

SSA/STM AMOS Workshop (Hybrid) September 15, 2021

EXECUTIVE SUMMARY

The rapid emergence of large Low Earth Orbit constellations (LLC) over the last two years increases the urgency to make progress in the top priority areas the workshop identified in previous years for improving international SSA/STM operations. This is an issue critical to the global community and the long-term sustainability of space. The increasing congestion of space due to on-orbit activities and the ever-growing amount of debris pose a growing risk of collisions in space that endanger the satellites that enable modern infrastructure, the quality of life around the globe, scientific discovery, and nations' security. Acknowledging this issue, a hybrid (in-person and virtual) international workshop (the 6th such event) consisting of governmental space subject matter experts and experts from non-profits was held in September 2021 to identify new priority areas that need to be addressed by the international community to promote the responsible use of space and to mitigate these risks.

The workshop attendees focused their discussion on the opportunities and growing challenges associated with autonomous collision avoidance systems rapidly being incorporated into emerging LLC operations. While there was consensus that space safety should take priority over proprietary information concerns, the workshop identified several concerns with autonomous collision avoidance systems and their scalability. Different LLC operators use different algorithms, concepts of operation, accuracy levels, decision calculus's and timelines, and make different business decisions in relation to their respective autonomous collision avoidance systems. This presents several problems if there is a risk of collision between satellites being guided by different autonomous collision avoidance systems. For example, who moves, or who moves first? Without some type of coordination or transparency into how each autonomous collision avoidance systems works, the autonomous collision avoidance systems may not be helpful. The workshop identified the need to redefine "transparency," expand what information needs to be shared in light of the use of autonomous collision avoidance systems, and even the potential for minimum standards for maneuverability.

The organizers stand ready to support the international community to progress on SSA data sharing, questions surrounding autonomous collision avoidance systems, and establishment of STM frameworks along with the other recommendations from this workshop. In parallel we will build upon these findings and engage with the wider space community at Space Symposium 2022.

BACKGROUND

The Maui Economic Development Board (MEDB) and the Aerospace Corporation led the 6th Annual International SSA Data Operator Exchange Workshop on 15 September 2021. This was the sixth invitation-only International SSA Data Operator Exchange workshop held in conjunction with the Advanced Maui Optical and Space Surveillance Technologies (AMOS) Conference, on the Hawaiian island of Maui. This year's workshop was held in-person for most U.S. attendees and virtually for international attendees due to the COVID-19 pandemic. The

workshop included government, and non-governmental organization (NGO) representatives from Canada, ESA, EU, France, Germany, Japan, NASA, the United Kingdom, and U.S. government representatives from the Department of Commerce, Department of State, the Federal Aviation Administration, and the U.S. Space Force.

The enduring goal of the International SSA Data Operator Exchange workshop is to provide an opportunity to develop and advance relationships and share insights among key international SSA data stakeholders including military, academic, civil, and commercial entities. To accomplish this, the workshop chooses timely topics relevant to the global SSA community and allows each participant time to present their views. This year's session was cohosted by the UK Defence Science and Technology Laboratory (DSTL), the Space Agency of the Deutsches Zentrum für Luft- und Raumfahrt (DLR) and the Centre National d'Etudes Spatiales (CNES).

PURPOSE

The 2021 SSA Data Operator Exchange workshop's purpose was to inform and shape international SSA/STM activities from the international SSA operator community's perspective.

DESIRED OUTCOMES

Desired outcomes included (1) relationship building across the international SSA operator community, (2) identifying new challenges, opportunities, and priorities for SSA operators given LLC constellations, (3) revalidating and re-emphasizing existing SSA operator community priorities, and (4) discussing what progress has been made in the last 12 months in addressing those priorities. Ultimately, the workshop's goal was to provide insights to policymakers on operator perspectives.

