



Via Electronic Submission

February 27, 2023

United States Department of Commerce
National Oceanic and Atmospheric Administration
Office of Space Commerce
Attn: Richard DalBello, Director

In Re: *Request for Information on Scope of Civil Space Situational Awareness Services* issued by the National Oceanic and Atmospheric Administration on January 26, 2023

Access to accurate, timely space situational awareness services are essential to ensuring continued safe space operations for all, preserving U.S. leadership, and enabling U.S. industry to make increasing use of space. The Space Data Association Limited (“SDA”) is pleased to provide its response to the above-captioned Request for Information.

As further described below, SDA considers the planned Traffic Management System for Space (“TraCSS”) program services are critically important for flight safety and the long-term sustainability of the space environment. We applaud the U.S. Department of Commerce’s (“DoC”) vision in improving on the important services now being provided by the Department of Defense (“DoD”) and demonstrating ongoing leadership and commitment by the United States in this area.

About the SDA

The SDA is an open, commercially operated, non-profit risk management entity dedicated to safety of flight and space sustainability.¹ SDA’s stakeholder participants are commercial, civil, and military satellite operators who have invested tens of billions of dollars in satellites on orbit and have come together to reduce the risk of satellite operations.

The SDA has been fully operational for almost twelve years now and was developed without any government funds. The SDA’s Space Data Center (SDC), operated by a U.S. commercial company, COMSPOC Corporation, has demonstrated reliability of more than 99.99% over those twelve years. The SDA’s “crowd-sourcing” model addresses proprietary and intellectual

¹ For SDA, “safety of flight” means the condition where satellites are positioned and operated in a manner that preserves their long-term operational viability, the long-term operational viability of any other satellites, and the preservation of the orbital regime(s) involved.

Space Data Association Limited. Company Number: 123616C

Registered Office: Third Floor, 4 Athol Street, Douglas, Isle of Man, IM1 1LD Great Britain

www.space-data.org

property issues, serving as a nexus for data from the U.S. government and a rich set of operator data. The SDC pioneered many traits that are now widely accepted as a baseline for a modern SSA system, including computationally and legally secure frameworks, firewalled processing to protect data, machine-to-machine interfaces, verified data normalization and conversion, operator phonebooks, data exchange and sharing, and extensive processes to maintain quality control and identify discrepancies in operator or government SSA data.

Since 2011 the SDA has combined U.S. space catalog data with measured satellite location and planned maneuver information from SDA's participants to offer the world's first private, cooperative space traffic coordination (STC) service. Today, 31 spacecraft operators participate in the SDA, operating 763 spacecraft spanning all orbital regimes, with over fifty percent of the GEO active spacecraft represented and 479 LEO and MEO spacecraft participating. These operators deliver some of the most critical communications and remote sensing capabilities today and, when not collaborating with the SDA, routinely compete as rivals. SDA also provides services in support of NOAA and NASA spacecraft. Satellite operator-contributed data allows the SDC to generate actionable, forward-looking collision warnings, deconflict planned maneuvers, and securely share selected space situational awareness data between participants.

Because SDA's products augment and improve upon existing DoD collision warning products and systems and SDA maintains a robust, ongoing operational dialogue with its participating operators in the LEO, MEO, and GEO orbital domains, SDA is uniquely positioned to provide relevant views for the Department's consideration for continued U.S. leadership and TraCSS deployment.

Relationship of the Space Data Association to DoC and TraCSS

SDA has consistently stated that DoC should qualitatively improve on the legacy DoD products for SSA and conjunction assessment to enhance safety of flight. This is because "safety" is not DoD's mission nor the result of its public products. New space operational paradigms including proliferated LEO constellations, electric propulsion with its constant low-thrust maneuvers, on-orbit servicing, space tourism, and autonomous flight operations challenge legacy flight safety capabilities. The SDA has mined its conjunction data to determine that close approaches are occurring five times more often than just five years ago. This dramatic change is due to the ever-increasing presence of orbital debris, our improving knowledge of the hazardous debris already present in orbit, and a more than doubling of the active spacecraft population over these five years.

