Three Neglected Space Issues:
Laser ASAT's, Cooperation with China and Russia, and Space Secrecy

Workshop Report

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Co-sponsored by the Nonproliferation Policy Education Center and the American Bar Association Standing Committee on Law and National Security

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Workshop Report

Introduction:

The virtual workshop began with the host from the Nonproliferation Policy Education Center (NPEC). He congratulated the winner of the College Debate Space Paper Policy Contest. The winning paper is based on their work involving transcripts from the previous NPEC and American Bar Association (ABA) sponsored space policy event.

Panels 1 and 2 were held on the morning of July 21, 2020, while Panel 3 was held on the morning of July 22, 2020.

The host explained the workshop's three topics. As with rendezvous satellites, dealt with in earlier workshops, ground-based lasers can be used for legitimate civil purposes or as anti-satellite weapons. The question is how might the United States best protect itself militarily and diplomatically against this threat. The second panel tackled the question of excessive secrecy which some argue is muffling America's public diplomacy and hobbling its military space programs. The final panel dealt with U.S. space cooperation with Russia and China. What is the future of such cooperation? Will it afford channels to sort out rules for military space operations or is this ill-advised?

He then introduced the day's discussants and panel one began.

Panel 1: The Ground-Based Laser ASAT Threat

Discussant started by hoping workshop participants had a chance to look at a recent report that was sent out as a read-ahead. In the past year, the Defense Intelligence Agency (DIA) issued a report noting both Russia and China's increasing pace for delivering and fielding ground-based laser ASAT (antisatellite) capabilities. Gen. Raymond, last fall, asserted that the Chinese are developing directed energy weapons, including lasers, and that China plans to use these weapons against us in a conflict. Counterspace capabilities have three overall main objectives or main effects. The least intensive one is disrupting, which includes dazzling. The next most severe is damaging, which includes disabling satellites or blinding sensors. Finally, the most severe is destruction. As to weaponized lasers, there are chemical lasers including hydrogen fluoride and chemical oxygen iodine lasers (i.e. coil lasers). Also, there are solid state lasers, which can be analogous to laser pointers or dental lasers but much, much higher power. There are semiconductor fiber lasers, which can be thought of as lasers that run in a DVD player, but again, much higher power. Also, there are free-electron lasers, which, despite the name, involves exciting electrons rather than atomic excitations. A lot of the ground-based laser concepts are focused on free-electron lasers, although chemical lasers have also been considered.

As to the types of deployment platforms, one of the challenges with laser technology is the power requirement. Moreover, miniaturization of the laser system can make it very difficult to get a sufficiently powerful laser to achieve the effects such as destruction. Thus, as fixed ground-based lasers are stationary, they can have the largest power supply. On the other hand, miniaturization has the advantage of making laser system smaller and mobile. Then, there are ship-based lasers, air-based lasers, or space-based lasers. For the laser weapons, we talk about power, beam stability (or beam coherence), and attenuation. As a laser propagates through the atmosphere, there are scattering and refraction effects, which, depending on weather patterns, can degrade the laser weapon. Beam quality and optics have to be very precise to be effective. On the other hand, adaptive optics is a key technology enabler, specifically to help compensate for that atmosphere distortion. Thus, the level of power and the sharpness of the focus determine the different dwell-time requirements for dazzling, disabling, or destroying. Naturally, higher power and better beam focusing allow for a shorter dwell time to achieve the desired effect.

An advantage for ground-based laser ASAT weapons is that you can attack with differing levels of intensity and have many more escalatory options such as just dazzling for temporary damage. Another advantage is the potential for a near limitless effective magazine as long as you have a secure power source. But, of course, there are also disadvantages associated with

ground-based laser ASAT weapons. You may have difficulty in performing damage assessment. Also, you may be unsure if the weather effects have caused the laser power to degrade too much when the beam propagates through clouds.

The first ASAT test was actually conducted by the U.S. in October of 1959, just two years after Sputnik. A missile with a kinetic kill was used to make the ASAT. For many years after that, kinetic ASAT was really the key approach until defense planners recognized the debris problem and wanted to have more options for escalation control as mentioned earlier. Defense Advanced Research Projects Agency (DARPA) and the U.S. services began researching lasers for satellite tracking as well as for ballistic missile defense applications. In the 1970s, there were reports about the Soviet Terra-3 system, which caused a very serious concern from the intelligence community about Soviet laser and particle beam ASAT technology, particularly for anti-ballistic missiles. This concern arose at about the same time as the Strategic Defense Initiative (SDI).

There were some discussions in the 1980s about potential for a laser gap. In 1989, when a number of U.S. experts went to visit the site in what is now Kazakhstan, the laser there was extremely low power and had small focusing optics. It was about 1000 times less powerful than the U.S. system at that time in the 1980s - the MIRACL laser (Mid-Infrared Advanced Chemical Laser). Ultimately, the team in 1989 assessed that the site was not operational militarily. On the other hand, this perception about the laser gap really catalyzed DOD writ large, and particularly the Air Force and the Navy, to really work on development programs for laser ASAT weapons in the 1980s - MIRACL laser for the Navy and then a low-powered chemical laser as well. The first full scale satellite lethality test that was done at the Army space and missile defense command happened in 1991. However, after that test, it was shelved for a couple of years due to the end of the Cold War and declining defense budgets. But then the program was resumed in 1997 with an exercise that was done in New Mexico, when Secretary of Defense Cohen had signed off at the time.

Interestingly, the laser was able to persist in a target for 1 second at 260 miles from the earth and then had another pulse lasting 10 seconds. While Europe recognized that the U.S. laser did not result in any violation to 1967 and 1972 treaties which covered warfare in space, there was a quote from, for instance, the Brussels newspaper, which was located near NATO headquarters, that “the Americans virtually had the power to blind or destroy satellites in flight and thereby to paralyze armies at war by depriving them of their eyes and ears. A frightening lead. This technological achievement reminds us that Star Wars is not entirely dead.” So again, this is from the European community, much less the Russians or the Chinese.

In 2006, China used a ground-based laser to dazzle an orbiting U.S. satellite which was widely viewed as a test. There was no significant reported damage to the satellites, but it was interesting to know that, in 2006, there was an unclassified Air Force budget submission for Fiscal Year 07. The submission became a little bit controversial during some of the congressional hearings because there was a project for advanced optics and laser space technology, in terms of some catalyzing event for additional research in spring as well. Recently, we began to see a lot more, albeit limited, public discussions about China working very urgently on directed energy weapons, including not just lasers, but also high-power microwave radio frequency railgun and particle beams. Also, some of the Chinese literature is very focused on, or has remarked about, lasers being a potentially ideal ASAT weapon because the effects can be much more hidden, as well as the potential difficulty of attribution.

The moderator asked about how lasers might be used for civilian purposes. The discussant responded that peaceful applications include the traditional use of laser to measure satellite orbits and the growing use of lasers for communications. As to our host's point of it being inadvisable to do any sort of blanket ban of lasers, discussant agreed because lasers are not solely for military applications, a ban would be detrimental to lasers' useful peaceful applications.

The next discussant started discussing where the United States, China, and Russia are on developing their own laser systems. He recommended the Center for Strategic and International Studies (CSIS) annual counterspace threats report, and the DIA's and the National Air and Space Intelligence Center's (NASIC) counterspace threat assessments. Regarding the U.S. and its competitors, the amount of direct information available on purposeful counterspace laser programs is scant, but we at least know that the United States, Russia, and China all have the technical resources necessary to develop high-powered ground-based ASATs if they chose to do so. In the U.S., as his colleague just noted, the United States has a long history of research into high-powered laser systems, but there are no explicit counterspace missions. In the United States, one should keep an eye on missile defense. The Missile Defense Review called for doubling down on research in the laser systems for missile defeat missions. However, that is not a plan to put weapons in space.

