wake-up call for the space community on the need for space situational awareness. The incident generated over 2,000 pieces of debris, many of which persist to this day.

After the Iridium-Cosmos crash, the United States Department of Defense expanded its support to Iridium and other commercial space systems, conducting daily screenings to identify potential collisions and issue warnings to satellite owner-operators. In addition, DoD began to release its unclassified SSA data to the public via the online **Space-Track** service.

For over a decade, commercial and civil satellite owner-operators around the world have freely accessed United States Department of Defense information

about known space objects and orbital data via Space-Track. Information on Space-Track.org comes from the U.S. Space Surveillance Network (SSN), a series of DoD and collaborator radars, telescopes, and sensors that monitor and track artificial objects in space. DoD also provides alerts and warnings to satellite owner-operators when its data computations predict conjunctions that have the potential of becoming collisions w/ debris or other spacecraft.



More recently, the private sector saw economic opportunity in providing space operators with enhanced SSA information and services beyond those offered by DoD. A robust market of commercial SSA firms emerged and became a hot growth area for space commerce. Recognizing the importance of SSA and space traffic coordination to space safety and sustainability, other governments around the world are also fielding, or have fielded, their own SSA/STC capabilities.

Space Policy Directive-3

In June 2018, the White House issued **Space Policy Directive-3**, providing guidance and direction to federal agencies to promote the safety, stability, and sustainability of U.S. space operations as space becomes increasingly congested and contested.

Among other things, SPD-3 named the Department of Commerce as the civil agency that should be responsible for freely disseminating the publicly releasable portion of United States Department of Defense space object catalog via an open architecture data repository.

The Traffic Coordination System for Space (TraCSS) will be that open data repository, providing basic space situational awareness data and basic space traffic coordination services, including timely warning of potential collisions, free of direct user fees. DoD will continue to operate the SSN for military

space domain awareness and provide unclassified data to DOC. Space-Track.org will continue to serve the public while DOC builds up its operational civil SSA capability.

SPD-3 also directed the Department of Commerce, in coordination with the Department of Defense, U.S. Department of Transportation, and NASA - National Aeronautics and Space Administration, to lead efforts to encourage and facilitate continued U.S. commercial leadership in SSA, STC, and related S&T. Per this direction, OSC is integrating commercial SSA capabilities into TraCSS and limiting the free TraCSS services to a basic set of inherently governmental safety functions, leaving U.S. commercial firms free to innovate and sell enhanced services.

Six years later, the U.S. government has progressed in implementing SPD-3 thanks to efforts by the White House Office of Management and Budget, White House National Space Council, and Congress to follow through with the funding and leadership support needed for departments and agencies to execute their assigned tasks.

For the U.S. Department of Commerce, this has meant significant budget increases to field the Traffic Coordination System for Space — up from a few million dollars a couple years ago to tens of millions of dollars today. Commerce Secretary Gina Raimondo and Deputy Secretary Don Graves have been instrumental in supporting the TraCSS program within the Department of Commerce and before Congress.

The Traffic Coordination System for Space (TraCSS)

"TraCSS is taking on the civil and commercial space situational awareness mission that DoD never asked for, and which shouldn't be their focus."
—OSC Deputy Director Janice Starzyk at the MilSatCom USA 2024 conference

The Office of Space Commerce is developing the new Traffic Coordination System for Space to provide basic space situational awareness information and space traffic coordination services to

space operators for spaceflight safety.

TraCSS is a modern, cloud-based IT system that will combine SSA data from the United States Department of Defense and commercial sources to provide basic STC alerts and warnings. OSC is following an agile software development process for TraCSS, with v1.0 on track for release to beta users by October 2024.

TraCSS consists of three main elements:

- TraCSS-OASIS: SSA data repository
- TraCSS-SKYLINE: STC service apps
- TraCSS-HORIZON: R&D and test environments for future capabilities

OSC is committed to integrating commercially available SSA data, software, and services into TraCSS, and has engaged multiple commercial providers in pathfinder projects to hammer out ways to achieve this goal.

