



## Space Situational Awareness and Space Security

### Panelists:

- **Presenter: Victoria Samson**, Washington Office Director, Secure World Foundation
- **Respondent: Moriba Jah**, University of Texas at Austin
- **Moderator: Daniel Porras**, UNIDIR

**Daniel Porras:** Ladies and gentlemen, welcome to the very first kick-off episode of the UNIDIR Launch Pad Web Seminars series. We're really excited to be coming to you all today, in your living rooms or in your kitchens as you can see where I am, or wherever it is that you are.

In this crisis that we're having right now, [inaudible 0:21] it's really important that we continue to be able to carry on these discussions. We are of course moving onto a new format. In that sense, I would like to just drop a couple of quick ground rules for how we're going to be conducting this event today. This should be quite exciting.

Before we kick it off though, I would like to start out by asking you to take a poll. Just a quick question. You've all been answering this question here already. That's really great. Thank you for letting us know where you're tuning in from. I wanted to ask somebody or I wanted to ask the audience just before the outset, if I could ask our producers to head on over to the poll question.

We're here today to talk about Space Situational Awareness and Space Security. As many of you know, one of the big issues that we have to tackle with the prevention of an arms race in outer space is often what can we see, what can we measure, and what can we verify in outer space given our current technology?

If any of you would like to go over to the multimedia viewer, you can please have a look at the [inaudible 1:28] right now. Speaking of ground rules, one thing that I must ask everyone to do...I think we've muted everyone's microphones at the outset given that there are almost 300 participants.

It's going to be important that we only have one person speaking at a time. However, I can still hear some things from other folks.

**Man 1:** It's [indecipherable 1:52] .

**Daniel:** Yeah, if anybody has their microphone on at the moment, please just mute that. Murph, also, if I see you down there, you can just [inaudible 2:04] . Thank you for that.

At the outset, I would also like to remind everyone that we are recording this Web seminar. We are going to be making this available later on so people can watch and listen. If you have any

problems with that and you don't want to be recorded, of course, only the speakers and myself are going to be on mic.

Just so everyone knows, this is going to be made available at a later time. We are going to be doing the events in English. The Space Security Conference and most of our other events are typically in English. Given the new modalities, maybe sometime in the future, we will have live interpretation but haven't quite gotten there yet.

In order to get the best experience from this, I recommend that you use the side-by-side mode. You can click -- I think it's up here -- on most of your screens. You can see that there are various different modes that you can use for Webex to see things. I have found that either the side-by-side views to be the best, or you can also use the video strip. You just click it.

If you want to ask any questions of our speakers, there's a multimedia viewer. You should already have that available. It's where you took the poll. If you can't see it, you have a button should be right down about here that has three little dots on it. You can click there and it will enable you to see multimedia viewer.

Finally, at the very end of the presentations, we are going to ask you all to submit evaluation form just to let us know how this experience went. If you have any questions or comments, you can give us feedback. With that, Murph, I think we can close out the poll and have a quick look. As we can see here, there are quite a few activities that folks think we can see in space.

I'd like to hand over to our presenter, Ms. Victoria Samson, who is the Washington Office Director for Secure World Foundation. Victoria Samson has been working with Secure World for quite some time and has been a very loyal partner of UNIDIR for quite some years I've gotten to do many of these events in the past.

Victoria, would you like to talk to us about this Situational Awareness and Space Security?

**Victoria Samson:** Nothing will give me greater pleasure. Hello, everyone. As Daniel said, my name is Victoria Samson. I'm the Washington Office Director at the Secure World Foundation. The Secure World Foundation is a private operating foundation that focuses on the long-term sustainable use of space.

We promote best practices and norms behavior to make sure that space is usable and sustainable for all over long-term. I would like to thank UNIDIR and FRS for their co-sponsorship of this webinar series.

As Daniel said, things are changing, and we're trying to evolve how we do things along with it. We are absolutely delighted that we've been able to have this webinar and that there's so much global interest in it. I'm really looking forward to hearing your questions and having the conversation later on.

I was asked just do a quick overview of Space Situational Awareness or SSA, and how it relates to space security. I'll be doing that, queuing up. Then the next presenter, Moriba Jah, will be

talking at it from a technical viewpoint. As I always say, I'm a political scientist, not a real scientist, so I'll be focusing on the policy and law aspects of this.

SSA is information about the space environment and activities in space that can be used to operate safely and efficiently, avoid physical and electromagnetic interference, detect, characterize and protect against threats, understand the evolution of the space environment, and provide awareness and transparency of space operations.

Most space actors do not have the resources or the capacity to provide their own SSA. However, many states have some national capability that they can contribute to a broader effort.

Achieving "good SSA" requires a large network, a geographically distributed sensors and information from satellite owners and operators. Therefore, it cannot be done by any one country working alone. You need to have government and private sector cooperation.

SSA collaboration-cooperation sharing is absolutely necessary for space security and stability. Better SSA is pretty much requirement for any space security agreement. That includes transparency and confidence-building measures or TCBMs, and norms, but also future treaties.