China also has a long history of R&D into lasers. DIA estimated that China has several systems in development for counterspace missions. They estimated that a laser weapon capable of dazzling would be fielded in 2020 and, by the mid-to-late 2020s, China may field higher-power laser systems that could damage the structures of low Earth orbiting satellites.

Russia also has long invested in laser R&D. Their leading program today is called Peresvet, and it is a high-powered mobile laser system. It is also part of a family of strategic weapons that Putin has been discussing in his annual state of the nation in the last few years. The system has been operationally deployed since 2019 with mobile intercontinental ballistic missile (ICBM) units and can be used to conceal their movements by dazzling or blinding the optical systems of enemy reconnaissance satellites. It will also be used for counter UAS (Unmanned Aircraft Systems) missions. On the other hand, the Russian government has not made any explicit declaration that the laser system has a counterspace mission. Still, that it is grouped together with Putin's others strategic weapons program suggests that the Russians are trying to at least telegraph that they are nearing these counterspace capabilities.

Of course, there are advantages and disadvantages to fixed, mobile, and airborne laser ASAT systems. A fixed, high-power laser station can interfere with reconnaissance or other imagery satellites that try to take pictures of facilities near the laser. On the other hand, it is more difficult to hide the laser in the battle space, and strike planners can strike the fixed laser station. In contrast, a mobile laser is easier to hide, but has less power. There is also the option of deploying a laser on aircraft. Actually, in the late 2000s, the United States tested a counter-ballistic-missile chemical laser mounted on a 747 aircraft, but that program was eventually cancelled. The Russians revived the Soviet era program to mount a laser on a cargo aircraft. That program is currently active again, but it is not clear if it is a chemical system or a solid state or semiconductor fiber system. It is also unclear if the system will have the capability to just dazzle or also to degrade, disrupt, or destroy satellites. There are certain advantages in placing a laser in an aircraft. At higher altitude, the air is less thick and there is less distance for the laser to travel. As a result, the quality of the beam will be less affected when it reaches the target. On the other hand, the mission is more difficult because the laser is moving and the platform itself is vibrating.

There then was a discussion of the three main categories of lasers -- disrupting or damaging or destroying. These three categories involve drastic differences in technical difficulty, barrier to entry, and limitations for effectiveness. Dazzling is much easier to setup but much more limited in objective that can actually be achieved. It is obviously a big step function from there to actually have any sort of damaging effects, which require much higher power, much better beam concentration, and much longer dwell time. Then, for the true destruction, another significant escalation beyond damage. Similarly, having mobile dazzlers, whether on ground vehicles or ships or airplanes, is much more technically feasible (e.g. lower power), while those destructive lasers would have to be at fixed ground stations, because, again, the power, the beam forming, and the dwell time requirements are so significant and difficult. One

participant noted that when it comes to countering fixed lasers, states would need to decide if they were willing to strike and destroy the site in response to attack.

The workshop then examined space situational awareness (SSA) using radars, telescopes, laser rangefinders, signals, intelligence systems and even reconnaissance in the cyber domain. All of these can be used to assess what is actually up in space, and then, if one is conducting ASAT missions, when target satellites are actually overhead. The SSA mission will be increasingly complicated because the space domain is increasingly congested, particularly in the lower reaches of LEO (low Earth orbit). SpaceX alone has licenses to launch tens of thousands of satellites for Starlink constellation in the next five years, and these satellites are actually going to orbit at altitudes lower than typical LEO satellites. Not only will there be more objects in space, but also there will be more objects in between your laser and what you are trying to shoot at. Next, you need command and control. You need to catalogue what is up in space and engage in deconfliction to make sure that your laser is not striking objects that are either in front of or behind the target that you are trying to hit. Finally, it is post-engagement assessment, from which you may not be sure whether your attack did the thing that you hoped for. For example, even if you have an idea of the materials that the target satellite busses or optical elements are made from, you still would not know exactly how much power is needed to dazzle without damaging it. So, if you are trying to engage in escalation control by doing reversible laser effects, you can never be sure that you did something reversible, instead of actually damaging or disabling the satellite itself.

What countermeasures might there be against ground-based laser ASATs? One could maneuver one's satellite. For example, the satellite images on Google Maps and Google Earth are taken orthogonally. That means the imagery satellite is looking straight down at the target vertically. But you can also move your satellites to take pictures at angles, and this is called oblique imaging. The discussant showed a DigitalGlobe (a company now known at Maxar) picture of Mount Fuji taken at an oblique angle. Typically, the satellite that takes such pictures orbits the earth at 600 kilometers above the surface. This picture was actually taken from an angle down range from about 2,500 kilometers away. If this satellite was directly overhead and the laser tried to hit it, the laser would shoot 600 kilometers straight up. From an oblique angle, the laser would have to shoot 2,500 kilometers to the side, and this would be more difficult for the attacker to do.

One could also use intelligence policy as a countermeasure. There is a practice called TCPED, which is tasking, collection, processing, exploitation, and dissemination. These are basically the ways that you gather information from the battle space and then you figure out how to use it and then get it to people who need it. There are steps you can take to change

your level of reliance on your satellites or on high quality imaging. For example, while the United States can and should continue to rely on its exquisite intelligence satellites, it is currently working on finding ways to rely more on commercial sources. Companies, like Planet Lab, are launching constellations of hundreds of satellites that are capable of imaging the earth multiple times per day. While that might be imagery of lower resolution, the intelligence community could work to develop methodologies and approaches to increase confidence in lower resolution, commercially sourced imagery. It is possible, for example, to utilize lower-resolution imagery for certain kinds of strike planning or strategic indications and warning.

Finally, one could enhance the resilience of one's space architecture. Commercial providers have initiated growth in large proliferated constellations and in reusable and responsive launch capabilities. The United States is building a more resilient space architecture by taking advantage of these commercial developments. The military also needs to demonstrate that it can see, navigate, and communicate in ways that do not rely exclusively on its own resources or on space. Reusable and responsive launches are being developed by companies like SpaceX and Rocket Lab and will be critical to sustainably repopulate the constellation if satellites are damaged or destroyed. It is also important to have satellites in reserve. This will require either adopting commercial-like approaches or contracting out the sorts of mass satellite production techniques being developed in the commercial sector today. We cannot depend exclusively on the years-long processes the military normally engages in to manufacture a single satellite. Instead, it should acquire satellites that are off the shelf and ready to deploy and just attach the sensors and the radios you want, upload the software, get the map, and go to the launchpad.

At this point the discussion returned to how to fight lasers ASATs. One expert referenced the DoD Instruction 3100.11, which is about management of laser illumination of objects in space. The Air Force Research Laboratory Directed Energy Directorate has a Satellite Assessment Center. The center is a key U.S. service organization and evaluates satellite vulnerabilities to different lasers, which is a key piece of data to baseline different challenges and potential issues. For example, people could imagine a quick reaction shield where the shutter would close upon detection of laser illumination to prevent significant lasing dwell time being achieved.

Another way to counter laser threats might be the use of heavily proliferated sensors. Technical advancements have been made with aperture synthesis for distributed sensing, which allows a much bigger network of different satellite operations to work together. If one were to be disrupted or disabled or destroyed from a laser attack, it could be compensated for by this distributed network. This idea is similar to a swarm telescope or a swarm satellite constellation.

Also, there are cyber options, such as cutting the power to the ASAT laser. There are directed energy responses, such as using high-power microwaves against ASAT laser hardware, supporting systems, or other nodes in the killchain. Also, arms control agreements could be reached to limit effective use of laser ASATs. However, even if we could have arms treaty negotiations between the U.S. and Russia, trying to get China to join as part of that negotiation will be very difficult.