TraCSS Accomplishments & Milestones

OSC has made significant progress standing up the Traffic Coordination System for Space since fiscal year 2023, when the program received a pivotal funding boost from OMB & Congress. OSC recently released an **infographic highlighting TraCSS accomplishments** achieved in FY23-24, including milestones in system development, partnership with industry, collaboration with United States Department of Defense, and policy & personnel.

Development Milestones

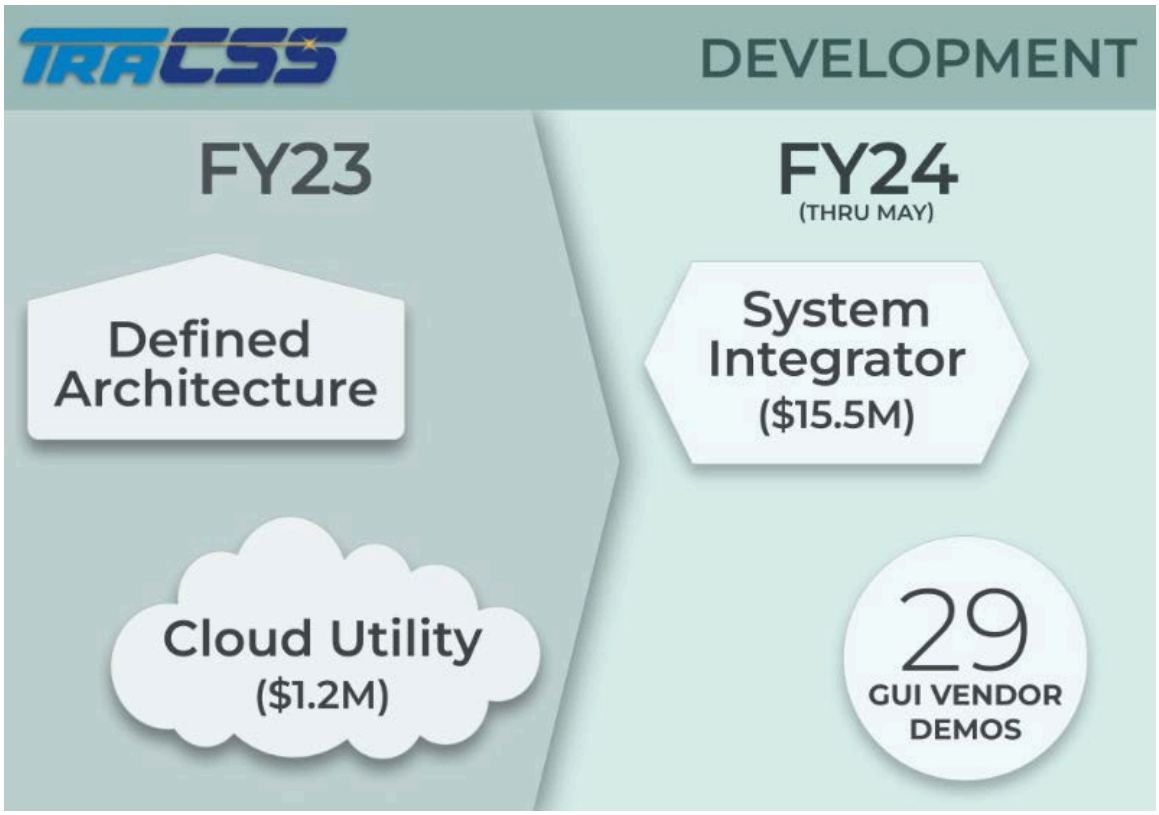
Over the past year, OSC's Traffic Coordination System for Space program progressed from defining its architecture and service offerings to awarding contracts for the core building blocks of the system. It passed various review boards and received Authority to Proceed from the Deputy Secretary of Commerce.

