



India's ASAT Test: A Jolt to Stability

Speakers

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Panelists:

- **Bob Hall**, Director, Commercial Space Operations Center, AGI
- **Ankit Panda**, Adjunct Senior Fellow in Defense Posture Project, Federation of American Scientists
- **Victoria Samson**, Washington Office Director, Secure World Foundation

Brian Weeden: Good afternoon, everyone. Thank you all for coming. I look forward to a very good discussion this afternoon about India's anti-satellite test.

As we all know, back at the end of March, India successfully tested an anti-satellite against one of its satellites, becoming the fourth country to demonstrate the ability to deliberately destroy a satellite. With this intercept, Prime Minister Modi held it as a major step for Indian security and proof that India had become a space power, in his words.

While reaction from most of the governments has been relatively muted, there has been concerns raised by civil society and the commercial space world about the test and about some of the impacts it has both on the space environment and to international norms of behavior in space more broadly.

Though, the topic of this afternoon's discussion is to talk about the test and what it means in the context of space security and stability and sustainability. Talk about whether or not there actually has been a precedent established that this is a responsible thing to do, how it will impact both regional security, as well as broader geopolitical issues. Is it an impact on other space actors?

With us here today to discuss this is a panel of experts, talking about different aspects of this. On the end of the table there, we have Dr. Bob Hall.

He's with Analytical Graphics Incorporated and serves as the Director of the Commercial Space Operations Center, where he oversees day-to-day operations of the ComSpOC, including sensor management and [indecipherable 00:01:55] processing. Bob has a background in systems engineering and project management of AGI's satellite toolkit software suite.

Sitting next to me is Ankit Panda. He's the senior editor and a journalist at The Diplomat and also a adjunct senior fellow in the Defense Posture Project at the Federation of American Scientists, where he focuses on international security, defense, geopolitics and economics.

Most recently, he has had some excellent coverage of South and East Asian missile and space security activities, covering activities in China and India and other areas in the region.

Finally, in between them is Victoria Samson. She's the Washington Office Director here at Secure World Foundation.

She's got 20 years of experience working on space and national security issues, with a particular focus on missile defense, nuclear arms control, and space security, and most recently has been traveling the world to different places talking with people about the reactions to Indian ASAT test and what it means. Hopefully, a little bit broader perspective on that.

The format for today, we've asked each of them to prepare a few minutes of open remarks, and then we're going to open it up to a Q&A discussion after that.

Also remind that today's event is on the record. It's being recorded and will be posted to website after the event.

Without any further ado, I think we'll start with Bob. From your technical background and what you'd be seeing through the data collected by the ComSpOC, I was wondering if you could talk about the dynamics to testing and what impact it had on the space environment.

Dr. Bob Hall: Thank you, Brian. Hopefully, what I prepared here is going to address just that. I am going to try and stick to technical facts about the space environment. I think from a policy perspective, I think the rest of the table has it well-covered. I will attempt to steer clear of policy comments.

I think I'd wrangle 10 to 15 minutes, but I am going to still have to speak fast. I apologies for that. We know by now that this test happened March 27th. India announced at that day, we were able to pretty quickly reconstruct it via things like a NOTAM where they publish a notice to airmen.

Very quickly, you can drill down through what ASATs are trying to orbit, owned by India and what flew that range that time, fast forward to later on, the 18th Space Control Squadron, formerly the JSpOC, has said that there are hundreds of pieces that they're now tracking as a result of this. As of Friday, there are 94 pieces that had been added to the public catalog.

That is a fraction of the debris that has been generated, but that just gives you a sense of the number of objects at -- I was going to say JSpOC -- the 18th is tracking.

Very quickly, there's example of the NOTAM, which is you can find it on the Web. In this case, TS Kelso, who you probably know, was very good at this. He was on it right away and dug that up.

Like I said, when you see that, now is your focus very quickly.

This is a representative scenario where we see Microsat flying north and the ASAT was launch in southerly direction. This was done in the day or two after the event using...We have debris modeling and simulation tools, fragmentation modeling analysis that have been validated that we use.

Based on the mass of the objects and engagement, our tools tell us that they were over 6,000 pieces greater than one centimeter were generated.