Since 2000, there has been a high energy laser joint technology office run out of the Office of the Secretary of Defense (OSD) known as the HEL JTO. It has a high-energy laser masterplan, which has a number of elements not just for ASAT considerations, but other applications as well. Given the drastic differences in difficulty among disrupting, damaging, and destroying satellites, OSD has different concepts of operations (con-ops) and different technologies associated with these con-ops. Most future military conflicts probably will have some element of coalition operations in space as well. Thus, it is important for all parties to understand space assets in a specific region including their windows and conditions of vulnerability and their proportional and non-proportional responses.

Earlier this month, Israel talked about new options to counter drones. The Israeli Ministry of Defense developed an artificial intelligence system that reportedly had a 78% accuracy to target and locate the drone operator. Instead of trying to destroy the drone, this system offers new counters, such as targeting the C2 node and other more exotic responses. Analogously, it might be worth looking at the broader ASAT laser system, especially its C2 nodes for non-proportional responses.

Another question the group discussed was what China's specific objective in developing laser ASATs was and were there any threats Beijing was trying to counter by developing these weapons? One answer offered was that China wanted to blind or disrupt our ability to see and pass information around under different conflict scenarios. Still, China, like Russia and the United States, has no explicit declarations of the intention to destroy space assets. On the other hand, there are all sorts of references and military documents and open source documents coming out of China about the importance of space for national development and the achievement of the China dream. The Chinese also note that the United States is treacherous in engaging all these activities that are endangering the space domain, and that China will take the steps necessary to enhance capacity and to operate safely in space. Otherwise, there is no explicit policy that they plan to disrupt or destroy satellites.

Yet another question that was discussed was whether China was developing these capabilities specifically to counter the United States or was just developing a big military that

has all the bells and whistles. One participant said he had been involved in laser discussions for at least three and a half decades and that China never formally recognized a right of a nation to image other nations. In fact, no such right is laid out in any treaty, but there is long-standing State practice that permits overhead imaging. The Chinese do not have a clear right to image any other nation, nor does the United States.

Thus, it is perfectly acceptable for a country to say that it chooses to go ahead and prevent you from imaging and, if the only way they can prevent you to do that is to dazzle your system, then it will do it. While the difference between dazzling an optical system and damaging a satellite is a huge gulf, the difference between dazzling a focal plane and harming it is a very small, thin line. So, if a country is in the process of trying to dazzle your system to prevent you from imaging but they end up harming you in the process, is that their fault for shooting or your fault for imaging something? The other great question is, if you do not admit that a reconnaissance satellite is in space, might an adversary shoot it with a laser, claiming it was just doing a laser test like a propulsion laser test?

It was noted that, just to complicate things further, there are some people who argue that although you do not have a right to image another nation, but if you were actually a party to New START, you do have an obligation not to interfere with national technical means (NTM). So, life gets even more complicated. One of the panelists agreed. You have to decide whether that national technical means proposition covers you in all situations. Or does that cover you only when you are imaging strategic sites such as the missile bases? But are tactical sites fair game because those are not national technical means?

One of the discussants noted that the overall arc of China's military developments is indicative of their broad intention to be able to counter a U.S. intervention in their region whether that is the South China Sea, the East China Sea, Taiwan etc. It is difficult, as it is with all sorts of dual-use technologies, to know for sure the main purpose of laser development. But it is at least possible to say that the Chinese understand the map and the science and have the R&D base and the academic institutional base to solve these problems. Many of the capabilities that are coming out tactically on the laser front to counter rockets, artillery, mortars, etc., are applicable to the space domain. It is really a question of whether one wants to point it at the sky or they want to point it somewhere else.

One China expert noted that China has not issued formal policy statements on lasers, but we should also recognize that China has issued very few policy statements on almost anything. To answer why the Chinese are developing ASATs, we need to look below the strategic level of what has Chinese foreign minister or Xi Jinping or Hu Jintao said. We need to

look at Chinese doctrinal writings, because this is what they are teaching their own military planners. In this country, unlike the United States, there is no Rand Corporation, CSIS, or alternative "civilian" thinkers and planners who would be called in to consult. Military knowledge is mostly the purview of the military, like 90-95% the purview.

In this context, it is useful to think about Chinese ASAT development along a couple of lines. First is the importance of being able to establish space dominance. The Chinese say it is not only the ability to use space to obtain, move, and exploit information, but to deny an adversary that ability. Space dominance, for them, is about both hard and soft kill and policy and military efforts to prevent an adversary from being able to access space. The Chinese have frequently insisted that no one has a right to image China or spy on it. Western concepts of deterrence, ranging from Schelling to Snyder, focuses on dissuasion. The Chinese concepts of deterrence focus on coercion, which the West does not accept as part of deterrence. While Western military thinkers think that those are two very separate concepts, the Chinese think of them as unified. Why does that matter here? Because, on the attribution issue, the Chinese may actually take this in reverse. What happens if I actually blind a satellite? I am not even trying to hide it: Yes it was my laser system that blinded that satellite.

This goes partly to the question of do you decide to hit a target in a nuclear-armed country because it disabled your satellite? Or do you do other things? The Chinese have written about ladders of deterrence the way we have thought about ladders of escalation. Their ladders are also a means of signaling their adversary. The issue - Taiwan, Hong Kong, South China Sea, Sino-Indian border - is so important that I am willing to take enormous risks to convince you that I am really serious. So, in this regard, attribution is desirable – I am not necessarily trying to hide it, although I might do that.

Why would China develop laser ASATs and things like that? It is because the Chinese think kinetic kill systems are very useful but carry a strategic premium. That is why their use is not banned but their use is not guaranteed. Chinese military authorities say the use of kinetic kill anti-satellite systems is to be made upon the decision of the highest political authority. That is not said about the soft kill, like cyber. The Chinese also do not say this about systems like lasers and other non-kinetic systems. Instead, they are described as not "generating debris" and so the political consequences of their use is, in their assessment, lower than if you lose a satellite completely to bits. Nonetheless, blowing satellites to bits retains a role because, again, going back to the deterrent as coercion aspect, it can signal to your adversary "I am willing to do this thing to show you how seriously I am taking this."

An issue that received particular attention was America's Airborne Based Laser (ABL) program. After Washington invested five billion dollars in that system, it cancelled the program. While it was expensive and potentially not that effective to operate in an anti-ballistic missile mode, would it be highly useful, particularly as laser ASAT against LEO satellites? The laser would never have to leave CONUS in order to perform that ASAT mission. The U.S. is looking into all kinds of other antisatellite capabilities today, and we had a potentially quite effective one sitting around and now in pieces down at Davis-Monthan.

Perhaps, but the cancellation took place around the time of sequestration so there was just lots of stuff on the chopping block at that time, and although the research was useful, it is easier to take out a satellite with a fixed site than it is with an airplane platform. Moreover, since laser research has been focused less on chemical lasers nowadays than it was back then, researchers might not have the interest to resurrect MIRACL, an old chemical laser.

On the other hand, with technological advancements since then in not only the laser technology itself, but in unmanned airborne platforms, air-based lasers deserved revisiting with COCOMS (Combatant Commands). It is an organization that did not exist at the time of cancellation and perhaps the repurposing of those technologies or exotic con-ops are worth exploring.

Another issue discussed had to do with just how vulnerable U.S. and allied military space systems were likely to be to Chinese ASATs. DIA has said that Chinese lasers may be able to cause structural damages to satellites in low Earth orbits by the mid-to-late 2020s. On the other hand, there are defense countermeasures against laser ASATs, but we do not know when they will be ready and deployed. For example, during 2025-2030, we still have to use legacy systems, such as reconnaissance satellites and other high-resolution satellites, whose structures are vulnerable to lasers. How are we going to protect them?

This leads to several questions. How do we protect a specific satellite that we must protect in a specific time period? How is DOD handling the timing issue? It has to meet two deadlines: When the satellite will become vulnerable and when the countermeasure will be ready to protect it. DOD cut out for it to come up with answers and to develop a road map. A basic road map exists, but it could be much more robust.

