Published on: September 29, 2022

2022 AMOS Dialogue report: Using SSA capabilities to verify future space security agreements

Since 2013, Secure World Foundation (SWF) has partnered with the Maui Economic Development Board (MEDB) to hold an invite-only workshop that promotes collaboration and cooperation on space situational awareness (SSA). The 2022 Dialogue took place as a hybrid event on September 29, 2022, as part of the Advanced Maui Optical and Space Surveillance Technologies (AMOS) Conference.

The goal of the AMOS Dialogue series is to facilitate discussion among key stakeholders in space situational awareness (SSA), thereby promoting greater collaboration and cooperation to enhance SSA for safe and responsible space activities. To accomplish this, the Dialogue brings together representatives from current and future SSA programs and initiatives around the world with a variety of end users and stakeholders so that they may exchange information and views in a not-for-attribution setting.

The topic of the 2022 AMOS Dialogue was using SSA capabilities to verify future space security agreements. The discussion took place under Chatham House Rule: topics addressed could be used in materials prepared by SWF and/or MEDB in their future endeavors but would not be attributed to any given speaker.

The major takeaway from this year's Dialogue is that SSA can likely be used to verify certain threats to space systems in orbit, such as destructive ASAT tests and uncoordinated close approaches, but is less helpful in verifying threats that are not as easy to physically attribute, such as cyberattacks and electronic warfare. SSA in general can help both in identifying patterns of life for normal space activities and when space objects diverge from those normal patterns, as well as verifying that behaviors agreed to as part of arms control discussions are being followed. However, SSA is simply technical information about activities in space: for a verification regime to fully function, it needs an analytical aspect to it to figure out what the measurements mean and validate them in a way that can be trusted by multiple parties.

The first session of the 2022 AMOS Dialogue discussed the relationship between SSA and arms control/verification, with the goal of clarifying how the SSA community thinks about monitoring/tracking of space activities versus how traditional arms control actors view verification.

The first session began with an overview of the four "Ps" of verification in arms control discussions. The first is the purpose of verification: is it intended to lead to arms control (that is to say, limit capabilities) or complete disarmament (eliminate capabilities)? The second aspect relates to the participants – whether the agreement is bilateral, trilateral, minilateral, or multilateral, as well as the technical proficiency of the states' party to an agreement impacts what can be verified. The third is practices – a five-step process of monitoring, analyzing, evaluating, resolving, and finally, acting. Fourth and finally are the penalties that can be imposed on states parties for noncompliance or breach of the agreement. Verification is a deterrence strategy that raises the cost of defection by both imposing costs for detected cheating and additionally by raising the financial and organizational cost of obfuscation or otherwise skirting detection. Effective verification must enable timely discovery and subsequent discourse among parties to an agreement about penalties.

There are different types of arms control agreements, which affects the types of verification that might be required for each. For example, there are multilateral agreements like the Comprehensive Test Ban Treaty (CTBT) or bilateral ones like the Strategic Arms Limitation Talks (SALT), The Treaty between the United States of America and the Russian Federation on Measures for the Further Reduction and Limitation of Strategic Offensive Arms (New START), or the Intermediate-Range Nuclear Forces (INF) Treaty. Multilateral agreements need a verification regime that is accessible to all signatories, who may have different levels of technical capability, while bilateral agreements may require less intrusive verification mechanisms.

The complicating factor is that while traditional arms control has generally focused on limiting or deterring, some arms control discussions have become more focused on behaviors and this is how multilateral discussions on space security and stability are evolving. For example, the Hague Code of Conduct requires countries to declare when they plan to launch ballistic missiles (as a confidence-building measure). The Conventional Armed Forces in Europe (CFE) treaty determined when, where, and how large military exercises would be held.

The question was raised of who gets to verify such agreements. For example, the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) is charged with building up the verification regime of the CTBT in preparation for the Treaty's entry into force, as well as promoting the Treaty's universality. The CTBTO has a widely distributed monitoring network involving many countries, which is a different approach than the bilateral verification built into SALT and may be more appropriate for space arms control that involves many countries. Another consideration was how to build trust if all the data comes from Western sources, which much of the current SSA regime draws upon. Diversifying sources can help mitigate the concern of bias somewhat: for example, one of the strengths of the commitment not to conduct destructive anti-satellite (ASAT) missile tests is that it does not rely solely on U.S. government SSA information to see if one occurs.

The suggestion was made to possibly think about scaling up verification regimes in formality, in that there may be an awkward liminal space between voluntary norms and legally binding treaties. For example, while the CTBT is technically not in force, it does have a monitoring network that is already operating.