That's what you see here, all these red dots. I'm going to abbreviate this because we'll see this again in a minute or two. A week or so later, it was the first time that the 18th released any data. They first published 58 pieces, and one of the things we always do see is we cross correlate.

If you can see here, the plane of the red lines, they're not all exactly coplanar, but they come together in a pinch point at the time that they originated from. You see that the pinch point is here, and sideways is here. They corroborate the analysis that this was the time, this was the place that all these debris pieces came from.

Since then, they've published another 30 odd pieces. Since then, it's like India went into the press tour. They put out a whole YouTube video saying, "Look at me. Look what we did." It was a treasure trove of information.

You may have seen that The Diplomat published an article just the other day. They did great detective work going through the engineering data that was in that YouTube video, which either India didn't care about or didn't realize that the level of detail that was in that video.

The best part was the kill shot at the very end. The very last second of what the infrared seekers saw right before it destroyed the satellite. This is a little bit of a view, a side view, of the pieces. This is the 6,400 or 64, 66 pieces greater than one centimeter.

It's a little hard to see the red dots with the lights here, but you may be able to see that some of them they're not all down here in LEO. Some of them have come way up here. The reason for that is that this is a hypervelocity collision. I know that the article the other day that Dr. Langbroek published, he did great detective work to pull out the geometry.

Thanks to the data they released. It is in some sense, a little bit insensitive to the geometry of engagements because it's a hypervelocity collision that we get this large dispersal.

Now, in terms of the debris being up there, there are cycles that we go through, solar cycles, which will help drive the atmosphere and the drag, and, thus, how quickly those pieces will come back.

Unfortunately, it turns out that we are here in between cycle 24 and 25, meaning the drag is slightly less. These pieces, relatively speaking, will be up there longer than, let's say, had they been generated five-ish years ago.

I want to dwell on this for a second. These are the results of our debris based on intercept and explosions tool or debris tool, which uses a NASA standard model for break ups with some ESA enhancements. This tool computed over 6,400 pieces greater than one centimeter.

That is a lot of new debris in the LEO environment, when the day before or the minute before, we didn't have these 6,400 pieces. How to read this is each contour is one unit. The reason I did that is because way out here, in this range, we even see some pieces out here.

In the two to five centimeter range, there are pieces that will be up there three to four years. Now. I've talked about what the 18th is publishing. For argument's sake, what it's being published in the public catalog is probably in the 5 to 10 centimeter range.

That's the detectability threshold, at least, based on what they publish, based on the SSN, the Space Surveillance Network's tracking ability. My reason for saying that is all these stuff down here is probably not able to be tracked without the new space fence, which is not yet online.

There's a ton of debris smaller than what's even been cataloged. The other thing is this graph looks so weird over here. That's because I went to contour levels of individual objects, and the contours are just too dense over here.

This really doesn't matter though because this is what we are now in the six-ish week range. We're over here right now. Like I said, most of the pieces come in within a few months but some of them are up there for way more than a year. Again, it's fragmentation analysis, which is, in past events we validated this.

Now, I want to talk about...These are the pieces that have been published by the 18th Space Control Squadron. I say, "published." Reports are that they are tracking hundreds of pieces. As I said, as of Friday, they're up to 94. All I can show you is what they've published, meaning they probably have many, many more.

This was backdated to the event. If you look at the timestamp up here, this is basically the day of the event. You see them spreading out in track in the orbit. If I could have stopped that at the beginning, you would have noticed that they were not all at a pinch point. That's due to the nature of TLEs.

What I mean by that is if you back propagate them all to the time of the event, they don't all come together. The planes come together but the in-track direction, they don't. It turns out that it's really, really hard to separate all these pieces into the orbitology on them.

We know that when you go back to the event, there's a little bit of spread. We don't get too wrapped up about that. I'm going to fast forward to, just Friday, five weeks at the event. Now, things are a little bit different. Yes, I changed the color anew just to confuse you.

Two things. The guys are spread out more around the entire orbit plane. Two, we've lost some. At this point, depending on how you do your math, we're on the order of 28 or 30 of the published pieces have decayed. At the same time, there's another 30 to 35 that the 18th has continued to add to the catalog. Around numbers, this is about the same as what I had in the previous video.

Then, for reference purposes, just to give you the sense of where we are. The ISS orbit is in green coming through. If you look at how high up these guys are going, and if you watch where the green orbit goes, the green orbit is below the highest of these.