OSC spent much of fiscal year 2023 defining the requirements and basic architecture of TraCSS. The team presented its build-out plan to the public in a series of workshops and a video released in **July 2023**.

In August 2023, OSC procured the first major component of TraCSS: the secure government cloud infrastructure where the IT system will operate. Amazon Web Services (AWS) completed provisioning of the cloud environment for TraCSS pathfinders in Feb 2024. In March 2024, NOAA: National Oceanic & Atmospheric Administration **awarded a $15.5M contract**

to Parsons Corporation to serve as the TraCSS system integrator, responsible for developing the software backbone and integrating commercial components into the platform. OSC has also made good progress on the third major element of TraCSS: a public-facing user interface. In FY23, the team issued the Presentation Layer RFI, and in FY24, they conducted over 25 demonstrations with commercial vendors.

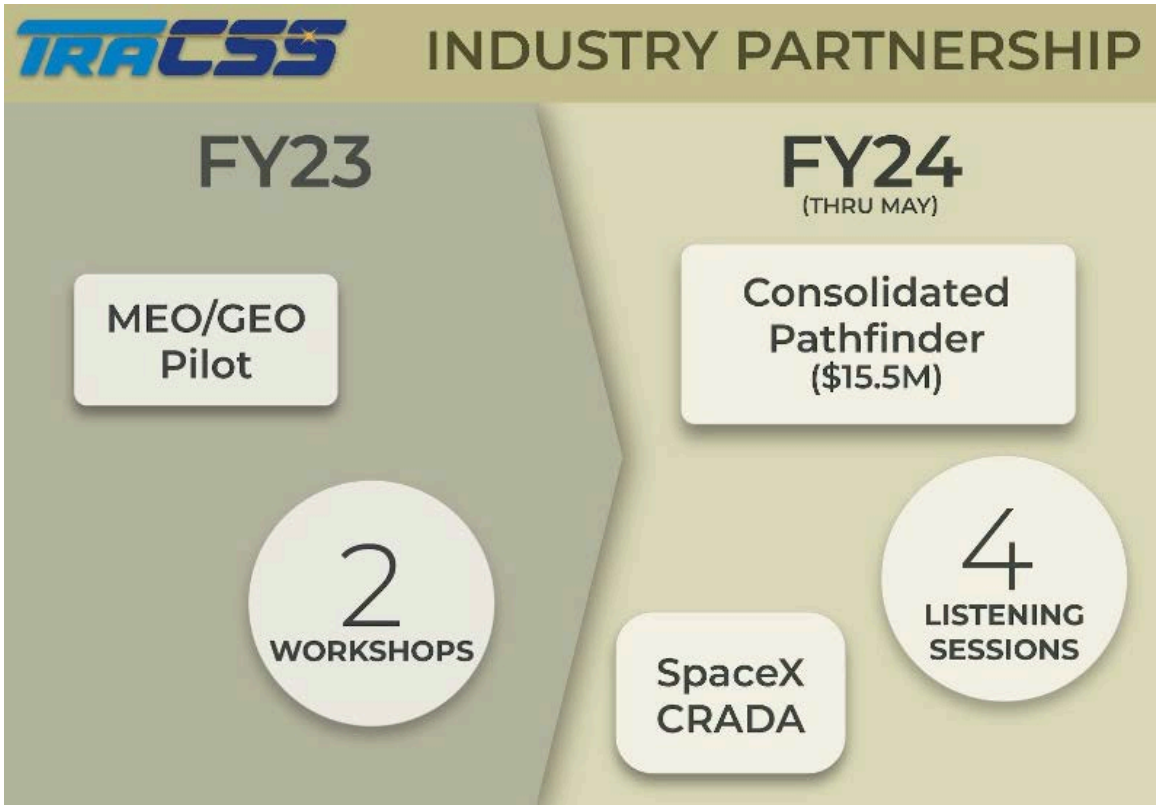
At the Space Symposium in April 2024, OSC announced the primary operations center for TraCSS will be located at the David Skaggs Research Center, operated by NOAA in Boulder, CO, with a backup site in Suitland, MD. OSC also recently kicked off a beta user group for TraCSS consisting of satellite operators across all orbital regimes. The TraCSS team has started coordinating with the group to collect their feedback ahead of this fall's release of TraCSS v1.0.