For example, right now, there's no global agreement on what use of force in space is or a common understanding of how the laws of armed conflict apply to space. If and when that is agreed to, SSA will be crucial for ascertaining where space activities fall.

SSA is a key to clarifying whether dual-use capabilities like rendezvous and proximity operations, active debris removal, or on-orbit servicing are being used in a benign or hostile fashion.

Space technology is neutral. It's the use of which there can be either benign or aggressive. It's the intent, not the hardware, that is going to be the primary way signal that actions in space are non-threatening, which raises a host of questions about what is needed to demonstrate responsible and non-hostile behavior on orbit.

As well, responsible space behavior can be a signal for good intent. Alternatively, reckless behavior in space can sometimes be a signal for malevolent intent, or at least, lend itself to misinterpretation about the nature of a particular space asset.

SSA can confirm whether space is being used in a responsible or irresponsible manner. Monitoring and verification like SSA can name and shame irresponsible actors.

Also, SSA is that important for the indications and warnings of potential hostile threats or actions in space, and is tied to identifying thresholds for self-defense. It gives you an idea of what is happening on orbit, but also, we'll be pointing out, I think we will be talking about this as well.

Situational awareness is not 100 percent. It's not a crystal ball. It's not great. If a satellite stops working, it is not always clear why and whether it's due to deliberate interference, environmental issues, technical malfunction, or some other reason entirely.

SSA is important because there's a possibility misunderstandings and mistrust. Actors could misinterpret an accident as a deliberate step to interfere with space capabilities if there are political issues or hostilities on the ground. SSA is very important to hopefully avoid unnecessary crisis escalation.

Then, a little bit of stats about SSA. The United States Air Force maintains a catalog of about 24,000 objects, 10 centimeter in diameter or greater. The Space Fence is a radar that just came online at the end of last year. As it continues to come online, the number is expected to go to at least 100,000 objects.

Currently, in terms of active satellites as of March 2020, there are about 2,600 active satellites. That is from the Union of Concerned Scientists Satellite Database, which I recommend everyone go check out if you're interested. It has a great catalog of what we can see in terms of nation satellites and where they've been launched.

Mega-constellations which started launching last year could add 50,000 more satellites to the over 2,600 satellites that are active currently. You can see that's an order of magnitude increase and that's a complicated picture for SSA.

Then with the advent of new actors in space, a lot of them are using SmallSats as they get used to working on orbit. These SmallSats provide their own SSA challenge, whether they're even big enough to be trackable, and if they're trackable, are they maneuverable? In that, you identify a potential close approach to them, can you get the satellite out of the way?

Some small satellites are launched with the inability to move once they're on orbit. They depend upon being pulled back to Earth's gravity to de-orbit.

In terms of who's in charge of SSA, largely speaking, no one is in charge of SSA. Nations have their own SSA capabilities. The United States historically, that has been the US military. Now, the 18th Space Control Squadron. Previously, there hadn't been a distinction between military SSA and non-military SSA.

The Trump administration issued Space Policy Directive-3 in June of 2018. This declared the Department of Commerce would be the lead for civil SSA. However, the United States Congress has not given the Department of Commerce the additional authorities and budget to implement the full scope of SPD-3.

In any case, right now, the 18th Space Control Squadron has won over 100 SSA sharing agreements. Russia has a very strong SSA network. The Europeans are developing their SST Space Surveillance Network. As well, Japan and India are investing in their capabilities.

Also just to point out, you don't need to have a whole network to have SSA capabilities. Owner-operator information can qualify as SSA information, as well as information from civil telescopes, so long as they are good ones.

I'd also like to emphasize as well that commercial SSA is growing in capability, and at times, surpasses what government networks can do. Its presence should be noted and those capabilities should be incorporated when discussing how do we use SSA for our stability measures.

National, regional, international initiatives at SSA can contribute to stability in space for all. The stability is of great strategic value.

Then when you're talking about SSA, what is the endpoint? What are you trying to achieve? Are you trying to achieve spaceflight safety? Are you trying to use it as a verification measure? Are you trying to use it for transparency?

No matter what the end goal is, I think there's a general agreement about the need to get a baseline level of information to all satellite operators for spaceflight safety and predictability in orbit, which helps shore up space security and stability.

I will add very briefly and we can talk about this more in the question section if people are interested, anti-satellite tests that create debris stress current SSA capabilities.

I'd like to end with the warning that SSA is not perfect. Keep that in mind, please, when thinking about how can we use this as a TCBM. It can be challenged by multiple satellites being launched at the same time, maneuvers on orbit, etc.

The US government cannot currently routinely monitor and track everything in space. Its SSA is largely based on looking back in time and predicting for the future, combined for the fact that it's not able to ingest planned maneuvers, for example, their predictions are sometimes off.

Again, I bring up the caveat because I think sometimes the policy folks think there's a technical solution, we can depend on that 100 percent. In this case, it is part of the solution, but it cannot be the only solution to thinking about transparency and stability in space.

That's a larger question, how do you achieve transparency in space and what role can norms play possibly including SSA verification, and establishing a stable and predictable space environment? With that, I'll stop and turn it over to Moriba. Thank you.