Additionally, verification requires not only taking technical data in but issuing assessments based on that data. That raises the question: who does the assessment? Going back to the CTBTO, while it provides data, it doesn’t make any conclusions. This can be a challenge for space activities, as not all states might have the technical expertise to adjudicate the data coming from SSA sensors or even the full picture of activities based on their limited number of sensors.

Another example given was the International Atomic Energy Agency (IAEA)’s ability to do hybrid verification, where it uses a combination of data from both states and commercial or non-state actors when collecting data. It has developed its own technologies but also leverages commercial; it may be helped that the IAEA has both a lot of buy-in internationally and authority.

Another question was raised about whether there are existing standards for establishing chain of custody of SSA data. The response was that provenance or chain of custody in SSA data is currently a challenge, in that we can sometimes detect spoofed data but it is not clear as to what degree and that more work is needed on this issue. One thing to keep in mind is that having more data helps: a decentralized system is harder to spoof. Another point made is that it is a good idea to be transparent about sensor calibration, performance, biases, and so forth, as that can aid with reliability of the data. Commercial SSA providers might be able to help with curating data roles or acting as fuse points for different sources of SSA data.

In terms of providing sufficient SSA to verify activities on orbit, it was pointed out that the biggest challenge in low Earth orbit (LEO) is scale. It is getting harder to keep up with everything, even as we get more data, and at the moment there are only a limited number of commercial providers. So perhaps in the near term for LEO, commercial SSA might be best used for tipping and queuing, and then follow-up can be done with more specialized government capabilities. This is as opposed to geosynchronous Earth orbit (GEO), where there are already multiple commercial providers and excellent coverage.

A participant noted that another factor is analyst degrees of freedom. For a verification regime, data is most valuable right at the margin of a decision threshold. Because of that, SSA providers might need to share, beyond just data, the code and models that went into the analysis.

It was noted that the space arms control community has not worked out the substance of what it hopes to verify. What sorts of actions need to be verified and what sorts of SSA capabilities are needed to do so? A debris-causing ASAT test could be detected by many types of sensors, while proximity operations might require more specialized capabilities.

As well, different states have different perceptions of what behavior is threatening. Is verification needed in order to demonstrate good intent, or at least the absence of malicious intent? Or another way of looking at it is that capabilities + intent = threat. So there needs to be some sort of assessment of what the intention of the actor in question is, which in turn is shaped not only by knowledge of their technical capabilities but also their budgets, policies, previous activities, geopolitical interests, and so forth.

Finally, it was pointed out that something else which may complicate factors is the question of whether using commercial SSA providers for international security purposes such as verifying arms control agreements may make them (even more of) a lawful target.

The second session of the AMOS Dialogue examined concepts arising from the work of the UN Open-Ended Working Group (OEWG) on Reducing Space Threats and how they might be verified using a variety of SSA capabilities. After a quick overview of the history of multilateral space security negotiations, the OEWG's mandate, and related UN resolutions, the discussion then went into different concepts of threats that are currently being discussed. These include direct-ascent ASATs, the secret deployment of satellites, rendezvous and proximity operations (RPOs), the placement of weapons in space, dual-purpose capabilities (like active debris removal), cyber and electronic warfare attacks, and uncontrolled booster re-entries.

Something to keep in mind is that the goal for verification shapes the timeline required for it. If the goal of the verification regime is to reduce tensions/instability, it will require a longer timeline, whereas if the goal is to determine the use of a weapon, verification will take a shorter amount of time.

The question was asked about what sorts of activities in an arms control agreement could SSA verify and what it could not. One example is proximity operations, which are pretty straightforward to verify via SSA. However, something like a cyber attack or electronic warfare would be very hard to determine via SSA and both are in general difficult to attribute. Perhaps SSA could be used in the latter to determine patterns of life and identify when something has changed in how a satellite is behaving. Broadly speaking, SSA is good for verifying something has/hasn't happened; determining why that did/not happen is not a job for SSA but rather for analytics.

Another consideration would be the protection of verification mechanisms/capabilities; however, there is no accepted definition of what harmful interference is in space.

Finally, it was pointed out that SSA could help monitor behavior, as well as verify compliance with agreements. For that to work, though, the norm of behavior must be something that is observable with radars/telescopes. And if atypical behavior is identified, it raises the question of what then. Is the onus on the accuser or the accused to prove that norms were being followed? And what recourse does the accused have to respond to accusations, and in what venue does this need to take place?

About Secure World Foundation

Secure World Foundation (SWF) is a private operating foundation dedicated to the secure and sustainable use of space for the benefit of Earth and all its peoples. SWF engages with academics, policy makers, scientists, and advocates in the space and international affairs communities to support steps that strengthen global space sustainability. It promotes the development of cooperative and effective use of space for the protection of Earth's environment and human security. https://swfound.org