Industry Partnership Milestones

Partnership with industry is a cornerstone of the Traffic Coordination System for Space program. Since fiscal year 2023, the Office of Space Commerce has funded multiple commercial space situational awareness pilots and pathfinders and engaged stakeholders in other meaningful ways.

OSC's commercial SSA purchases are not only investments in the growth of new space markets; they are helping OSC pave the way for an operational TraCSS that leverages commercial market innovation and existing capabilities.

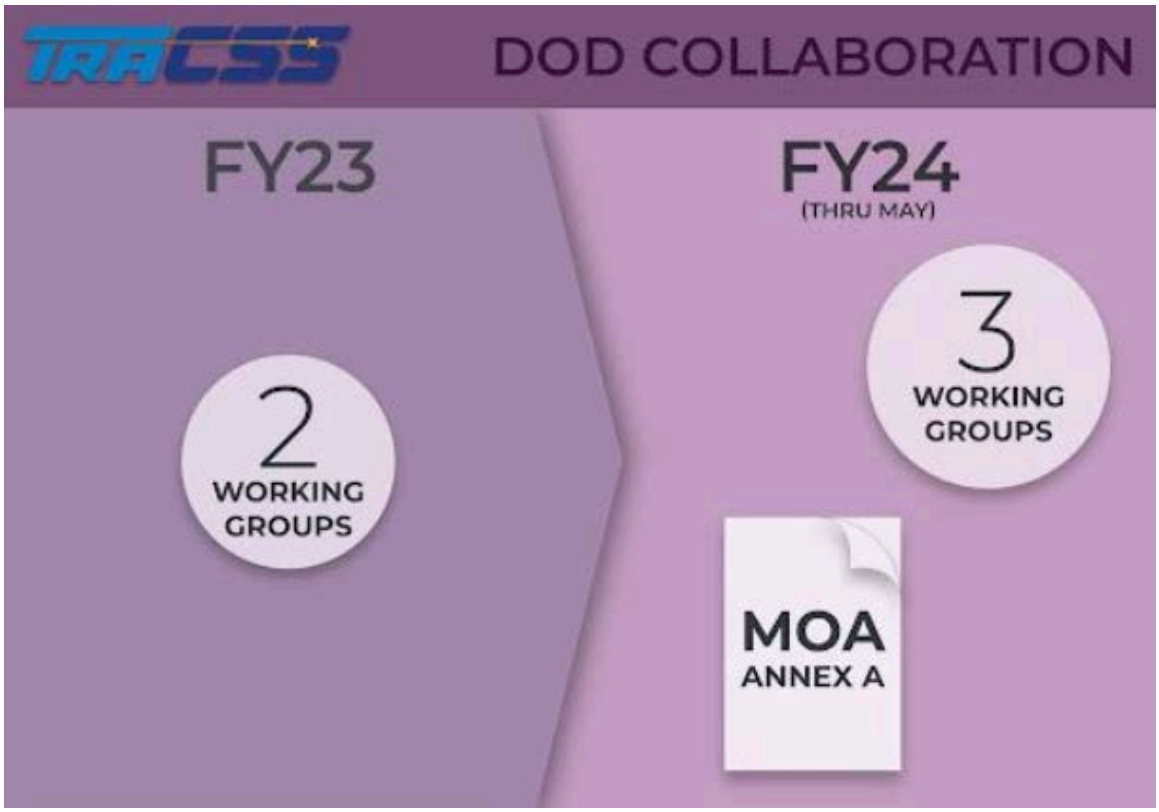


Since January 2024, the **Consolidated Pathfinder project** has been blazing trails toward the use of commercial data and services in the operational TraCSS. It is a limited-term effort focused on demonstrating SSA services for the LEO regime using commercial SSA providers. OSC **recently extended** the Consolidated Pathfinder by a month, increasing the project's total investment in commercial SSA data and services to $15.5 million. In FY23, OSC similarly ran a **MEO/GEO Pilot** that used commercial data and analytics to evaluate industry's ability to provide space traffic coordination in MEO and GEO. OSC has also signed a no-exchange-of-funds **Cooperative Research and Development Agreement** (CRADA) with SpaceX to study the automated collision avoidance system used in SpaceX's Starlink constellation for potential application to TraCSS.