**Daniel:** Great. Thanks so much, Victoria, for that. That's a great kicking off point. You raise a lot of really good questions that we're going to come at from a policy side.

Now, we want to talk a little bit to Moriba. He can tell us more about the technical side of Space Situational Awareness, what it is exactly, and what people do so that they can see things in space, and what it is that is in our space.

With that, it gives me great pleasure to introduce Dr. Moriba Jah from the University of Texas. He is an astrophysicist, an astrodynamicist, and all-round gentleman and scholar. With that, a man who needs no introduction, off to Moriba Jah.

**Moriba Jah:** [laughs] Thank you, Daniel. Thank you, Victoria. Hopefully, people can hear me. Yes, if I can get...

**Daniel:** We can hear you loud and clear, sir.

**Moriba:** Excellent. I'm a currently Associate Professor of Aerospace Engineering and Engineering Mechanics at the University of Texas at Austin, and I lead a research program focused on space safety, security, and sustainability of which Space Situational Awareness is a nice aspect of that.

I want to say the following because Victoria did a very good job of laying down some definitions that you could consider for Space Situational Awareness. She gave some statistics on things that are tracked and that sort of thing.

I like to think about the space domain in near-Earth with three main themes. Theme number one is that near-Earth space is geopolitically contested. We've seen this since the Cold War and Sputnik, and all these things. We've seen that more and more countries are acting in space, and doing all sorts of activities and their own national interest, so that's not changed.

Theme number two is that near-Earth space is commercially contested, and so we've seen a new space race, a new bonanza gold rush. We know from Outer Space Treaty, *res communis*, there are no titles or deeds for orbital space.

Notwithstanding that, here in the United States, there is a term called squatters' rights. Some people may be familiar with this. It's a first come, first served in a great sense.

Let me put it this way. Physics tells us that when two things occupy the same space at the same time, sometimes bad things can happen as a result. If we have objects that are occupying a specific orbital region -- I'll get to this here in a little bit -- if the carrying capacity of that orbital habitat or region is saturated, then you can't put more stuff there.

Which brings me to the third thing, which is near-Earth space is a finite resource. All of our space may be infinite, but near-Earth space is finite. It's a finite resource. We don't launch things just anywhere in space. We put things on very specific column orbital highways.

The carrying capacity of these orbital highways can become saturated, at which point, you can't put more stuff there. There's no cleaning crew to come and sweep things away, even though you have Astroscale. You have some other companies that are trying to build business models.

You have ClearSpace, which is going to launch something that...They're leaded at EPFL with Muriel Richard's going to launch something in 2025 to rendezvous with this VESPA Payload

Adapter. You have some folks looking at that, but currently, there's no space sweeping or clearing of these orbital highways.

Near-Earth space is in desperate need of environmental protection -- desperate need of environmental protection, norms of behavior for sustainability. The World Economic Forum has been developing this thing called Space Sustainability Rating to try to incentivize launchers and space actors to behave responsibly in a way that would lead to sustainability.

These are all things that are taking place. Again, the themes are spaces geopolitically contested, spaces commercially contested, and near-Earth space is in desperate need of an environmental protection.

Yesterday, I was interviewed -- I won't say by who -- they were asking him about the risks. What are the risks in space? I said, "I don't want to just look at things in terms of conjunction and collisions. Let's start trying to quantify these risks against these three Ss. We have Space Safety. We have Sustainability." The thing that most people tend to gloss over is the Security piece.

I would say that from a technical perspective, the information requirements that would go against space safety issues like collisions. We have radars. We have telescopes that collect observations. I'll put it this way. You can't manage what you don't know and you don't know what you don't measure. You can't manage what you don't know, don't know what you don't measure.

It all comes down to measurements. If we're not measuring things in the environment, if we're not measuring the environment, we can't possibly know that environment, and so we can't manage that. There is no space traffic management without space traffic knowledge, and there's no space traffic knowledge without space traffic measurements. It's all about these observations.

There's no globally accessible, shareable pool of space traffic measurements to then infer the knowledge, to then get to the management piece, which is the big deal, but very briefly to close up here before we can open things up to more dialogue and questions. The requirements for collisions is not as much as the requirements, to say, reconcile some dispute and space.

People by and large think that space security is just about intelligence, agencies, or militaries, and things like that. I think that that's -- to put it mildly -- ridiculous and naïve. Just looking at two companies, let's say SpaceX and Amazon. Not that this would happen, but there's been no domain of human interaction, of human activity that's been absent malicious intent.

To think that two companies up there that are big competitors, it's impossible for one of them to behave maliciously towards the other. I think that's naive. The thing is it's probably happened. It definitely will happen, especially given theme to that I said, space is commercially contested. There's a lot of money to be made or lost in that domain, and it's mostly unmonitored.

I will say that the 18th does a really great job in having this catalog of 26,000 objects that Victoria spoke about, but it's not pervasive monitoring. This whole thing of Article VI of the Outer Space Treaty about continuing supervision that states have responsibility for. Nobody continuously supervises anything.

We just had an experiment that happened successfully, MEV-1 rendezvoused with this satellite and geo. Now, this thing is attached to the satellite and gave it extra life and that thing. I can tell you that people were observing that from all over the world as possible.