We have enjoyed an ongoing relationship with the Department of Commerce. The SDA helped conceive and conduct a data fusion exercise for Space Traffic Coordination and Management (STCM) in September 2020. NOAA, in its role as a weather satellite operator, participated in this exercise. Implemented and conducted in just four weeks, this STCM data fusion campaign demonstrated how commercial innovation and capabilities, in partnership with government data and participation, were able to achieve dramatic improvements in SSA knowledge. For example, accuracy improvements of between ten and fifty percent in Low Earth Orbit, tenfold

accuracy improvements in GEO, and as much as one thousand times improvements in the Launch and Early Orbit Phase of LEO missions were achieved. This study was unique in taking a requirements-based approach by assessing what positional accuracy requirements must be met to allow SSA data to meet the needs of operators and the way they conduct flight safety. The results of this rapid demonstration led us to conclude that such a government/industry partnership is not only effective, but imperative if we are to effectively address and facilitate enduring space sustainability.

More recently, the SDA participated in the DoC's GEO Pilot Program on SSA services from December 2022 through February 18, 2023, contributing curated data products from selected SDA member satellites to multiple sensor and analytic providers also participating. SDA is confident that as DoC analyzes the results of the Pilot you will conclude that commercial capabilities can be significant enablers to rapidly implementing TraCSS.

Effect of TraCSS on the SDA and Other SSA Providers

As DoC fields TraCSS, or other credible, effective, and widely available SSA solutions emerge², the SDA will eventually be able to deprecate its Space Data Center technical operations. Even though SDA is a commercially operated, non-profit SSA provider, this would represent a successful milestone for the SDA, reflecting its longstanding vision to serve as a bridge between legacy public SSA solutions and anticipated modern, public paradigms such as TraCSS. SDA would likely continue to serve as a trusted information-sharing platform and an important forum for the development and exchange of standards and best practices to promote flight safety and contribute to space sustainability. Because most SDA costs arise from its SDC technical operations, SDA welcomes the development of TraCSS.

The RFI asked whether any of the basic SSA safety services readily available from the current U.S. SSA industry and are these services affordable to owners and operators of spacecraft. In short, no.

The SDA extensively researched providing a basic set of GEO/MEO-based SSA capabilities like TraCSS, which would have relied on support from commercial SSA providers for observations to transparently generate an independent, robust space catalog and timely, actionable products. Through an RFP process and multiple interviews with satellite operators globally we ultimately determined that while the *technical capability* to perform the service existed, there was insufficient support from SDA's member-operators to fund the necessary 3rd party (commercial) observational inputs from other SSA operators, coupled with the analytic capabilities required. The situation in LEO was even more challenging, at that time, due to the limited availability of sensor observations.³

² For example, the European Union Space Surveillance and Tracking (EU SST) initiative continues to invest in capabilities afforded fee-free to space operators. See <https://eusst.eu/>.

³ The SDA assumed that metric observation data from the U.S. Space Surveillance Network (SSN) sensors would be *unavailable* for processing due to U.S. sovereign concerns. Presumably this *would not* apply to a Department of Commerce government service, such as TraCSS, allowing DoC to leverage the public investments made in SSN

Thus, SDA resolved to continue and deepen its partnership with the U.S. Department of Defense, to collaborate and improve on the safety products provided, and to encourage the emergence of products optimized for flight safety⁴ vs. the traditional U.S. national security mission of space domain awareness.

By aggregating demand for commercial sensor observations and leveraging modern, proven, commercially available analytic capabilities for TraCSS the DoC is likely to *improve* the commercial market by creating stable, predictable levels of ongoing baseline demand for multiple market participants while preserving upside for commercial innovation and development of related, evolved services. However, as with all emerging industries, SDA expects consolidation and change over time. We believe public authorities such as DoC are best suited in the long term to provide the fee-free Basic Services to ensure all responsible space operators benefit and that certain, specialized services may be provided commercially on the open market.

SDA Recommendations and Questions Raised by DoC

SDA offers the following general recommendations, observations, and responses to the questions and issues raised in the RFI. We would be pleased to discuss any or all these further with the DoC.