To ensure TraCSS meets user needs, OSC held a CEO roundtable and 2 stakeholder workshops in FY23 and 4 virtual listening sessions in FY24 on various technical topics. Industry feedback has helped shape the requirements and architecture of the operational system.

Department of Commerce-Department of Defense Collaboration Milestones

The U.S. Department of Commerce and the United States Department of Defense are working diligently on the migration of SSA and space traffic coordination responsibilities to the TraCSS program under a **Memorandum of Agreement** (MOA) signed in September 2022.



A joint working group on SSA data exchange concluded activities in mid-2023, producing "Annex A" to the MOA. Signed April 2024, Annex A details the DoD-to-DOC data transfer requirements for TraCSS.

Three other DoD-DOC working groups continue to make technical progress in the areas of state management for data synchronization, machine-to-machine data transfer to support TraCSS, and migration of services & users from the Department of Defense and the Department of Commerce.

DoD & DOC signed a personnel exchange agreement in Fiscal Year 2023 allowing the departments to embed experts in each other's operations. OSC stationed a team member at Space Delta 2, Vandenberg Space Force Base, in late 2023.

Policy & Personnel Milestones

Since the start of FY 2023, the Office of Space Commerce has significantly ramped up its staffing for the TraCSS program, with 12 federal employees hired by May 2024 and several more in the pipeline.

That number does not include the various contractors, detailees, and political appointees supporting the TraCSS team, such as Chief Engineer Sandy Magnus of MITRE. In just 1 year, the TraCSS team has grown from a skeleton crew to an entire Space Operations Division with component branches focused on systems engineering, operations, and IT security. The team is still growing: opportunities to join the TraCSS program continue to be posted in **USAJOBS** and on OSC's "**job announcements**" webpage.

To receive expert feedback on TraCSS development, OSC established an **Independent Review Board** consisting of six well-recognized leaders in space program management and space traffic coordination. So far, they have convened twice since Jan 2024.

Beyond people, OSC also needs authorities to fully implement the TraCSS program. In Nov 2023, The White House released a **legislative proposal** that,

among other things, would explicitly authorize the Department of Commerce to provide free, basic SSA services with relevant legal protections. If enacted, the proposal would also empower OSC to authorize and supervise uninhabited space missions of private actors. Looking to the future, the government's supervision of such missions could potentially involve use of TraCSS or other space traffic coordination services.

OSC's TraCSS Stars

Among the Office of Space Commerce's staff are several individuals who are leading the efforts to stand up the Traffic Coordination System for Space.

Together, they are responsible for everything from engineering the scope of the IT system; acquisitions, procurements, and contract support; policy and international engagement; and more.

Sandy Magnus of MITRE has served as Chief Engineer for TraCSS since March 2023. In 1 year, she transformed the program from a PowerPoint into a major IT system with Authority to Proceed from Department of Commerce Deputy Secretary Don Graves.

Christine Joseph is OSC's Policy Advisor supporting all aspects of TraCSS,, from technical standards development and programmatic reviews to external stakeholder listening sessions and legislative & communications strategy.

Ethan Baumann recently joined the TraCSS team as the Systems Engineering Lead after 25+ years supporting flight research projects at NASA's Armstrong Flight Research Center - most recently as Chief Engineer for the X-57.

Mary Butler is Chief of the TraCSS IT Security Branch, responsible for assuring cybersecurity & data integrity as OSC incorporates SSA data from external sources and manages data flows to users.