Those at certain point, far away, where they couldn't distinguish the two objects anymore with telescopes. It was one kilometer. Now, have you ever looked out your window to see how far one kilometer is? It's not that close. What could happen within one kilometer that everybody else couldn't perceive?

If we want for space to be secure, then the observations and the monitoring that we have, we have to have a body of evidence where we could reconcile any disputes, a ledger of a sequence of events so that we could say, "This is what A did to B all throughout this timeline." At any point, if that becomes ambiguous, we're in big trouble.

I'm going to stop there for now, but needless to say, this is an iceberg-type of topic, which I'm happy to dive deeper into. Thank you very much.

**Daniel:** I can tell that we're going to have a lot of good discussion today because as always, Victoria and Moriba are bringing their A-game and raising a lot of really good issues.

In order for everyone to be able to ask questions, I just want to remind you, just check the multimedia viewer. You can't see it in your screen. There's a button that should be right about here. I think most of you, it's a three little dots.

If you just poke that, it'll bring up the multimedia viewer over to the right of your screen, and then you can enter the questions there at the bottom. Being the host of this meeting, I'm going to take my progress and be the first to ask a couple of questions. First one is for Victoria. Victoria, are you there?

[pause]

**Daniel:** Maybe the first question then will be for Moriba. Moriba, at the very beginning, we showed a quick poll that had a bunch of different activities on it. We asked, "Are these things that we can measure and detect potentially tracking space?" Of that list, how many of those things do you think are technically trackable, observable, and verifiable today?

**Moriba:** Here's the thing. Anything that relates to where objects are located, that's usually what we can assess -- locations of things in the sky, mostly because of radars and telescopes. Some of these are actively being measured. Others are just listening passively, like telescopes are just looking at reflected light off of surfaces of objects.



When it comes to location-type stuff, usually, those are the things that are measurable that might be verifiable. Like I said, I gave the example of this MEV-1 rendezvoused, which within one kilometer, people just couldn't distinguish the difference between the two objects.

In terms of other things that aren't measurable by like these telescopes, for instance, like radio-frequency interference, so telescopes won't be able to assess anything about radio-frequency interference, for instance.

These are the things where we have to say, "What are the things that people care about? Given the things that people care about, if we want to know about these things, what are the things that I would have to measure to be able to get to know how this is happening, or to what extent?"

Then focus on those measurements being available to a group of people that could independently corroborate those activities, those issues.

**Daniel:** Now that we've just gone ahead and opened that. Are we able to see and observe things in all the orbits the same? We have low-Earth orbit, the medium-Earth orbit, and the geosynchronous orbit. Are capabilities to see things in those areas the same across the board, or are they different orbits?

**Moriba:** Thank you for that. They are different. These are different orbital habitats. The species of space objects that live in these habitats behave differently based on that local space environment, that habitat and so.

For low-Earth orbit, radars tend to be the more effective things. Telescopes require nighttime conditions mostly and that sort of thing. Telescopes don't see well through clouds. There is that, but that's just a common thing.

The dynamics -- how things move and behave in that environment -- make it very nuanced and how to observe those things versus something that geo which is fairly fixed, with respect to an observer.

At the same time, things that geo, it means that only parts of the Earth that fall directly under that geo region can observe it, but people that live on the other side of the globe can't see that region of geo.

I hear from Austin, Texas, you cannot see the region of geo that is above China, for instance, and that sort of thing. But, a low-Earth orbit satellite that might belong to China, eventually, it'll come over the United States because of the dynamics of the habitat. These things are nuanced, and it's not a "Lord of the Rings" observation system to rule them all that will actually work.

**Daniel:** OK, great. Victoria, are you there?

**Victoria:** Hello.

**Daniel:** There you are.

**Victoria:** Hello.

**Daniel:** There's been a word that has gotten thrown around a few times now. I want to circle back to it so you can highlight the danger behind this word. That word is "verification." We often hear about verification and why it's important to discussions on space security. Can you just tell us a little bit about what verification is and why it's important to what we're working on?

**Victoria:** Sure. Verification comes out of arms control disarmament discussions. It's the idea that you have some agreements and usually, it's a legally binding agreement or treaty.

There is a way to have, as Moriba was talked about, outside independently agreed upon observation and confirmation that the behavior of the treaty or what have you is being followed the way that the parties agreed to.

That makes sense, I think, in some context for arms control disarmament. When you're talking nuclear weapons, for example, part of the verification process is that you go and you say, "How much nuclear material do they have? What are they doing with their...?" You can visit sites and say, "Have they got that ICBMs mated together with the warheads?" That sort of thing.

You can go and physically see these things. Verification historically forms control disarmament. It has looked at a technological response. It's technology doing what you agreed that either would or would not be doing. The difference we run into for space is that verification is going to be different because a space technology is essentially the same.

A satellite that can be used for monitoring, crop growth and plantation can be used for spying and intelligence gathering. It's not necessarily the hardware you're looking at, it's the behavior. That seems like a nuance was an important one because we were talking verification for activities on orbit, yet it's still OK. What behavior am I finding threatening?