Panel 2: Does the U.S. Exercise Too Much Secrecy Regarding Space-Related Matters?

One of the discussants led off noting how difficult it is to separate the general topic of secrecy and a classification from a specific domain like space. Secrecy is universally excessive in all domains. It is always easy and accurate to say we have too much secrecy. We also believe in the protection of sources, methods, and tradecraft. The Edward Snowden revelations, though, have changed everyone's perspective on how much transparency is warranted. The most controversial parts of the revelations were the business records and telephone metadata storage program run by NSA governed by Section 215 of the Patriot Act. This is a program that was put in place as a direct result of 9/11 and the accusation that the Intelligence Community really could not connect the dots between communications between the plotters overseas and the plotters in the United States. That is why it was established. But, it was handled as a deep dark cloister which, as things unfolded, had many negative consequences. At the time when the program was established, the conceptual need for the program was publicly explained in writing. The public should not have gotten any more excited about this collection than FBI's files of millions and millions of fingerprints of innocent Americans. When you think about it, fingerprints are a lot more biometrically intrusive than the metadata programs.

After the Snowden revelations, though, a lot of previously classified documentation, particularly obtained in the Foreign Intelligence Surveillance Court, was declassified in the interest of trying to foster and restore public faith and confidence in the Intelligence Community. The lesson learned is that there needs to be more transparency and less secrecy by the Intelligence Community.

One of the discussants recounted his memory of a grizzled Army four star he worked for in the mid-80s. Whenever the four star was contemplating some action or decision, he would ask the staff for the "yebits," the "yes-buts". It, in this case, is public transparency, which certainly is "always a two-edged sword", because adversaries go to school on that very same transparency. For example, he was amazed, in fact stunned, at the technical detail that was included in volume one of the Mueller Report. The American people are entitled to know what the Russians did in preparation and in more evidentiary detail than they provided in the Intel Community's assessment in January 2016. The downside is the Russians and others are certainly going to school on that material and back engineered every revelation there. Thus, it will be a lot harder to detect their interference in the 2020 election.

The same two-edged sword applies to national security related to space. Do we accept becoming more and more transparent about space capabilities and operations? The adversaries can simply exploit that transparency. This is not to say we should not be transparent. As one discussant noted, there is always a tradeoff, particularly with respect to, or at least approving, new foreign intelligence. It is especially true in the case of the adversaries, such as China.

In this regard, one discussant recommended a recent article written by Bob Work, former U.S. Deputy Secretary of Defense, and Dennis Blair, former U.S. Director of National Intelligence. The title is "Stovepipes in space: How the US can overcome bureaucracy to improve capabilities." One discussant said he could not argue with what they said. However, he did not think the situation is quite as stark or as negative as they make it to be. Actually, he thought transparency is better than it used to be. He remembers the time when the very existence of the NRO (National Reconnaissance Office) itself was a deep dark secret.

An aspect of secrecy overlooked by many people is that classified information has a temporal dimension. A piece of intelligence gathered today will potentially have a different value and, thus, a different degree in secrecy potentially tomorrow, next week, next month, next year, next decade. This is especially true in what we now call "GEOINT". Our classification system at large, only crudely recognizes this temporal dimension of secrecy. If we want to reform our system to protect secrets in space or in any other domain, we must, and can, reform our classification system, making declassification more relevant, practical, and time sensitive.

One lesson a discussant learned from his years in government was that what can really impel more transparency and less excessive secrecy is an actual operational mission imperative. This is illustrated by the example of commercial imagery, which has profoundly changed the whole world of geospatial intelligence. After 911, we were under pressure to update mapping data on Afghanistan, which previously had not been on our top priority. But, all of a sudden, it was. Our government exploited available commercial imagery to augment what we could derive from our dedicated satellites to help play catch up. Such commercial imagery has only become more available in the intervening 20 years.

Another takeaway germane to this panel is, unfortunately, the competitive relationship between the National Geospacial Agency as the proponent and procurer of commercial imagery and the NRO's involvement of NTM derived imagery. This competition became progressively more counterproductive and inefficient as time went on. So it made sense for champions for intelligence integration to push moving the responsibility for commercial imagery to the NRO, where they would become advocates of commercial imagery on the NGA's behalf just as they had traditionally been for NTM. By making the NRO responsible, they then have to consider

commercial imagery as part of their overall architecture. Bringing them up to speed on those exotic capabilities only the government can or should do, they would see the real appeal of commercial imagery such as far lower costs. Then, commercial imagery and NTM can complement one another rather than compete. The complementarity would have the effect, given a mission imperative, of broadening and exposing technology both ways. This certainly made the relationship more integrated, more efficient, and less compartmentalized.

The observation here is that functional integration is an effective stimulus for removing some, but certainly not all, of the shrouds of secrecy. Again, the point is, the best impetus for reducing secrecy is actual operational mission imperative. Another aspect of this, with regard to the issue of secrecy in the space domain, is the relationship with foreign partners. There are two categories here:

1. those who are dependent on us and,
2. those who actually have their own capabilities, which are growing.

There are several allies that are gaining more capabilities in space. We should do all we can to exploit those capabilities by being more willing to share both ways.

One discussant offered a modest proposal. It might be appropriate to convene a super group, which has sufficient seniority to look across the board at the whole issue of secrecy in space. The group should represent the principle stakeholders in the government, Space Force, NASA, and the Intelligence Community. It should figure out some mechanism whereby industry could determine what might be done to break down unhelpful secrecy barriers and, conversely, to keep or even resurrect secrecy rules that should not be eliminated.

Another discussant highlighted another secrecy worry. Most people do not realize that much of the intelligence budget that Congress rules on is space-related**.** So, if you are not aware of each program's potential capability and cost, you are not oversighting very well. In one case, he remembers that he and his colleagues were arguing about capability and size of mirrors for this next generation of satellites. However, he could not communicate with certain people in the Department of Defense because there were compartmented classifications on the characteristics of these space systems. The craziest thing is that other nation states and even commercial entities were launching satellites with comparable technology into space. While these satellites were starting to proliferate, Congress could not discuss them even on camera.

When China first launched its anti-satellite missile, it took about three weeks to convince the national security bureaucracy that we needed to have a broader conversation in

Congress to garner support for spending additional money to develop a proper set of responses. One discussant noted we've moved from, "yes we absolutely have to have secrecy, don't tell nothing to nobody, no way no how" to "but, maybe that's probably not efficient" to "you know what, I don't know if we're doing this right."

The Center for the Study of the Presidency & Congress (CSPC) completed a study on how best to integrate commercial space into the national security sector to get to a more efficient and economic use of technology. There are certain things we want to keep not only secret, but top secret, compartmentalized, and that "don't tell no one, know how to, know where." There are pieces that need to remain that way.

But, there is a whole bunch of secrecy that we can either knock down to a lower classification level or eliminate. Again, the best part of deterrence is knowing that you have the capability to stop an adversary doing something. However, sometimes we have hindered ourselves from that deterrence capability by keeping these things bifurcated, compartmentalized, and too highly classified based on an old model of how we looked at space. We have over mystified space. It is a warfighting domain today, and we need to engage in conversations that reflect that, including technologies that we can use and that are currently available in the commercial market to fill in holes in our overhead architecture plans both in LEO and higher orbits.

The discussant noted that as we develop the Space Force, we must protect pieces of technology that allow us certain capabilities. On the other hand, you still need the public engaged in supporting the cause. If you ask most Americans today, they have no idea how at risk we are in space and how space could be used against their ability to get up in the morning and do what they do every day. We need to close that gap if we are going to continue to get support from the American people on the expenditures that we make and the efforts that we are making in space, and why these endeavors are important. We cannot close the gap under the current classification system.