This is exactly what Jim Bridenstine was talking about several weeks ago, where he said, "This event has increased the threat to the human lives on the Space Station because the debris has gone higher." That is both this and the previous analysis.

The Indians have said the debris was going come down within 45 days, it was a head on hit. Dr. Langbroek's article the other day showed us why that's not true. Again, the data analysis says it's not all coming down to 45 days. In fact, this is what we put together as of this morning. These are the pieces that have been published.

This is measured in weeks after the event. I'm at a pretty bad angle here, but we're sitting here about six weeks. We've had about 20 or 30 pieces come in, and there's this longish tail. The interesting thing is we have, at least, one piece way out here. That one piece is over three years. That's a piece that's big enough to be tracked by the 18th.

That's a piece that's probably, at least, 5 to 10 centimeters. Actually, this morning, I was working feverishly on this because I was questioning that. I had some of our orbit experts back home reverifying that. [indecipherable 00:13:21] this piece, if you take the data that the 18th has published is not going to come in for almost three years.

The other thing we're seeing with some of these pieces is as we continue to assess the lifetime, day-after-day and week-after-week, some of the predicted lifetimes are stretching or growing.

Part of it is there are some uncertainty in the TLEs that are being released, but part of it is just due to the nature of the objects themselves and perhaps how their orienting into drag and how big they are.

Bottom line is India said they'd come in within 45 days, which is right around, I think this week will cross 45 days. We have a lot of pieces still up there, tracked pieces. Remember the fragmentation analysis, there's 6,000 pieces total, so we'll have hundreds of pieces that'll be up there for awhile.

What does that mean? We have another tool, this debris risk evolution and dispersal tool that can measure the accumulated or integrated likelihood of fragments in the orbit where the object is. For several objects, we see that likelihood for pieces that came off this event exists including number 58 on the list at the ISS.

These are not huge, huge numbers, but still, these are numbers above zero. Let's say the risk has increased for these objects due to this event. Bottom line is both are fragmentation modeling and analysis of the published data. We have to emphasize that that means that they are above a certain size. It's not the whole population to show that the claim that India made is not true.

That it's going to be up there. It's gone higher than they said. They said, "Oh, we're gonna hit a head on. It's all going down." That's not the case. It's going to be up there much longer than what they claimed. The implications of that, I'll leave to you guys.

Brian: Thank you very much, Bob. That was great. With that technical background in mind, let's now turn to more of the political and geostrategic analysis. Ankit, I'll give it to pick up things where we are here and talk a bit about what the Indian domestic politics were and how they saw the motivations for the test, and how they view it as part of their goals.

Ankit Panda: Sure. Thanks a lot, and thanks, Bob, for that great set up on the technical side of things. I'll talk about a few things. The way I really see this Indian anti-satellite test is less as a demonstration of a counterspace capability per se and more as a real live validation of exoatmospheric hit-to-kill technologies.

The nice thing about those technologies, depending on your perspective, of course, is that you can use them against orbital targets like India did or against sub-orbital targets like ballistic missiles. There is, obviously, a history here.

In 1999, one year after India and Pakistan both broke out as nuclear possessor states, India's ballistic missile defense program began in earnest.

20 years later, we see this anti-satellite demonstration. While it's true that this was the first time India shot down an orbital target and shot down a satellite, what is also true is that this is the highest ever intercept apogee that India has demonstrated with its ballistic missile defense testing.

In 2017, India used a Prithvi defense vehicle interceptor to conduct an intercept at a hundred kilometer altitude. This was considerably higher. I think it was at about 282 kilometers. Prime Minister Narendra Modi said it was 300 kilometers. That was, obviously, emphasized. I'll just talk a little bit more specifically about the Prime Minister's remarks on the day...I was watching them live. It was about 3:00 or 4:00 AM in New York City, where I'm based.

I heard that the Indians were about to make a surprise announcement, and nobody really had any idea what it was going to be regarding. There was just a major India-Pakistan bout of escalation at the end of February, of course.

There was some concern that it might have been pertaining to that issue, but it wasn't. Modi announced that India was now a space super power, and that it had destroyed one of its own satellites in low earth orbit. He emphasized that this was a very prompt operation. The promptness was something that the Prime Minister really talked about.