That's where we run into issues because even though we've been in space for some time, there still isn't really 100 percent agreement across the board in terms of, "Here's a series of actions on orbit that we find OK, and here is a series that we all agree to that we would find threatening."

When you're talking verification, what exactly you're trying to verify? I think oftentimes, when we're trying to focus on the security and stability aspects of space, we want to jump ahead. Jump five steps down the line, talk verification and treaties, and that sort of thing.

We need to back up. We need to figure out what are we trying to accomplish? What do we consider to be responsible behavior on orbit? What do we consider threatening behavior on orbit? Then we can go on and say, "How do we verify that this behavior is either being followed or not being followed?" and go from there.

**Daniel:** Let me go ahead and just follow that up with maybe the next logical question, which is, you mentioned that we should think what are the norms first, and then try and figure out if

they're verifiable? We've been discussing, and you and I have been engaged in a lot of topics and discussions that have covered host of behaviors or technology, and everything that has come up.

Are there any specific areas or any specific types of behaviors or technologies that you do think could be the subject of a verifiable agreement? Not saying whether it's legally binding or politically binding, but just are there any activities that you think, "Yeah, that's something that if we set a rule up for it, we could check it and make sure that people are hearing to their obligations."?

**Victoria:** I think there's possibilities for behavior. You can say, "We can verify whether or not a behavior is being followed." For example, a very obvious one is, "Are you deliberately creating to bring an orbit with an anti-satellite test?" That's pretty much something you can verify one way or the other.

If someone launches a ground-based ASAT, it hits the satellite, creates debris on orbit, other people are going to see the debris. It's not going to be a secret.

I'd like to point out that in 2007, when China had their anti-satellite test, the way that the global community found out about it was because Amateur Satellite Observation people were watching the skies and said, "Ha! That's weird. There was an object there and then suddenly, there's a bunch of objects over there. Something must have happened there."

They were the ones that came out and said, "They probably should look into this." I would just like to point out that as much as people might like to think so or governments like to think so, actions on orbit can be misunderstood, but people can see them.

Oftentimes, there's a wish to make a lot of things secret. Maybe, that made sense a couple decades ago when there wasn't widespread technologies, but when people can go and point their phones up at the sky and say, "What that satellite is." A lot of this secrecy is gone. It's no longer an option.

That might be an option, but as well, you can have discussions about actions on orbit that are threatening or non-threatening. That's where you come up and say, "What we think about for things like close approach or rendezvous and proximity operations. That's where, I think, the commercial sector has really led the way in discussing what they see as being responsible behavior in orbit.

As well, it's important to bring in the commercial sector in these discussions. I know that there's a larger reluctance to do so because for security reasons, they want to be held under the guise of nation-state discussion points. But, the commercial sector is very obviously going to be part of this conversation one way or the other.

Again, I'd like to emphasize looking at the launch of these mega-constellations. It's not nation-states that are launching these constellations. It is the commercial sector. As probably as

uncomfortable as well, the multilateral fora with bringing in non-state actors, it has to be some way to incorporate them in this conversation.

**Moriba:** Yeah. Daniel?

**Daniel:** Go ahead.

**Moriba:** I love everything that Victoria said. To add on a few things to what she said and what you asked, for sure I can tell you this. In terms of low-hanging fruit and what we should verify, I would start with debris mitigation. Just like what Victoria said, when people deliberately seeing debris, that thing is one thing.

I would even say just compliance and non-compliance with Debris Mitigation Guidelines that the IADC has put out that the UN COPUOS has put on terms of LTS guidelines. In the public square, we should have evidence of who is complying and who is not complying with these guidelines, and just let the public weigh in on the opinion on what they think about this.

Again, near-Earth space is a finite resource. The biggest problem with debris and these sorts of things is that we have a high percentage of non-compliance. European Space Agency and other entities know about this, except that that's not necessarily public. That needs to be public.

Different people from across the globe need to be looking at the evidence providing a combined set of observations where people from around the globe can infer that stuff. That's something that we should look at low-hanging fruit and that we should be able to do.

The other thing too when Victoria was talking about, RPO, commerce is leading the way. I fully agree with that. Commercial entities, it would be in their best interest to have independent monitoring have their own actions to cover their own rear-ends, so to speak, when the rubber hits the road.

What I mean by that is this. If there are two companies -- one of them is trying to do some rendezvous, with another one to refuel it or any of these things -- I think just from a legal perspective, it's in their best interest to say, "How many other people can observe what it is that I'm doing so that there's this independent body of evidence?"

If something happens that we didn't expect or whatever, Person A can't just go into, "Hey, these people did this to me, and it was on purpose and also other stuff." If it wasn't and there's evidence that it wasn't, that would surely be nice. Commercial companies, they tend to be out in front of the headlights from my perspective in terms of regulation and that sort of stuff.

They just want to go, go, go, but they should think about, "Hey, from a legally responsible and liable perspective, maybe it makes sense for as many people to be observing me and I should make myself as observable as possible so that there's this independent body of evidence that could be used in case there are any issues."