One participant noted that it is absolutely maddening trying to get through the morass of what is and what is not, and to have a conversation from a government official to somebody or a small company who has a unique set of technologies that would benefit the United States and wants to find out where to plug in. It is just near impossible, and we need to fix that. We need to be more open and allow these groups to find their way into the government and share this technology that might be changing in the way that we use to defend ourselves.

During the first part of the question and answer period, three questions were raised. First, what do we need to do to open up the public discussion concerning secrecy? Second, if a Commission was created to review tech classification chaired by the ODNI and DOD together, how could they cut through the bureaucratic morass that exists inside each of their empires? Third, we have the Plain View Doctrine domestically that allows us to see a lot of things that might otherwise be forbidden under the 4th Amendment. Now we have the ability to see things from space, which has put the Plain View Doctrine on steroids. How should we balance the rights to privacy and reasonable search against the growing availability of imagery? Also, the Foreign Intelligence Surveillance Act in court is under reform at the moment, and some parts have not been "re-upped." What should our intelligence community be authorized to collect?

One discussant noted that he had used the Plain View Doctrine in his previous career. The amendment has solid basis in law and protects constitutional rights. On the other hand, if you are in your own backyard doing something that you probably should not be doing, do you have the right and expectation for privacy to disallow a satellite to take a picture of what you are doing? It depends on the resolution. If that is a general fuzzy picture, discussant 4 thinks that the law should allow one to take a picture. If the camera can read the name on the baseball cap, that is a different story. In any case, he would argue there is probably going to be the redrawing of lines in the legal community about what that would allow.

Another discussant noted with specific respect to space that a super group should be composed of people in a senior and up position from the IC (Intelligence Community), NASA, and Department of Defense to identify which space-related technologies needs to be protected and which need to be segmented and compartmented or not. He noted that the stand-up of the Space Force may create an appropriate juncture to look at space secrecy. People in the Intelligence Community need to be super conservative about protecting certain space technologies. When technologies, intelligence capabilities, intelligence sources, and methods are exposed, we are forced to reconstitute. That is why there is a natural proclivity is to be protective. As Bob Work and Dennis Blair acknowledge in their article, if this had been easy to do, it would have been done a long time ago.

Another discussant noted that when there are leaks involving sources and methods it is very disruptive. The country incurs such losses, because somebody else decided, outside of all the checks and balances to prevent the leaks, that they were offended by what they thought was happening. What we found out is that people, who had disclosed these things, thought there was something going on and came to find out was not. Actually, there are lots of checks and balances in the classification system. If you have something that you do not like, there are ways for you to go to someone to have those conversations. In the Snowden case, none of the

checks and balances, including contacting the House Intelligence Committee, were used. Snowden just decided on his own, and same with the Manning case. They did not find the need to submit their grievance through any proper channel, but just decided they had the right to make those revelations. We have to fix this problem. When we lose bits of technology even if it is for that 2 to 7-year window, that can still be harmful to us because there might be some technologies we need to keep secret for 2 to 7 years. Let us use parabolic mics again as an example. There was probably pretty good reason they needed that technology quiet and classified at the time. Over time, when that need went away, everybody can use such mics for any purpose. We are going to have really unique sets of capabilities that must be protected. That is an important way in keeping the technological edge in the intelligence business.

Yet another discussant noted that if reform is left with just the ODNI and DOD, little will be done. There are whole programs built around the idea that "this is mine;" "nobody can talk about it;" "you do not really know what I do and, therefore, I can do this forever." If you create a Commission, you are going to have a working group that actually works through every single issue, hurdle, classification on what is coming next. If you try to do this piecemeal by sitting around the table, we will have this same conversation five years from now. It won't work, because there are lots of big personalities. Whether a Commission or not, any reform effort must have both White House and Congressional stamps on it. The Commission will get what it needs and will come with recommendations. It would be acceptable if they are classified up front so as to be able to work through the differences on those recommendations. Moreover, if we are going to keep the public with us, we have to have some level of transparency and, if we are going to keep the private sector engaged in helping us solve this problem, we have to find ways for them to get into this equation.

The panel had a vigorous question and answer period. One panelist commented that, if we look back at the many gaps we have had over the years — the bomber gap, the missile gap, and the BMD (ballistic missile defense) gap — they arose because of government secrecy, and nobody on the outside knew what was going on. He emphasized that people on the inside also did not know what was going on. The United States has repeatedly made major deployments of strategic forces without understanding where these deployments might take us. For all of its promotion of limited nuclear war doctrines and avant-garde nuclear strategies, the U.S. had essentially zero capability to do those things. These problems occurred because so much information necessary to weigh these decisions were wrapped in secrecy. Thus, secrecy is more than just like an open debate in a democracy. The broader point is to prevent the government going down the road that itself does not understand, and if that happens here, it could happen in China and Russia as well.

Yet another discussant noted that excessive compartmentalization risks making duplicative investments in similar classified programs. Such duplication is particularly problematic, as we enter a period of more constrained resources. Over the next decade or so, every dollar in the defense budget counts even more so than it now does. Instead of devoting those limited resources and having excessive duplication, those resources should be used to make multiple bets, especially for some of the more exotic technologies, to really see which ones might pan out. Another challenge associated with some of the very challenging problems is that excessive secrecy limits the pool of innovative ideas that can really be brought to bear. Despite all of our great technical talent in the service labs and with some contractors, new ideas are still limited.

Another role secrecy plays is in the world of private equity investing in defense. One participant noted that investors use the number of top-secret or higher clearances the employees have to value companies because clearances are needed to secure government contracts. This counting has nothing whatsoever to do with protecting national security and is really a way to create a barrier to entry to newcomers. Also, once a company gets the contract with a three-letter agency, you cannot learn what it is about because you cannot get the clearances to know what is going on. Without such information, it would be difficult to write a proposal with a better system. What the private equity groups in the Washington area are trying to do is to bring some of the companies that they are investing in into this highly compartmented defense sector, which is full of top secret and SCI (Sensitive Compartmented Information) clearances. You do not even know what technologies these companies are using, so you do not know how to beat them. Thus, a private equity firm would value a company by the number of top secret or SCI clearances, without which you do not even have a rough shot. This is slowing down innovation. In the private sector, companies will not protect their suppliers nearly as much if somebody comes up with a better idea. But, in the military sector, the military and civilians are really paranoid about violating secrecy, so there is a disincentive to open up the competition.

In space, government officials publicly talk about threats, but rarely talk about solutions to counter these threats. That we do not hear solutions is because those with clearances and in the know are usually just silent. So, when the government is silent, we really do not know whether they still are trying to figure out a solution or they want to keep an effective solution secret. This ambiguity makes the public worry about these threats and prevents the innovative experts without clearances to contribute to the solutions. So, the question was raised if anyone had seen cases in which secrecy was used to hide that the government did not know how to handle a specific threat or if they lacked a solution or policy to manage it? The answers from the most senior and experienced participants were that, absolutely, they had seen such cases.

Others, however, asked if the public should know about the possible technical solutions. In panel 1, the working group talked about the ground-based laser threat to satellite sensors, the laser threat to satellite structures, and the rendezvous threat. The government does not tell the public the solution to counter any of these threats. One retired intelligence official noted that military and technical solutions to a weapon system is often not the purview of intelligence. The intelligence mindset is to let us in on as much foreign intelligence on a foreign weapon system as possible. For an ASAT system, the intelligence community is not necessarily involved directly in making decisions about how to respond to that threat. That response or solution is the purview of the operation community.