He said this whole thing was done in three minutes. That's a little bit of a strange thing to emphasize with a counterspace capability in some ways, but it's highly relevant when it comes to ballistic missile defense.

Immediately after the Prime Minister's address, the Indian Ministry of External Affairs was ready with a FAQ document that was sent out to reporters and publicized widely. In that document, it answered the question of what exactly India had used as the kill vehicle. They clarified that it was a Ballistic Missile Defense Interceptor. Capital B, capital M, capital D.

It wasn't called the Anti-Satellite Interceptor or anything like that. They owned up to the fact that it was a BMD interceptor. The DRDO video that Bob talked about, gave us a little bit more information about the code name of the weapon itself, which is apparently DRDO is calling this the Prithvi Defense Vehicle Mark-II.

This is very much technologically the latest iteration of India's indigenous ballistic missile defense capability. It just so happens in April reports in India suggested that DRDO had now declared that phase one of India's indigenous ballistic missile defense efforts were now completed.

Those reports weren't necessarily related directly to the ASAT test, but I just find it interesting that just a few weeks after the anti-satellite demonstration we see India declaring phase one of its BMD plans completed. Why does this matter and what are some of the strategic stability and geopolitical consequences?

Since 1998, since South Asia really entered the nuclear age, we've seen a game of cat and mouse between India and Pakistan in terms of coping with these new realities in the region. Basically, since the mid-2000s or so, around 2007/2008, India has been put in a box by Pakistan given Pakistan's deployment of low-yield battlefield nuclear weapons.

In particular, here I'm talking about the Nasr system. I'll just briefly talk about both countries nuclear strategies since I think it's important to understand that, to understand why this kind of a ballistic missile defense interceptor demonstration might matter in the future.

In 1999, India releases a draft nuclear doctrine emphasizing a policy of no-first-use, trying to clarify that India's nuclear weapons will only be used to retaliate proportionally. That changed in 2003 to clarify that fact that India would retaliate massively and inflict unacceptable damage on Pakistan.

To cope with that, Pakistan transitions to the development of these low-yield tactical nuclear weapons that will be deployed early in a conflict, with the intention of effectively nullifying an Indian strategy that was developed in the early 2000s to use mechanized conventional brigades to enter Pakistani territory.

That was done after a crisis between the two countries in 2002 after a Pakistan-based terrorist group attacked the Indian parliament. What happens by the late 2000s is that India doesn't really have a good response to that.

Because it's simply not credible that if Pakistan were to one day use low-yield tactical nuclear weapons against Indian mechanized divisions on its own territory, that India would retaliate massively against a Pakistani city. The solution to that we're still waiting to see an actual change in India's doctrine.

The doctrine remains the same, but there are signs that Indian strategy is beginning to shift to deal with this new reality. Some of that has been seen with the recent crisis between the two countries. That India's old practice of strategic restraint is maybe less restrained today.

The crisis in February marked the first use of conventional air power by one nuclear arms state against the territory of another in history. In the Kargil War in 1999, when the two countries fought each other, the Indian Air Force did not cross the line of control to strike Pakistan. Yet this time, we saw Pakistani territory stricken.

Anyways, coming back to the issue of ballistic missile defense, why can BMD enable India to potentially move away from the kind of nuclear strategy that it's deployed since 1999? BMD would allow India to think more seriously about damage limitation against Pakistan.

In a crisis, India may choose now to use conventional weapons to try and disarm Pakistan of its own nuclear weapons. Effectively, in the nuclear jargon, deploying a counter-force style of nuclear strategy. Ballistic Missile Defense would allow India to effectively sweep up the residuals.

If, let's say, a Shaheen-III medium-range ballistic missile, which would reach an apogee of around 600 kilometers on its way to a city like Kolkata on the Indian east coast, were to be launched by Pakistan.

These kinds of hit-to-kill, high-altitude, exoatmospheric interceptors like the Prithvi Defense Vehicle Mark-II demonstrate to Pakistan that India is now entering a place where these kinds of technologies are starting to become available. I would fully expect in the future that we will see India conduct a similar test against probably a sub-orbital target.

There are certain reasons to choose an orbital target for a first demonstration. The ease of intercepting an orbital target given the kind of information that India had, obviously about Microsat-R trajectory specifically may have made that a compelling candidate for a first kind of test.