**Daniel:** Thanks, man. [laughs] You always give me a lot to think about. We've actually got a lot of questions that are coming in from the audience. I want to see if we can try and discuss some of these. I know that you guys have been answering them quite a lot.

Victoria, there's a question for you here. You mentioned the Space Situational Awareness capabilities for the US-Russia, and there's also Japan and India but not China. Do we know what types of SSA capabilities China has? Do they share any of that information?

**Victoria:** Yeah, obviously, it's a space operator. They have some their own SSA capabilities. For specifics, just because I don't want to get into a really long technical conversation right now, I would direct anyone who's interested to Secure World Foundation's website. We have a Counterspace Threat Assessment document, which can be found at [swfound.org/counterspace](https://swfound.org/counterspace).

We go into US, Russia, China, India, North Korea, Iran, France, Japan. We discuss our SSA capabilities specifically, so you can find more information there. Obviously, we know specifics about China's SSA capabilities. Technical specs are not really shared. To my knowledge, they are not involved in any external SSA sharing. I believe that they just use it for their own purposes.

Again, I would direct you to the [swfound.org/counterspace](https://swfound.org/counterspace) to read more about that document and I'm always happy to answer questions later on if you have more after reading that.

**Daniel:** Moriba, I actually have a good follow-up for you as well, and I know you're your AstriaGraph system depends on SSA data from a number of sources.

This question is, are there any international forums at least between Russia, China, and the US to discuss SSA data exchange or anything similar? If not, is it because of lack of awareness, space issues, or active objections? Maybe, that refers to political objections.

Maybe, you can tell us a little bit about how you've gotten countries like the US and Russia to give you data if you tried to maybe reach out to China in the past.

**Moriba:** Thank you for that. I would say the IADC is government's meeting and talking with each other. I've never been to one of those meetings, never been invited to one of those. That's a separate webinar we should have maybe. [laughs]

**Daniel:** Yeah, [inaudible 40:23] Inter-Agency Space Debris Coordination Committee.

**Moriba:** Yes.

**Daniel:** A lot of space agencies get together and talk about space debris.

**Moriba:** Absolutely. Thank you for clarifying that for the audience. I know that one of their working groups is on measurements, and they discuss these things. When I speak to some of the IADC people in terms of actual sensor observations, those typically don't get exchanged in that form.

Really, that's what we need. We need to be able to share the measurements, the observations of things in the domain, in the environment and that sort of stuff. I can tell you that this AstriaGraph project that I've been leading. So far, we've had JSC Vimpel catalog from the Russians. They've been happy to share that with us and that gets updated every couple of weeks.

We also have some owner-operated data from Planet. Planet has been very, very forward-leaning and providing us with ephemeris of where their satellites are located and all these other things. We've started getting some data from SpaceX as well on their Starlink satellites.

LeoLabs provides us some free radar measurements on some subset of objects for scientific purposes, non-commercial purposes. They even have their own opinions now about where some of these things are located, so we get to ingest those.

More from Russia, I'll tell you that I'm actually partnering with the International Scientific Optical Network or ISON. We share a telescope in New Mexico. The Keldysh Institute of Applied Math and UT Austin have signed a memorandum of understanding where we share a telescope in New Mexico. That's a really cool thing.

In terms of collaborations with India, I can tell you that we just signed a memorandum of understanding with the Indian Space Research Organization. One of my telescopes is going to be shipped to India within the next few months.

They actually came from India to do the final signing here at UT Austin, which was awesome. It happened during the Space Traffic Management Conferences. You know that we have here every year at Austin, so that was great.

With China, that is a bit more nuanced. It turns out that the Chinese Academy of Sciences has national astronomical observatories. I've started dialogues with some of these astronomers, people looking at debris and that sort of thing because they do have some telescopes.

Some of it is laser tracking. I haven't gotten any of their data yet, but I'm hopeful that we'll get to that point, hopefully, sometime this calendar year.

People are starting to add and add more observations to the system. I think it's going to be to everybody's benefit because again, it's independently corroborated evidence about what's going on out there, and really getting to this idea of how do we supervise and monitor behaviors and activities in a domain?

**Daniel:** Victoria, this is another question. Both of you will have plenty to say about it, but let me start with you. The military, more or less, leads the SSA efforts. I think most of us are aware that the US Air Force is the main one who provides SSA data at the moment.

We're starting to see a lot more other actors who are getting involved in this area. How can we refocus the Space Situational Awareness mission to be more civilian-led as opposed to military-led?

**Victoria:** That's a really good question. [coughs] Excuse me. Within the United States, there's been a discussion for some time about who should be in charge of SSA just because SSA sharing, as you said, is being led by the United States Air Force, but that is a secondary mission.

Really, monitoring what's up in the skies on orbit that came out of Cold War considerations where the US was monitoring -- let's be honest -- the North Pole to see if there are Soviet ICBMs coming over it. As an aside, they're like, "Oh, yeah. We can also keep track of the space objects. We'll do that too." But, it was never really a primary mission.

Then sharing the SSA data, which they've been doing for over a decade now that, again, it's done for spaceflight safety, but it's not necessarily a national security mission for them. There's a discussion in the United States. How do we get this so it can be have a different head? That's something that we're still working out.