Let us presume that the U.S. has created a way to defend its imaging satellites against lasers. Let us just say that the defense scheme works well to protect both commercial and military satellites serving as national technical means. Would we want an adversary to know that we had done that, or would we love them to waste their time trying to develop such ineffective ASATs? One participant said it would be the latter, not the former. So, you really do not want a public discussion about what is going on. One of the great things about having a representative democracy is that folks like congressmen, get to hear responses that the DOD brings forward in a classified venue. These conversations happen all the time in government. We do not go ahead and keep secrets from our Congress and the whole purpose of that is so that we can actually have a quote "public debate" but not in the public in ways that would compromise our security. The House and Senate intelligence committees have to be surrogates or representatives for the American public, and for that matter, the rest of Congress. It is not like the Department of Agriculture, Department of Commerce, Department of the Interior, where virtually everything they do is open and transparent. It cannot be that way with intelligence. That is why the two Congressional intelligence committees are so important and why they are only effective when they're bipartisan.

Think about our nuclear weapons program. Everybody knows we have a program. Everybody knows that it is not in great shape. We talk about the number of missiles we have; that cat is well out of the bag. Still, we do not tell people how we build them. We do not tell people what their internal capacity is. We do not tell them how we shape uranium to put it on the head of a missile system. Those are highly classified events. We have to have that element of secrecy. While we know we can defeat an adversary's anti-system, we are not going to tell you how we do it. That is a really important difference in having a public discussion about a certain capability without disclosing the technical advances that we might make in making it happen.

Another participant noted that it would be important to figure out how to have the debate about our military space vulnerabilities and capabilities a bit more like the public debates we have about nuclear strategic matters and missile defense. Does anybody here think that our deterrence is actually as robust for space as it is for nuclear things? This could be accomplished without creating any space commission.

An experienced Congressional player noted that classified hearings can help move policy debates within the government. These hearings are not the most exciting work all the time, but they are truly important to raise the difficult questions our government must tackle. When an adversary's technology advances, do we know what his intentions are? Are our counter measures where we need them to be? Is there something that we need to be doing differently? All of this is fair game in a classified session in Congress. For the worldwide public, the worldwide threat briefings are really important because we need to show the public what threats we face. At these hearings, public concerns are aired and the intelligence community and Congress engage in these discussions. The Armed Services Committee have public hearings to discuss nuclear readiness and its command and control. They also have lots of classified meetings. Both public and classified meetings are important.

Also, sometimes you want intentionally to reveal capability to an adversary, and the committee would have to make that policy call. However, current mechanisms do not lend themselves to a rational systematic approach doing this. One participant who was experienced in Congressional affairs noted that in the past there had been true bipartisanship on some of these issues, and a focus on what was an appropriate way to go forward for the nation. We could have that again, he noted, although we are in a rough patch currently. This will be essential as we decide what information about space should be revealed.

Panel 3: What Should U.S. Space Cooperation with China and Russia Be?

The Artemis Accords were developed with an eye toward cooperating with all nations in lunar exploration, including China and Russia. NASA is proceeding with the Artemis Program with the goal of putting the first woman and the next man on the moon by 2024, which will kick off the new era for humanity of sustainable, long-term, permanent operations on the moon in preparation for future human missions to Mars. The Intergovernmental Agreement (IGA) is the legal framework that governs and supports the International Space Station (ISS). NASA also found IGA provisions very applicable for another space station or gateway, which will be an orbiting outpost around the moon. The ISS is a multilateral structure with a lot of countries working together to keep a space station going. However, as we look at bilateral activities enacted by NASA with international partners, or operations like lunar rovers or ISRU (In situ resource utilization) or lunar orbiters or anything similar in space, or even going on Mars, we need a new legal framework to support dynamic opportunities that the Artemis Program is going to open up, and we cannot continue to use the IGA which was set up for space stations to do so. And that is where the Artemis Accords come in.

The Accords fundamentally are agreements to support bilateral partnerships to enact activities underneath the Artemis Program. NASA wants to ensure that the countries that participate in Artemis agree to a series of principles to create a safe, peaceful, and prosperous future in space. We want to establish these principles, not only for the U.S. and the Artemis partner countries, but for other countries that are unlikely to be a part of the Artemis Accords, such as China and Russia. The Artemis Accords principles are grounded in the OST (Outer Space Treaty), although there are a couple of areas relative to common practices that are not clearly in the treaty. There are other principles where we are really implementing the requirements, goals, or objectives of the treaty. The very core of what NASA is trying to do with the Artemis Accords is to avoid conflict. The peaceful purpose is a very important part of the Accords, just like the OST. Everything that comes afterwards in the Accords - transparency, interoperability, orbital debris, space resources - is designed to prevent conflict, which is particularly important as we look at what is occurring with China and Russia. Even now, as we look at the launches to Mars, we have got three spacecrafts going to Mars today. We expect to be even busier on the moon.

The talk, then, turned to the registration of space objects, which is required under the OST. If we do not register, we cannot have transparency, cannot assign liability properly, and cannot avoid harmful interference. Regarding the release of space scientific data, this is not

required by the OST, but it is very much in the spirit of the treaty. NASA releases all of its data publicly, but China does not. On transparency, if you are going to be responsible out there in space, your plans, operations, and what your agency does, need to be transparent. On interoperability, it is important not only for people to be able to talk to each other in space, but for systems, spacecrafts, space suits, to be as interoperable as possible. On emergency assistance, the Artemis Accords are reinforcing and reaffirming what the United States has agreed to in other multilateral treaties, including the agreement of the rescue of astronauts.

Regarding the protection of heritage sites, the United States needs to protect them on the moon and Mars. There needs to be a multilateral conversation on this issue. This is an area we can engage productively with China and Russia on at international forums such as COPUOS (The Committee on the Peaceful Uses of Outer Space). At the same time, the United States wants to ensure that all states may extract and utilize resources on other planets, moons, and asteroids in space. We are asking our partner countries to agree to this simple principle and believe it is well established by the OST.

Deconflicting harmful activities in space is another desirable objective and obligation under the OST. The way to do that is by establishing safety zones, which is the area where you would be conducting an activity within which you might create harmful interference with another activity. So, all that we are requiring within that zone is notification, again, an aspect of transparency where you have to tell the United Nations and publicly where you are and what you are doing. Also, you agree to cooperate to avoid harmful interference. There is the consultation process required by the OST.

If China or Russia were to enter a safety zone, they would have the same obligations under the OST as we would to avoid harmful interference. The only way to accomplish that is through notification and coordination. So that is what we are trying to do with deconfliction of activities. To be clear, safety zones are not to be confused with exclusionary zones. We are not preventing free access, but we are just trying to implement the obligation in the OST to prevent harmful interference. Hopefully, this will set a modest precedent to reassure the private sector that you can count on the OST to prevent interference.

In all of this, we want to provide some teeth to the OST because it lacks an enforcement mechanism. A great deal of the Accords is reinforcing aspects of the OST, with the exception of a few, such as the public release of scientific data or implementing the avoidance of harmful interference via the safety zone.

Would the U.S. treat Russia's lunar landing sites as heritage if they sorted them as such? Perhaps, modern missions could also use heritage plans as a way to prevent access to sites. It is essential to ensure not only heritage sites, but also safety zones, are not abused. The State Department is currently seized with this task. We want to protect robotic sites on a heritage basis so that there would not be any harmful interference. However, if it was being enforced in such an unreasonable way like the keep out zone (in the South China Sea) that China, as well as Russia, want, that would impinge upon our activities and we would not accept that. It is important to conduct the negotiation bilaterally. Then, we will just need to decide with our partner what is proper relative to these principles and then take it on a case by case basis. This type of bilateral give and take may inform future multilateral discussions, and eventually, international framework.

This last point prompted consideration of a set of legal questions. How do we define protection? How do we define safety zones? One answer is with the Accords that lay out basic principles. They may not get into details (e.g., is a safe distance 50 feet or 100 feet), nor can you set these in stone as there are a wide variety of operations. Some may be on the surface of the moon; some may not. So, the safety zone for an operation will be very different depending upon the geography. Also, the specific activity of a rover or an ISRU will have very different safety zone than the landing of a spacecraft of some sort. So, in the Accords, you want to set the principle at a high level to get notification coordination and avoid harmful interference. But that will have to be altered on a case-by-case basis. We will implement on a bilateral basis in accordance with the principle and tailor the safety zone to the particular activity.