The Indian official response, of course, merits a little bit of discussion, because what I've said is not in India's official FAQ document. None of it is. It's worded as a very anodyne document saying that this is about protecting our own space-based assets because India is a civilian space-faring nation as well.

That just doesn't really make all that much sense to me because the theory there would be practice effectively deterrents by punishment. That if another country were to shoot down an Indian satellite that India would retaliate in kind using its counter-space capabilities.

Yes, we can have a discussion about co-orbital counter-space capabilities, but really, I think this is more about Pakistan. Of course, there is the prestige angle that merits discussing. The fact that the Indians decided to call this test mission Shakti evoked the 1998 nuclear tests which were called also Shakti. The fact that that was again redeployed mattered for the prime minister.

Obviously, we're in election season right now in India. We'll find out the results of that at the end of this month. The fact that this test did also occur before an election I think merits a little bit of discussion. The result of the February crisis, of course, should not be seen in the context of this anti-satellite test.

There was an initial Indian attempt in early February before the major terrorist attack in February that killed 40 Indian soldiers that precipitated the crisis between the two countries. India was planning on doing this in the first place. There is an interesting counter-factual there.

That if the February 12th intercept had actually succeeded and India's anti-satellite test had occurred then, would the prime minister have made a national address? It's not so clear to me. Obviously, we don't have that counter-factual.

He chose to do it, and it was really a moment of emphasizing nationalism and the fact that India had now entered this exclusive club of countries that had these kinds of capabilities. With regard to China and the potential application of a weapon like this, I said this a day after the ASAT test when asked by reporters about how the China angle factors into this...

I really think that in any hypothetical China-India conflict, if India is at the point where it's seriously considering escalation by destroying Chinese satellites in lower Earth orbit, the crisis has probably escalated to a place where India is going to be poorly positioned to manage that conflict. This is less about China.

It is about prestige, but overall, the main strategic significance boils down to the applications that hit-to-kill technologies do have for ballistic missile defense. I'll end there. I'm happy to elaborate on that in the Q&A.

Brian: Great. Thank you very much. Also, for reminding us that even though us space people tend to focus about space stuff. There are broader issues here at play that may impact things beyond just the space world. Victoria, you just came back from a trip to India. We're talking about space policy.

If you could talk a little bit about what the international reaction has been, what the Indian space world's talking about this? What do you think the impact might be?

Victoria Samson: Sure. Good afternoon, everyone. As Brian said, I just came back. I was in India last week, New Delhi. The Secure World Foundation co-sponsors an annual conference every year, the

Kalpana Chawla Space Dialogue, which looks at various aspects of issues affecting space security and stability and sustainability.

Of course, ASAT test was discussed. I'll be talking a little bit about the rumor mill, that I heard. Things people said to me that I read, that I heard about there and talk a little bit about India's, their thinking on this issue and some of their capabilities. One of the things I just want to emphasize, and this always surprises me when I think about it.

India has been a space power since the early '60s. They've been very thoughtful and strategic in how they use space. India does not actually have a national space policy. Think about that for a minute. No white papers, nothing really just directing how they're going to go on this. They have the 1991 satellite communication policy. They have a 2011 remote sensing policy, and that's it.

If you talk to Indian policymakers they say, well, this is a feature not a bug. This gives us some flexibility. There has been discussion about maybe now that they're expanding their use of space, they need to have some sort of national space policy, or maybe they only need to have a civil space policy and let DRDO take care of the military space.

This was a tipping point for them in terms of, OK, things are changing, we need to really think about how we're going to go ahead with this. Interestingly enough, while they don't have a national space policy, I read an article that said they're looking at a security space strategy because now they have toys to play with and they probably should figure out how to handle it.

We'll see what ends up happening with that. Ankit talked a little bit about Prime Minister Modi's statement, but I want to emphasize that while he said repeatedly, "Our capability is not against anyone, it's defensive entirely," I heard repeatedly, OK, it's defensive, India has a right, peaceful use of space, protecting our space assets.

But we have to protect ourselves against China and Pakistan constantly. It's not against anyone but it's protecting against China and Pakistan. As well, Prime Minister Modi said, "India has always been against an arms race in outer space.