As I said before, there is a dispute about which non-civilian organization should be involved to the Department of Commerce. It should it be the FAA. At one point, the FCC was offering to be involved in it. We're still sorting that out, but I think it just it comes to the larger discussion about whether SSA should be civil or military nature.

I guess the question is...It's a public good, essentially, and so I would argue there's a certain baseline SSA that everyone needs to be able to have, whether you're a military actor, whether you're a civilian actor, whether you're a commercial actor, or what have you [inaudible 45:38] .

On top of that, what do you need your SSA for? Do you need it to be able to do exquisite monitoring of treaty behavior? Or, are you trying to make sure your satellite just doesn't bump into a piece of debris? Are you trying to do some on-orbit servicing or refueling a solid orbit, which requires being able to get up and get close?

It comes down to what are you trying to accomplish with your SSA? I think in general that we probably went into is classification precludes a lot of data sharing, and then just that sounds goofy, but formatting across different networks is often a challenge as well. We've seen that if you've ever tried to switch for a Mac to a PC, it should be easy transition, but it often is not.

It's just a larger conversation about the need to have these international discussions. We bring in all the stakeholders, not just the ones that have the SSA powers and capabilities, but those who use SSA to make sure that the owner operators are familiar with the information and that they can share it across the board.

We've already seen this done. There have already been a couple commercial entities. The Space Data Association, for example, set up a way to share SSA data within the organization. You can imagine if these guys are competitors on the marketplace and yet, they find that they can

comfortably share SSA data, again, for spaceflight safety thing, then we should be able to do it around globally.

But again, it requires a conversation about what you're trying to accomplish, and how do you go about doing it? I think it's encouraging that there is a definite interest globally and this issue because you can't fix. We don't acknowledge as a problem. We're starting there. Now, we have to figure out where we go from here.

**Moriba:** Daniel, the quick thing that I just wanted to say following up with what Victoria said is I think what we need in general is a Waze-type application for space.

What I mean is the very basic SSA capability should be like a Waze for space where you can see what are the general traffic patterns and these sorts of things to help people navigate and steer around that space traffic as much as possible for safety and security reasons, and that sort of thing.

For commerce, for people to make money, to not destroy the marketplace for commercial associate providers, that stuff. As you know in Waze, there's a lot of information, but at the same time, you don't necessarily know the identity of every vehicle on the road in Waze. You don't know that this is a semi versus this is a Vespa versus this is that or the other.

There is an ability that given that fundamental Waze-space-type app. There's an ability for a commercial as the folks to leverage that and actually provide more exquisite knowledge that people could charge a fee for. I think that there's a way to provide that basic level of understanding for free, and then on top of that, allow people to leverage that to make businesses off of that capability.

**Daniel:** Excellent. Sir, I'm going to ask you just one other question for both of you and I don't want to do a final poll, but are you good, sir?

**Moriba:** [laughs]

**Daniel:** Artificial intelligence, what role might it play in Space Situational Awareness?

**Moriba:** Thank you for that. The first thing that I want to say is this. The thing about AI and machine learning is that they assume that tomorrow looks like today, and so if your version of today is pretty crappy, without a lot of resolution and finite, very good knowledge, then the prediction of tomorrow is going to be lousy.

It's a "garbage in, garbage out" thing. AI and ML is not all sentient. It's dumb, so you got to train the thing.

**Daniel:** [laughs]

**Moriba:** You want to feed it lots of todays, lots of different todays over the years and all that stuff so that tomorrow's prediction can be as accurate and as precise as possible. One of the



things that space is missing is a big data problem. There is no big data problem in space for SSA. I think that that is to our detriment.

Big Data, Science and Analytics works really well in other domains. Pandemics, like all these other things, right? We don't have a big data problem space. Every time I raise this, I hear people say, "Oh, but sure we do. I have terabytes and terabytes of telescope observations."

I tell them, "That's not big data. That's a lot of data. It's not the same thing. Big data are lots of data from very disparate and different sources."

The thing is, in order for us to get the best picture of space, we need to combine all these disparate sources, and then we can start discovering causal relationships between entities in the domain, and then train AI and ML on those things to help the human out.

The AI needs to complement human cognition, not replace it. The way that people think about this needs to be very different. It's not this automated thing that you just flip the switch and outcomes the answer.

No, it needs to complement human cognition. The training set needs to be on a big data problem, which we currently do not have a big data problem in space. Nobody has a big data problem in space.

**Victoria:** Daniel, I know you had a question for me as well. I just want to jump in on Moriba's response. AI can also be helpful in terms of analyzing and making the data in the format as usable for owners and operators.

I know oftentimes when people get information about potential closed approaches, they're not sure exactly what I am supposed to do with this, how do I understand this? That's where AI can help build in some understanding about what do you do with the data. It's not enough to have it. It's ability to analyze it and make it useful.

**Daniel:** Excellent. In that case, I think we're pretty much starting to run out of time here. I know we've given folks a lot of information.