One member of the workshop asked about a July 2011 document that aimed to protect lunar sites that have instruments we have left on the moon and how that might work. One expert replied that, at a high level, all parties would respect heritage sites. Then, as they move forward with activities nearby, the parties would agree to details about how to show this respect on a case-by-case basis. This matter received an interagency review via a Circular 175 Procedure to ensure the proper exercise of the treaty-making power. The consensus was to go high level related to heritage. If we are looking at activities that really were historic, that is one thing. If it is just an instrument that does not necessarily have that much value, obviously we would probably go in a different direction. The moon is large, we could conduct most activities without running afoul of the heritage site concepts. But again, that depends on people not abusing it. When a heritage site is violated, the teeth is the triggering of consultation process in Article IX of the OST. So far, China has responded with a neutral to positive comment that they need to engage and discuss these kinds of global space governance issues. On the other hand, it is hard to say what Russia thinks of the Accords.

The working group then went a bit deeper to review the history of Chinese space cooperation. The first period goes back to the 1950s and highlighted Qian Xuesen's return to China and his vital contribution to Chinese space and rocketry programs including its first ballistic missile, satellite and anti-ship missile system. The second period began in the mid-1990s and the investigation of a Hughes Apstar satellite explosion, shortly after a failed Long March launch, which uncovered documented instances of technology transfer, which likely contributed to the improvement of China's rocket technology. The third period started in 2003, when China launched their first astronaut. This was a milestone that only two other great powers had achieved — the USSR and the U.S.

Central to this effort was the development of the human-rated launch vehicle and the Shenzhou capsule. Setting somewhat of a precedent for contemporary cooperation efforts, cooperation was agreed to at the presidential level at a summit between George W. Bush and Hu Jintao in 2006. Space programs are often considered the crown jewel of the nation, and so they are afforded very high priority in the administration. Then NASA administrator, Michael Griffin, traveled to Beijing for a bilateral summit with the China national space administration that included tours of scientific facilities, but notably not human space flight facilities, because these are actually governed under a different authority. There are two teams that were formed to focus on earth science and space science, and they exchanged low-level data and non-sensitive data related to space geodesy, atmospheric measurements, and lunar science data.

Any progress that would be made basically evaporated in January 2007 with the launch of China's ground-based ASAT test, which sparked a global outcry and effectively froze any cooperation for a full year. It was both a technological achievement for China, but also as destabilizing event worldwide as it created a massive cloud of space debris. Working group cooperation resumed in mid-2008 culminating in another joint statement by then President Obama and Hu Jintao that instructed their respective space programs to conduct reciprocal visits in the space flight facilities. Then NASA administrator, Charles Bolden Jr., visited space facilities in Beijing and the Jiuquan space launch center in the Gobi Desert in October 2010.

Shortly thereafter, appropriations legislation was passed that barred bilateral cooperation between NASA and Chinese officials so that subsequent visits never occurred. Congressman Wolf explained his rationale for the amendment as wanting to send a really strong message regarding the decline of human rights protections in China. The differences in norms of behavior has become quite clear, particularly since the mid-2000s, when both China's capabilities and tensions became stronger. There has always been somewhat of a lack of trust between the militaries and a lack of transparency.

This raised a question about Article IX in OST for the Artemis Accords. The U.S. has focused on Article IX in anticipation of lunar operations. Yet, Article IX was not utilized for the 2007 ASAT test that really changed the landscape (in this case, massive creation of space debris). To what extent did the 2007 Chinese ASAT test damage the strength of the consultation provisions in Article IX? Should states talk separately about issues pertaining to Earth orbits and those for lunar operations? Can the consultation provisions still be strongly implemented for lunar operations, even if we have missed an opportunity for operations in closer orbit, low earth orbit? Is there an opportunity to more generally rehabilitate the Article IX consultation provisions?

One participant noted that we should have leveraged consultation during the ASAT test but argued that we can rehabilitate the use of consultations by implementing the OST in a more operationalized fashion as we move forward to the moon. The ASAT case was a missed opportunity. But there is a second chance to make that consultation process work, as we are in a new era with a different context on the lunar surface or elsewhere in cislunar space.

That being said, consultation is inherently a weak tea. We could move forward with something a little more firm such as adding more details to the principles of both the OST and the Artemis Accords. To repeat, the principles that Washington laid out in the Artemis Accords are intended to spur and act as a catalyst for more detailed multilateral global rules that would hopefully add more meat to the skeleton of what we have today. Ultimately, if these rules are widely shared and that there actually exist shared norms of behavior, then there should be penalties associated with not engaging consultation. On the other hand, if there is no penalty to not engage in consultation, then nations mostly would choose not to share that norm of behavior.

Should America's diplomatic strategy start by using Article IX to resolve lunar conflicts? In some cases, a lot of NASA's scientific data is already freely and openly available. So, it is not that difficult for us to provide cooperation regarding operations on the moon. Military cooperation is a much more difficult area. One might ask China to join the START extension in order to prohibit the interference with the national technical means including many satellites. The other military agreement, recognizing the importance of registration, would be to register mobile ground-based laser stations. If China and Russia agree to either or both proposals, that is a win for us. If they do not agree, Washington would still win because, even though this would be disappointing, our allies and partners would understand and support us in seeking military alternatives to deal with Russian and Chinese noncooperation.

One workshop participant noted that while the Artemis Accords principles are couched in their applications to civil space, all of them would be beneficial for dealing with military issues as well. The registration of space objects, for example, could be promulgated as part of the civil effort, but would augment commercial space situational awareness data and make destabilizing "accidental" military space conjunctions less likely.

All of this recommends reaching out and saying what others, even China or Russia, should do. It is so important for us to lead by example and embrace our values in terms of who we are. Show the world what a responsible space actor is, both relative to national security and relative to civil space. In the end, we have to hope that others will then fall in line. At least we will have established a precedent and credibility. It is the right thing to do, and so long as we are not naive about what we may see on the other side, there is great benefit to leading by example. Meanwhile, we should be exploring a bilateral set of relationships and agreements to help shape space with like-minded countries, then create a stronger sort of legal norm.

One workshop participant knowledgeable about China agreed with all that was said but pointed out that we have a problem, because China's principles are quite different from ours. China comes from a different culture in which there is a total lack of the rule of law. In 5000 years, China never developed an independent judiciary. The judiciary itself, even in the Imperial age, was a direct subordination to the emperor and the Imperial household. So, the Chinese do not have rule of law. Instead, the law exists as one of several instruments used to achieve what has been previously ordained. When we look at the rule of law, we seek to apply the laws equally. That simply is not the view of the Chinese.

Nor does China view transparency the way we do. The Chinese say if they have a knife and we have a gun, transparency does them no favors. China does not see transparency or crisis stability in the same way we do. Our knowledge and thinking about foreign policy are shaped by our European heritage. We talk about the prisoner's dilemma. Yet, it is not at all clear that China has really developed a concept of prisoner's dilemma, security dilemma, or that China integrates it into every undergraduate international relations course the way it is in the U.S. This has implications for the desirability of transparency, the utility of transparency, and crisis stability. In starkest terms, the idea that the U.S. or the Soviet Union would send 500 or 1000 troops 20 miles across the border into East or West Germany in the middle of the Cold War is inconceivable, whereas, the Chinese sent troops across the border into India, a nuclear armed neighbor. We are not talking under Mao but are talking about what happened within the last few months. That is a fundamentally different view of crisis stability. So, these are issues of principles. This same participant was also sure the U.S. or its allies could not succeed in cooperating on intellectual property rights with China given its disrespect of such rights.