That policy has not changed." I guess it comes down to different definitions of how you look at arms race in outer space, and that's a broader discussion about how the US looks at space security and stability.

Maybe some of the other countries look at it. Other countries look at it as a space property is only something that literally goes up in space. Whereas, I think a lot of people in the United States have a broader discussion of anything that disrupts the stability of the space domain can be threatening.

The Ministry of External Affairs, as been mentioned, put out a statement almost immediately. They said, again, the test was done to verify that India has the capability to safeguard its space assets. Again, defensive. Space is a common heritage of humankind and that you see a lot from MEA statements.

The emphasize is India's a party to all the major space treaties, participate in the Committee on the Peaceful Uses of Outer Space. India has supported the idea of no-first-placement of weapons in space. This is important because this is largely affiliated with the Russians. That's something that they've been pushing in international fora pretty widely.

Also, interesting because it's something the United States does not typically support. We don't support no-first-use for nuclear weapons and we typically do not support no-first-placement in space because that implies there's going to be a second placement.

As well, the Indians have come out supporting the idea of the PPWT, which is a very long acronym for a proposed treaty by the Russians and Chinese looking at the prevention and placement of weapons in space. Primarily, space-based missile defense.

Again, this has been a bone of contention at international discussions because it comes down to, what do you see as the biggest threat for space security and stability? For Russia, China, and their allies, this includes India I guess in this context, there has been a focus on an actual weapon placed on orbit.

Whereas, an anti-satellite test like India had, like China had, like the United States tested in 2008, would be A-OK according to the PPWT. Whereas, the US and its allies tends to look at it more as an idea of congestion, competition, that sort of thing. The change of the space domain, that's really where a lot of the threats are.

Yeah, so they pushed that as well. There was a speaker from the MEA at the dialog last week and he talked about how international legal system is insufficient for currently how space is being used.

He said in multilevel fora there has not been as much progress as has been expected, due to difference of opinions on key issues i.e. no agreed upon definition for space weapons, satellites and other objects are dual use, may not be able to comply with the future regime, and then he pointed out only a few nations have SSA to verify compliance.

But emphasizing India has opposed the weaponization of space, and then pointed out that India wants to be a constructive role and to be as responsible as a space-faring nation, would like to participate in future negotiations to strengthen international legal regime applicable to arms race in outer space.

Then they pointed out that India would actually support legally binding transparency and confidence-building measures. Again, the multi-level fora that has been a push-pull between how are we going to ensure that space is secure and stable long-term. Do we have a treaty? Do we have non-legally binding yet powerful transparency and confidence-building measures?

The secretary Pandey said that India supports legally binding transparency and confidence-building measures as long as there is universal application that are non-discriminatory and agreed upon by states. I thought Ankit's, that was very interesting. I'm going to focus on the space aspects, but the BMD stuff is definitely relevant as well.

This change, having an ASAT test, was the first time for India. According to the head of DRDO, Satheesh Reddy, this is not a one-time event. He has said they're working on a lot of different technologies. He gave the rogue's gallery for discussion, working on directed energy, doing EMP, doing co-orbital.

Again, I recognize a lot of this may be just playing to the crowd or discussing the needs for domestic audiences. Certainly, every country does that when they're talking about the capabilities, but if you look at our counter-space threat assessment, we do discuss some directed energy work that they've been doing, and so it doesn't surprise me that they are thinking about it.

Co-orbital doesn't surprise me as well, just because that's the next step in terms of a closer approach for space capabilities. Just a side note. We work at a project for DARPA that CONFERS, Consortium For Execution of Rendezvous and Servicing Operations. Did I get that right?

Basically, the idea that commercial actors will come together and talk about best practices for close approach point of view and proximity operations.

Talking to Indians last week, they're very interested in what's going on with that and they'd like to learn more about it. There's absolutely an interest in close approach work there. Again, that's always dual use. It doesn't mean necessarily it's going to be weaponized. It can be done for completely legitimate, non-weaponized things, but the interest is definitely there as well.

Satheesh Reddy said that it is "feasible" to target multiple satellites with multiple launches at the interceptor. They can go up to 1,000 km and they're reportedly interested in reaching both LEO and GEO with ASAT.