At this point, I want to ask the same question that we just had, or that we asked at the very beginning of the meeting, just to see if folks still feel the same way that they did about some of these different topics, and what we might actually be able to measure or verify with the current technology.

While you're doing that, one, I want to do a little promotion for our own work. UNIDIR did do a paper on this topic of Space Situational Awareness and Space Security last year called "Eyes in the Sky." It's file four from The Space Dossier.

If any of y'all would like to check that out, highly recommend that you go to our website and look that up, where we also talk quite a bit about what might be the possible subjects of agreements that could also potentially be verifiable.

Now, it's important so that states can feel confident that any obligations that might be picked up, whether they'll be legal or political in nature, are actually being adhered to. In addition, I want to thank our speakers for coming, Victoria and Moriba. They've done a really great job today.

I would also like to thank our co-sponsors, the Secure World Foundation and the Fondation pour la Recherche Stratégique, as well as the European Union and the Swiss government. Some of our other funders, such as the Russian Federation, New Zealand, and Swedish governments. They've all been really helpful.

Our consultants, Rhys McCann, who are doing a great job in making this a little bit extra special meeting. Finally, I would like to remind everyone that we're going to be doing these Web seminars once a week. Wednesdays at two o'clock.

Next Wednesday, we're going to be doing another presentation about cyberwarfare in space. That's going to be featuring Beyza Unal from Chatham House. I'm sure many of you know, and of course, my very dear friend, Raji Rajagopalan, from the Observer Research Foundation in New Delhi.

With that, Murph, if we can just have a quick look again at the results from the slides so that everyone can have a quick look. I think that's interesting. We've definitely seen that a lot more of the choices have grouped around certain activities, so that is an eye-opener.

Moreover, what's interesting is what people are not because that shows that we still have some limitations where Space Situational Awareness can continue to grow. We've got another five minutes. Victoria, Moriba, would you like to just wrap up with anything? I can certainly shoot you a couple more questions that the audience has put through us before we wrap up.

**Moriba:** I'm fine with the audience questions.

[crosstalk]

**Daniel:** In that case, let me just shoot you a couple more. Moriba, we have talked about a number of countries that have put up a fair bit of debris in the past and that we're still tracking. Can you tell us where a lot of that debris comes from? What is it? Are they old satellites, are they old rocket parts or junk floating around?

**Moriba:** Part of it is so-called mission-related debris, which for years, whenever you put a satellite up there, you'd have these explosive bolts. You'd have covers on cameras that would be popped off. That mission-related debris, things related to just normal operations. I think people in general have been saying, "Yeah, let's try to minimize that or not have that at all."

Some of it is that. Certainly, when things die up there, most of the stuff that dies up there never comes back, and so that pretty much is effectively debris large rocket bodies, these sorts of things. Every once in a while, a couple things will, again, occupy the same space at the same time.

KaBOOM, that becomes smaller pieces. Sometimes things explode. We've seen some upper stages and geo-transfer orbits apparently explode in the past couple of years that's generated many thousands of objects, unfortunately, in geo-transfer orbit. This is the behavior of the population. We don't fully understand the aging process of stuff -- space object gerontology.

Yup, I just made it. It's a thing that I just made up, but understanding how things age, how they deteriorate and flake off, and this become dismembered. Sorry for such a graphic thing. But, we don't understand that yet, so there's more science that needs to be done there.

**Daniel:** Excellent. Thank you, sir. Victoria, here's another one of those million-dollar questions for you. Do you envision a future system where SSA data will be gathered from all international actors with one mediating entity in the middle acting as a clearinghouse to send out data to everyone else? Do you think that's possible?

**Victoria:** Nothing's impossible. [laughs] But, in the minute I have left, I would just caution that having one global entity being involved in sending information out to a database, it would be nice, but I think probably unrealistic, given information actors have about the secrecy of the data, whether it's from the national security viewpoint, commercial viewpoint, what have you.

I think it's probably likely it will be [inaudible 57:41] networks, where they coordinate information across the board, and then share information that way. I think that can be a multi-polar world. Going back to my international relations training for SSA data sharing, I think that can be as stable as a uni-polar world. It's just a matter of do you have confidence this information?

Whether or not one entity's in charge of sharing it out, or if it's going to be shared out via a bunch of different entities, do you have confidence in the information? can you trust it? That's going to probably be a larger hurdle to clear than figuring out who's going to be sharing it out.

**Daniel:** Excellent. This is someone who has done a lot of work on that particular subject as well. I think I would also add that I do prefer having many entities, who can cross check each other, as opposed to just having one, because that way it keeps everyone honest.

With that, ladies and gentlemen, it's 3:00. We have come to the end of Episode One of the Launchpad Seminars. I hope you've all taken something interesting away from this. If you have any questions or comments, please let us know.

We have an evaluation form that we've set up. If we don't get out the link now, we'll just send it to you in the next couple of days. We really appreciate any feedback you've got, and hope that everyone is staying safe and secure in their respective lockdowns.

Thanks again to everyone. Moriba, Victoria, thanks again.

**Moriba:** Booyah, booyah.

**Victoria:** Thank you, everyone. I appreciate your time, and thank you, Daniel.

Transcription by CastingWords