KEY FINDINGS

1. Rather than discussing LLC implications for the SSA community in general, the discussion focused heavily on the growing challenges associated with autonomous collision avoidance systems rapidly being incorporated into the emerging LLC operations. The NASA-Starlink automated collision avoidance work-around agreement is good but highlights the issue and the need to find a way forward, especially when more LLC operators, and other satellite owner operators begin using their own autonomous collision avoidance systems. In their autonomous collision avoidance systems, different LLC operators might use different:
 - algorithms
 - communication interfaces (protocols, formats)
 - concepts of operation
 - space object/tracking catalogues
 - tracking data accuracy levels
 - decision calculus's and decision timelines,
 - business priorities

2. This raises many questions about scalability and presents several problems if there is a risk of collision between satellites being guided by different autonomous collision avoidance systems:
 - Who moves, or who moves first?
 - How are dueling autonomous collision avoidance systems deconflicted?
 - What type of coordination among owner/operators is needed in design, operation, and management of autonomous collision avoidance systems?
 - What designs, algorithms, and other information need to be transparent in autonomous collision avoidance system.
 - Are autonomous collision avoidance systems the solution to the increased risk of on-orbit collision from LLC's? Or do autonomous collision avoidance systems create a host of difficult new SSA information sharing problems?
 - What are the alternatives to using autonomous collision avoidance systems?

3. The above challenges drive:
 - the need for improved rapid close approach/collision screening processes to reduce lag time, i.e. the usual five-day predictions are invalidated by autonomous collision avoidance systems
 - the necessity of even closer collaboration and cooperation
 - the imperative for more data sharing and transparency among satellite owner/operators and international SSA operators

4. New questions for governments also arise from LLC's and autonomous collision avoidance systems:
 - Liability
 - Can/should governments require transparency into owner/operator autonomous collision avoidance systems?
 - How can governments mandate or incentivize voluntary algorithm and other coordination and sharing among owner/operators?
 - Can/should governments create a minimum standard for spacecraft maneuverability?
 - What 3rd party notifications are suggested, and who would be responsible for them?
 - Agreements
 - Are potentially hundreds of bilateral agreements among governments the way forward?
 - What are the alternatives for governance of so many spacecraft maneuvering autonomously?

There was general consensus that the 2019 priorities list for development of SSA/STM standards, guidelines and best practices, [reaffirmed in 2020](#) remains useful. Priorities are:

1. Operationally useful, consensus-based standards for timely, transparent, trustworthy, secure, SSA/STM data sharing (data base/data repository/data exchange) that is capable of automation.

2. A reliable, 24/7/365 system of rapid communication among operators that enables transparency and coordination for the operational community.
3. A national SSA/STM regulatory framework that can evolve into an international framework.
4. Operationally useful standards for on-orbit operations.
5. Methods for incentivizing positive behavior.

National representatives reported progress in the five key areas although there is still a need for some global minimum standards for spacecraft to enable effective space traffic coordination.

PROGRAM ON 15 SEPTEMBER 2021

Welcome Remarks

Leslie Wilkins, Maui Economic Development Board (MEDB)

Overview of AMOS 2020 Workshop

Mick Gleason, Aerospace Corporation

Kickoff presentation

David Goldstein, SpaceX Starlink

Panel Discussion

Moderated by Josef Koller, Space Safety Institute

Challenges and opportunities for SSA operators given Large Low-Earth Orbit (LEO) Constellations

Panelists:

NASA CARA: Lauri Newman

US Dept of Commerce: Mark Mulholland

EU SST: Pascal Faucher

Roundtable Discussion

Moderated by Mick Gleason, Aerospace Corporation

Organizational updates on workshop priorities and progress in data sharing, transparency, and 24/7/365 system of rapid communication among operators.

Provided by Canada, ESA, EU SST, FRA, GER, United Kingdom, United States.

Synthesis, Summary, and Next Steps

Jeff Ansted, Aerospace Corporation

Closing Remarks

Leslie Wilkins, MEDB