1. *Does the proposed basic safety SSA service provide sufficient data to allow ongoing operations of orbital assets at a level equal to or beyond that currently provided by the DoD?*
 - TraCSS should holistically provide, to the greatest practical extent, accurate and timely positional knowledge suitable for generating actionable flight safety products for all space objects. This will require the gathering of best-available knowledge from spacecraft operators, government, and commercial SSA, agnostic of a space object's size footprint, orbital regime, maneuverability, or whether the object's owner or legal authority is a participant in DoC's services or cooperates with DoC by sharing their data.
 - DoC should include the ability to refine planned maneuvers AND non-cooperatively detect, characterize, and recover from unknown maneuvers. This is critical to achieving accurate CA and must be incorporated as a foundation of basic DoC orbit maintenance. The DoD's current CA screening products have had limited usefulness for maneuvering spacecraft because they don't incorporate operator maneuver plans and data, recover quickly from non-cooperative maneuvers, incorporate maneuver uncertainties to achieve covariance realism, solve orbits in the presence of maneuvers, and predict through future (planned) maneuvers.

operation even if using U.S. commercial analytic capabilities to undergird some of the TraCSS offerings. Also, at that time SDA could not obtain LEO observational data on commercial terms – only non-transparent “services” in LEO (i.e., like U.S. DoD offerings) were then offered commercially; as transparency is critical, operators rejected such services as an unsuitable basis for flight safety.

⁴ Most services rely on the DoD's “SP data” and the probability of collision are sometime absent and not reliable due to inaccuracies of the covariance information and the failure to include planned maneuver information.

- The DoC’s robust catalog should be constructed as a part of DoC’s basic services and fully leverage commercial SSA data and analytics. DoC should obtain necessary metric observational data to maintain accurate solutions for all objects (spacecraft, launch systems, debris), both cooperative and non-cooperative, in all orbital regimes, sourced from spacecraft operators, commercial SSA systems, and government tracking network(s).
- The DoC’s resulting set of orbit solutions should be provided to the space community as a basic service, allowing spacecraft operators, commercial SSA analytics providers, and the research and academic communities to further refine conjunction alerts, associated methodologies, and to develop risk mitigation strategies.
- While we agree that each of the planned Basic Service offerings are valuable, we recommend amending the service definitions in some cases, as described below. We also recommend including three additional services as part of the Basic Service, specifically: (i) Additional Concierge Services, (ii) Anomaly Resolution, and (iii) Breakup Detection, Tracking, and Cataloguing, to ensure parity with EU SST services and the resilience of publicly provided services. 24 x 7 x 365 support is essential in the space operations domain and should become a baseline TraCSS offering.
 - **Concierge Services** should be included in TraCSS, particularly as a touch point for less experienced space operators, ensuring coverage for real-time issues, and serving as an alternate/backup to comparable EU SST services. Support does not need to be via telephone, but can leverage other communications technologies (chat, messaging, e-mail, etc.).
 - **Anomaly Resolution** and **Breakup Detection, Tracking and Cataloging** are services available today through DoD interfaces, using the unparalleled resources of the United States. The SDA notes that these services, while not heavily utilized, can be critical in emergency situations to promote flight safety and prevent creation of additional, long-lived space debris. Accordingly, we recommend that these services remain available to commercial and civil space operators from the U.S. government, whether or not included in TraCSS.
- Specifically, we recommend revising the service description for the Conjunction Assessment (CA) service to state: “To screen primary objects against a robust satellite catalog, both routinely and on demand; and to generate CDMs for objects that violate the predefined physical volumes and/or collision probability thresholds used for the screening activity.”
- We recommend adopting and incorporating internationally standardized CCSDS orbit and maneuver data exchange messages to ensure that a standardized terminology, timing systems, reference frames, and formats are used. TraCSS needs to be able to service satellite operators who are unable to provide data in the required frame and/or standardized format.