Of course, this interceptor, I don't think would be able to get to GEO, so I'm not sure what that means, that there's something else they're working on, or if it's just conjecture, "It would be nice to have" sort of thing. We could have a whole discussion about why they need to get to GEO. What are they targeting there? That sort of discussion, I haven't heard much about.

Then finally, with Reddy, he said space is important in the military domain. The best way to ensure security is to have deterrence.

He said there's no further plans than testing this particular ASAT, so we'll see what happens, but probably, taking a lesson from the US and China's book and just have a missile defense test and use the same interceptor and call it a win, because they pointed out their accuracy was pretty high on that.

Going into, a little bit, some of the rumor mill. As we heard, Indians said, "We're trying to be responsible. We design the test very carefully," and I'm sure they did, but that's more of the microcosms of having this capability proliferated, is that things don't always work out exactly as you intended.

Oftentimes, you can have a great test, but things happen, and perhaps your angle of approach is closer, pointing up higher than you think, as we saw from Bob's presentation, and it goes from there. There is a lot of people insisting that General Hayden had justified India's concern about their worry about their space assets.

When he testified in Senate Armed Services, if you go back and read the testimony, he said "they feel they need to have this capability." He did not say, "I think India is being threatened and they need to have this capability," but if you talk to a lot of Indian policy makers, that's the implication that they got from that.

There are concerns about Pakistan. Given everything that Ankit talked about, obviously things are bad. Side note, my flight was delayed for quite some time because we were not allowed to fly over Pakistani air space. I was on Air Canada flight.

There is concern that Pakistan would somehow get some assistance from China. They would be able to demonstrate its own ASAT capability. They saw that as a distinct possibility. This is the fifth year this particular composite dialog to secure all this bit that involved them over the past four years.

I would say the rhetoric in Pakistan is probably the most aggressive that I've heard in the four years I've been going to this.

Then, also interestingly, one of the presenters did a relationship map of China with its countries in the neighborhood.

They had India listed as a foe of China, just some of the thinking there. Some policy-makers have said, "Debris was created, but the ISS can handle it. They're fine. They have a debris-monitoring thing. They've got hardened shield. They are OK. They can deal with it," which is probably not what the space station would like to have to handle with.

That probably goes back to Bridenstine's criticism of it, as well. I had one person say to me, "300 pieces of debris were created. In the grand scheme of things, there are hundreds of thousands out there. What's the big deal?" He explained it's not just mattered.

Debris was created, it's at that particular altitude, what that means in terms of orbital use and [indecipherable 00:37:17] . It's probably not the best thing.

Emphasis, India feels like going on space. They've got the second mission on the moon. They've got their Mars program. They've got the first human astronaut coming up in the next three years or so, so they must make sure that space is stable and the ASAT helps them determine it's stable.

One of the things also Ankit mentioned national pride. I heard a lot. We've seen that here. The westerner who wrote about this issue got this comment at some point, "Why is it OK for the United States, Russia and China to have ASAT capability, but not for India?" There is a sense that if they are a major space power, they should have that capability as well.

One thing that I thought was pretty interesting is that they were very interested in the difference in response from the West, from the 1998 nuclear test to this ASAT test. With the 1998 nuclear test, immediately criticized, put under sanctions.

A lot of very harsh rhetoric came out from this, whereas for this particular ASAT test, State Department said, "We see that it happened and India as a strategic partner..." which I understand is how they like to phrase it. The only US government, person that came out critical of this, is Administrator Bridenstine who almost the next day later had to dial back what he said under pressure from the White House.

They've taken that lesson to heart. Now they are a strategic partner, they have more flexibility in terms of what they can do.

Then finally, there is a common concern by the Indians and I've heard this before, that they're being held accountable for treaties that they did not sign.

They pointed out their missile technology control regime, the United States put Israel under sanctions for colluding with the Russians back in the early '90s, saying they didn't actually signed the missile technology control regime. India has since joined it, but that's in the last couple of years.

Of course, India has always been upset that it's being held as a non-nuclear weapon state [indecipherable 00:39:26] nuclear non-proliferation treaty. That has been a point of frustration for them.

Finally, I'm going to wrap up, because I've gone over my time a little bit, but talking a little bit about some of the space situational awareness capabilities. Right now, India has 18 commercial satellites of its own, 20 earth observation, 8 navigation, 2 space science.