The People's Liberation Army's (PLA) role in the Chinese space program is massive. Every launch facility is a PLA base. The space program is part of the PLA strategic support force. There is extensive cooperation between Russia and China, mostly to stymie us. So, if there are things we want to cooperate on with one or the other, we better make sure that what we cooperate on with one does not wind up in the hands of the other. With regard to China's approach to get intellectual property (IP), how many of you here would be comfortable basically installing a Chinese app knowingly onto your computer? How many of you would be comfortable using the internet in China when you are there negotiating, to check on your bank account or even your social media? Finally, perhaps most importantly in the practicalities issue, is the lack of knowledge of China's organization of its space program. While we know the blocks in the line and plot chart, we do not have a very good sense of the lines. How are things organized? Who reports to who? Where are the lines of authority? In the simplest terms, we do not even know what China's space budget looks like. Even the top line, we have guesses but we have never seen a number from the Chinese and, frankly, we don't have one about China's space budget from our own side.

Finally, when we look at China's behavior internationally with regards to other treaties, we should not be reassured. The idea of using safety zones as a way of asserting sovereignty, is it not that what we are seeing in the South China Sea? It is trying to, first of all, build artificial islands on top of reefs. Then turn around and say this is now a permanent feature. It gets not only a 12 nautical mile territorial sea, but a 200 nautical mile exclusive economic zone. Then we see how the Chinese behaved towards U.S. minesweepers in the face of a hurricane. International norms are that, in the face of a natural disaster or event, ships are allowed safe harbor in a noncombatant situation. Two U.S. minesweepers were facing a major hurricane near Hong Kong back in 2009, and the Chinese, because at that point we and the Chinese were once again in a trough in relation, basically said no you may not enter, contravening most norms.

Finally, specifically on space, there has already been mention of the Long March 5 problem, where the engines went into low earth orbit. Then, it came down and the Chinese did not warn anyone. There is pretty good evidence that they crashed in Cote d'Ivoire. But prior to that, the Chinese assured everyone that Tiangong-1, the Chinese space lab, was under control and they knew exactly what was going to happen. They were going to de-orbit this lab.They did not warn other people, which was a violation of the current norms. This raises real questions about how far cooperation is going to go. When we said well maybe we can lead China to a better path. That comes across as hubris at best - that a 250-year-old civilization is going to

teach a 5000-year-old civilization. The idea of leading China belies the reality that China may choose not to follow many of those principles as well as practicalities.

So, while there are the dragon lovers and the dragon slayers, it's unclear if we use space to tame the dragon, to get China to pursue a more international model. Can we be more like foxes or are we confronting a hedgehog who will not respond to foxlike initiatives in space? A typical fox approach might be to use commercial contracts to secure the release of scientific data or prospecting data. Might such an approach work with China?

The Chinese are pursuing commercial ventures. Their commercial ventures include state-owned enterprises that are hiving off normally commercial subsidiaries. Space launches, such as the recent launch failure with Kuaizhou-11, are still bankrolled by the state-owned enterprises.. The Chinese are also fostering satellite internet access. The Chinese clearly go after Western technologies. There is no reason to think space ventures are different. They are likely to use their own commercial companies to foster partnerships with Western firms to get the intellectual property they need.

There might be a path where we could use a commercial Chinese entity to get the release of scientific data. However, the onus should not be on us to do so. Moreover, even if we could go that route, it is important for the government to adopt that principle and produce publicly available scientific data. If China is not willing to embrace that, we could get the data via a work around of some sort. But then, we really have not dealt with the fundamental issue relative to the Chinese not respecting that principle. That is to say, we are addressing the symptom but not the cause.

Relative to taming the dragon, we need to lean into our principles as Americans and show the world what good looks like. We should try and rally as many nations to our cause and our paradigm as possible and isolate nations that do not follow those principles. Then, we hope that everyone would join with us. We crafted the Artemis Accords in such a fashion that, if China acts responsibly, there should not be anything here that they disagree with. However, China's reactions should not change what we need to do. Again, we continue to lead by example and embrace who we are. Then, whatever will happen will happen.

If we look back in the 1990s and 2000s, the idea behind embracing China was to integrate them into the world system so that they would adopt more western ideals and western norms. For example, in December 2001, China joined the WTO (World Trade Organization) and its most favored nation status was made permanent. They were integrated in the world system technically. But rather than the world system changing them, they end up

changing the world system and actually dramatically changing the global supply chain and causing a lot of other effects. Thus, there is a little bit of hubris to say, 'let them see how great the western institutions are and they will completely change their style of government.' That did not happen. In fact, they are changing some of those systems to a more illiberal bent, and we have to be cognizant of that.

Take Hollywood as another example. We could argue exporting our movies to China would help them learn our culture. Yet, our filmmakers are now so dependent on the Chinese box office that Hollywood is now censoring itself in order to get films over into the Chinese market. So, our practices to change China often backfire on us in many ways.

At this point, the working group focused on the role arms control negotiation might play in reducing military threats from China. One participant remarked that there are two rather dour views of how arms control played out with the Soviets. First, the fall of the Berlin Wall and the collapse of the Soviet Union were caused by a severe form of military competition, Strategic Defense Initiative. Arms control agreements did not bring the fall of Moscow as much as military competition. Second, ultimately the most interesting nuclear reductions came with the INF (Intermediate-Range Nuclear Forces) treaty. This treaty, however, came as a direct result of Pershing II and GLCM (ground launched cruise missile) deployments and our intelligence community acquiring sensitive targeting information. It was hardly the result of merely reasoning together with Russia. It also helped that military science progressed to such an extent that reliance on large indiscriminate yield nuclear weapons did not seem to be militarily all that attractive. So, getting rid of these things was more the result of military science than any standalone diplomacy.

Currently, the only space arms control proposal is from China and Russia. They are suggesting no weapons in space, but, with the emerging dual-use robotic spacecraft, that is impossible. Still, their impractical proposal garners them support in the United Nations. Since the U.S. has no alternative proposal, we now have the reputation of a naysayer. So, how do we tame the dragon (China) as we had been discussing?

One possibility would be to have an agreement about safe distances for space craft operations among the Western alliance. Then we tell China and Russia that, if you want to participate in the U.S. and the Western space business, you have to follow our rules, including zones. This is hardly our current approach. Instead, China and Russia have a very small share of the space business compared with that of the West, yet they have a disproportionally strong voice and support in the international space community. Meanwhile, voting on important

United Nations space resolutions, the U.S. often votes no with the support of only a few other countries. Nearly every one of our allies and partners abstains.

The strengths of the U.S. and the West include free and open access to data and science and our role as a center for global science. While we may not be able to compete with China's state capital corporations, we do have companies like SpaceX, which are doing a pretty good job. Companies should be allowed to pursue market opportunities and state support should be available when needed, but not at the level of China. Our universities draw the world's talent to our doors, and we have to preserve strong academia, from which we gain a lot more than educating students for other countries. The U.S. space program, which we are carrying forward, has a global message of hope and inspiration that space is for all, and we invite people into our program, and we extend it very broadly. On the other hand, some of these other players are not doing that as effectively and, in fact, their message is not hope and inspiration, it is the opposite.

We should not be ceding the United Nations to China or to any other country because it is a platform for influence like any other. China has a dozen people working in the office for Simonetta Di Pippo at United Nations Committee on the Peaceful Uses of Outer Space and UNOOSA, and we do not have any. If you go to the UN mission in Vienna where COPUOS is located, the first thing you see is a model of a Long March when you are walking into that door. In contrast, we are still fighting for funding to get some of our own models in. Instead of ceding, we should build that coalition and then go to the UN and other multilateral forums to push our principles forward. We may or may not succeed in taming the dragon, but at least we can proceed in a way that we can be proud of. The key to dealing with China is by embracing what makes America great in terms of diversity, the respect for law, and that the freedom that we represent will ultimately win one day.