The following table compares the DoC Basic Service with those of the EU SST and offers comments regarding specific services, with ●=Included, ◐=partial inclusion, ○=Not Included

#	DoC RFI services	DoC Basic Service	EU SST	Comment
1	Satellite Attributes, Capabilities, Status, and Point of Contact	●	◐	EU SST uses ESA DISCOS DB and Space-Track SATCAT
2	Receipt and Sharing of O/O-predicted Ephemerides	●	◐	Ephemeris sharing not included
3	Routine Collision Assessment (CA) Screening and Conjunction Data Message (CDM) Production	●	●	
4	Special CA Screening and CDM Production	●	●	
5	Data Quality Evaluation	●	●	
6	Launch Collision Avoidance (COLA) Screenings	●	●	
7	O/O Ephemeris Generation and Curation with Covariance	●	○	
8	Re-entry Management and Assessment	●	●	
9	Precision Probability of Collision Calculation	●	●	
10	Collision Consequence and Debris Production Potentials	●	○	
11	Conjunction Object Solution Improvements with Additional Tracking	●	●	
12	Expected Tracking Determination	●	○	
13	Risk Assessment Time History Plots	●	●	
14	Space Weather Sensitivity	●	○	
15	Fusion of CA Products	○	○	
16	PC Variability	○	●	
17	Additional Concierge Services	○	●	TraCSS should include this service.
18	Anomaly Resolution	○	○	The U.S. Government ⁵ should continue to offer this service <i>on an emergency basis</i> to affected operators.
19	Design-time assistance for improved CA	○	○	
20	Maneuver Trade Space (visual aid)	○	●	
21	Optimized Maneuver Recommendations	○	○	
22	Breakup Detection, Tracking, and	○	●	The U.S. Government should

⁵ We state "U.S. Government" as this essential emergency service could be provided by the DoD, DoC, or other U.S. Government activity.

#	DoC RFI services	DoC Basic Service	EU SST	Comment
	Cataloguing			continue to offer this service <i>on an emergency basis</i> to affected operators.
23	Maneuver Detection and Processing	○	(Unknown)	

2. *What, if any, information should owners and operators of spacecraft be required to provide to OSC to participate in TraCSS?*

A key tenet of SDA's operations is that participants recognize a shared responsibility for flight safety through willingness to contribute and exchange information, *most importantly planned maneuvers*, to allow deconfliction with other space operators and debris. Information is protected using *binding legal agreements* requiring contribution of specific information and governing its permissible and impermissible uses, which SDA recommends DoC require prior to authorizing TraCSS access for any operator.

We recommend TraCSS incorporate additional data from spacecraft operators such as operator points of contact, spacecraft dimensions, attitude flight rules, and wet mass to help obtain better collision probability estimates, including realistic covariance information and/or scale factors to evaluate collision probability variability.

3. *What should happen when owners or operators fail to provide the relevant information to OSC or fail to take actions consistent with the tenets of participation?*

Under the relevant international legal framework States bear the ultimate authority and risk of space operations by civil and commercial actors. Ultimately, the DoC must balance the benefits of safety, including long-term space sustainability, against actions of those, hopefully few, operators who would choose to act contrary to the needs of the global space community. Each case would need to be considered on the unique facts and circumstances, however sustained non-participation would likely be recognized by e.g., authorizing administrations in determining whether and under what conditions to (re)authorize a particular actor. Education and persuasion are preferable to coercive regulatory actions, but as space usage intensifies a rules-based order will likely emerge.

4. *Where applicable, at what level or how often should the service be performed? How often should OSC's basic safety SSA service provide these assessments?*

SDA recommends the TraCSS model should be observation/event driven which provides updates as soon as new space object orbits and predictions are obtained. The timing may also be dependent on the orbit regimes involved. As a practical matter, updates for GEO satellites provided every hour or two, rather than DoD's current eight hours, would be more useful, relevant, and promote increased safety.

* * *

In sum, SDA welcomes the development of TraCSS and stands ready to offer the DoC additional perspectives, dialogue, collaboration, and the benefit of our experience working with operators, SSA providers, and administrations globally.

Respectfully submitted,
SPACE DATA ASSOCIATION LIMITED

/s/
Andrew R. D'Uva
Senior Policy Advisor