As Director of OSC's Acquisition Management Division, Tomeka Evans oversees OSC's extensive portfolio of contracts, focusing on TraCSS development and support. An Army veteran with over two decades of federal acquisition experience, she brings invaluable expertise and dedication to the TraCSS team.

Dr. Mariel Borowitz is OSC's lead for international SSA engagement. A renowned expert on temporary assignment from the Georgia Institute of Technology, she focuses on the development and implementation of an approach to international coordination on space situational awareness and space traffic coordination. She also works directly with the team developing the Traffic Coordination System for Space..

International Collaboration

As the United States is developing the TraCSS system, many other nations and organizations around the world are also developing or improving their own space situational awareness capabilities. As these developments continue, OSC is committed to maintaining an open and transparent system that enables global coordination with other SSA providers and ensures reliable and efficient services to global spacecraft operators.

This type of closely coordinated system will be necessary to minimize the potential for spacecraft operators to receive conflicting information about potential conjunction events.

It also lays the foundation for future space traffic coordination efforts, which require that spacecraft operators have consistent information on the likelihood and nature of potential conjunctions, allowing for a safe and efficient adjudication of the issue.

Much needs to be accomplished to move from the status quo to a future in which TraCSS is one of many national or regional SSA providers working in close coordination on a global level.

To that end, OSC has published and is beginning to share its "**Vision for Global SSA Coordination**."

Recently, OSC has engaged in commercial space dialogues with over a dozen countries, and space situational awareness has been on the agenda every time. All spacefaring nations are interested in promoting space safety and sustainability. Within these dialogues, OSC is promoting its vision for global SSA coordination.

The growing list of international partners and collaborators includes the Ministry of Foreign Affairs of Japan, Centre National d'Études Spatiales, European Commission, IN-SPACe, German Aerospace Center (DLR), Ministry of Foreign Affairs, Republic of Korea, the Italian Ministry of Foreign Affairs, Canadian Space Agency | Agence spatiale canadienne, UK Space Agency, Australian Space Agency, New Zealand Space Agency, and the Philippine Space Agency.

OSC will continue to engage with close international partners to enable cooperation between national and regional SSA systems in operation or development around the world. For example, with Europe's EU SST program, OSC is conducting studies to assess and improve results when combining U.S. and European SSA information.

Recognizing that space requires truly global cooperation, OSC will also seek to open lines of communication with nations operating SSA systems that have not traditionally coordinated their efforts with the United States.

SSA, Space Sustainability, and the United Nations

In June 2024, the United Nations Committee on the Peaceful Uses of Outer Space (UN COPUOS) opened its 67th annual session.

At the UN COPUOS, over 100 nations have collaborated for years to promote the sustainable use of outer space, so it can continue to be accessed and used by all humankind. In its work promoting open lines of communication on global SSA, the Office of Space Commerce attended and participated in the session.

In 2019, the UN General Assembly adopted **21 Guidelines for the Long-term Sustainability** (LTS) of Outer Space Activities, as developed and recommended by COPUOS. At least six are directly related to STC:

- A.5: Enhance the practice of registering space objects.

- B.1: Provide updated contact info & share info on space objects & orbital events.
- B.2: Improve accuracy of orbital data on space objects & enhance the practice & utility of sharing orbital info on space objects.
- B.3: Promote the collection, sharing & dissemination of space debris monitoring info.
- B.4: Perform conjunction assessment during all orbital phases of controlled flight.
- B.5: Develop practical approaches for pre-launch conjunction assessment.

The United States and other COPUOS member states are working to incorporate them into domestic regulatory and policy frameworks. UN COPUOS is building upon these achievements through implementation of the guidelines, capacity-building activities, and identification of new challenges to the long-term sustainability of outer space in a follow-on working group, known as LTS 2.0.

Adopting standards and best practices for space situational awareness (SSA) data sharing is an important step in facilitating international cooperation and ensuring clear and efficient services for spacecraft operators.

As noted in the United Nations Long-term Sustainability of Outer Space Activities Guidelines, “When sharing orbital information on space objects, operators and other appropriate entities should be encouraged to use common, internationally recognized standards to enable collaboration and information exchange.”

Space Standards and SSA

In the United States, Space Policy Directive-3 similarly directs standards development to improve SSA interoperability and enable greater data sharing and to establish best practices for space safety.

The Consultative Committee on Space Data Systems (CCSDS) standards are the most widely adopted standards in the SSA community today. OSC's Traffic Coordination System for Space will leverage CCSDS & ISO - International Organization for Standardization standards that are directly applicable to the types of SSA data and information that TraCSS is likely to provide.

OSC participates in many of the working groups developing new space standards in order to foster economic growth and technological advancement of the U.S. commercial space industry.

This April, OSC and National Institute of Standards and Technology (NIST) hosted the CCSDS annual technical meetings in the U.S. Department of Commerce in Washington, welcoming 200 delegates from 11 international space agencies to develop standards for space communications and data exchange, including for SSA.

The Office of Space Commerce has also published a compendium of space industry technical standards, including standards relevant to space situational awareness and space traffic coordination. The searchable spreadsheet provides a consolidated reference to space-related standards, best practices, reports, and other documents developed/coordinated by ISO - International Organization for Standardization, Consultative Committee on Space Data Systems (CCSDS), ASTM International, National Institute of Standards and Technology (NIST), NASA - National Aeronautics and Space Administration, CONFERS | The Consortium for Execution of Rendezvous and Servicing Operations, AIAA, and other organizations.

Check out the Space Industry Technical Standards Compendium **here**.

Activities Beyond SSA

The Office of Space Commerce also plays a role in pre- and post-mission activities that help reduce overall debris and traffic.

Debris mitigation refers to pre-mission planning and design to minimize the generation of debris during mission operations and when spacecraft reach end of life. Successful mitigation means less debris to track and coordinate.

The U.S. Orbital Debris Mitigation Standard Practices (ODMSP), updated in 2019, apply to government missions and inform the regulations imposed on commercial space missions by the Federal Communications Commission, Federal Aviation Administration, and NOAA: National Oceanic & Atmospheric Administration. In recent years, FCC and FAA have adopted or proposed new debris mitigation rules that go beyond the U.S. ODMSP and the internationally recognized Space Debris Mitigation Guidelines of the Inter-Agency Space Debris Coordination Committee (IADC).

To avoid duplicative regulation, NOAA/OSC's Commercial Remote Sensing Regulatory Affairs division currently defers to FCC debris mitigation rules when licensing commercial imaging satellites, despite having statutory authority to regulate those satellites' disposal upon termination of operations. We are now reconsidering this approach in light of the evolving regulatory

and international business environment. Earlier this year, **OSC issued a RFI soliciting industry responses** on satellite disposal requirements.

OSC plans to hold a public stakeholder listening session this summer on its commercial remote sensing regulations.

OSC is not only involved in pre-mission debris mitigation efforts, it also supports post-mission activities aimed at improving the debris environment, including satellite mission extension and active debris removal.

- Mission extension refers to refueling satellites, or attaching fuel/propellant systems to them, so they can continue operating for years and/or maneuver to avoid collisions. This limits generation of new debris objects and new satellite traffic.
- Active debris removal (ADR), or debris remediation, refers to the capture of space objects so they can be towed to disposal orbits (graveyard or reentry) or even salvaged for reuse.

The commercial space industry has innovated many new technologies for mission extension and ADR, some of which are operational or being demonstrated at this time. OSC advocates within the U.S. government for policies that support these commercial endeavors, including policies on in-space servicing, assembly, manufacturing (ISAM) and rendezvous and proximity operations (RPO).

Under The White House's legislative proposal for novel space mission authorization and supervision, OSC would become the main regulatory authority for many commercial missions involving mission extension and ADR.