Overall, India has launched over 400 satellites. Of those, 297 were for foreign countries, for 31 different countries. India, obviously, has a very active space program, but they're largely dependent on TLEs in the United States.

They're actively working to improve their space situational awareness that they have and the capability, which is good, because if they're going to be having an ASAT test and throwing things up in orbit, you really hope to have the ability to track it and not just do it and design the test and walk away from it at that point.

They commissioned their tracking radar. Supposedly, there have been discussions with the United States on the space situational awareness agreement that has not come to fruition yet, but they're working on it.

They do space object proximity analysis. They do close approach analysis. They've a multi-object tracking radar which can track objects at a 50-cm dimension at 800 km range, that has successfully tracked the PSLV upper stages and the electron RV as debris targets that's presently undergoing refurbishment and internal assessments.

They have a new thing called NETRA, network for space object tracking and analysis, which is dedicated facilities for SSA. It would have observation facilities, three optical telescopes, a couple of radars, existing facilities with a control center for analysis in Bengaluru.

The objective would be to establish observation capabilities in space objects through a network of indigenous tracking, to evolve a mechanism to process tracking observations, make an assessment of SSA, and disseminate SSA information in a timely manner. Finally, to participate in global efforts on information exchange on resident space objects.

They have a proposed phased-array radar with multi-object tracking capabilities and the idea they retract space objects more than 7 cm in diameter up to 30 to 100 km range. Even if they go for GEO, they can't track it, but they're trying to do LEO, at least.

With that, I will stop and read the questions.

Brian: Thank you. An opener for questions now. I've got several that I prepared, but I want to start by asking Irene, did you want to ask a question before you have to head out?

Irene: [off-mic comment] .

Brian: OK, great. As usual, if you want to ask a question, please raise your hand, identify yourself, and make sure you state your question in the form of a question. We want to start up here, towards the front.

Mridu Pawan Das: I was obviously listening intently to the views expressed by the panelists. This is a free, independent country and I respect all your views. India is also a free independent democratic country, really proud country, indeed.

All of you referred to FAQs which came out in the MEA. You referred to our prime minister's remarks.

Before I get down to those specific things, I would first get into the tendency of people to get into China and Pakistan immediately. You are aware of some of the things which happened, specifically in February, on St. Valentine's Day, which was a day of love converted into a day of terror by you know who.

Let's not try to conflate issues here. Let's stick to what we have on the table, because India doesn't need to be apologetic about whatever it has done. We have a minimum credible deterrence in place. First, no-first-use doctrine is well known.

While I'd not like this to get into a nuclear kind of debate that India need to do this and that, because if you ask me, honestly, during the period of February, March specifically, when we were absolutely restrained in conducting ourselves.

There were statements coming out of a particular government -- I'm not going to name it, you know it, trying to distract world attention from the core issue of terrorism, by drawing the world into something which they normally do, into some kind of nuclear scenario where they say that, "Two nuclear arms powers close to each other, now what's going to happen?"

They're going like, "This is going to escalate into a nuclear kind of thing." They keep on doing it. We did not do it. We're very restrained, though we believed that our threshold was being tested and you know about Balakot. Let's not get into that. Let's not conflate issues. Let's stick immediately to ASAT.

Though the panelists -- and I'd respectfully defer to all of them -- did mention the FAQs, I think it's my bounden duty to tell you some of these things which are very important. One, I saw some data being shown -- I respect, as I said, studies -- on the debris and all that, but I'd like to address those concerns.

India was conscious of such concerns, to begin with, and the dangers posed by space debris. It conducted the test in a manner to minimize the incidence and longevity of such space debris.

It's not merely for effect. Our prime minister has said so, and I'm going to repeat here, that after having conducted extensive simulations, the ASAT test being referred to on the 27th of March was intentionally conducted in low-earth orbit, at an altitude of 280 km, to ensure that there would be minimal space debris, and that it would not pose any danger to objects in outer space.

As far as the simulation studies, whatever debris would have been generated, we're not saying no to it, right? Whatever debris would have been generated was expected to have decayed and fallen back to earth within a brief time frame.

Further, I have again heard references to ISS and all. I don't think there's any specific concern in relation to the ISS, which is at an altitude much higher than that at which the test was conducted. If I may add here, there was an initial statement from NASA expressing concern and then there was another statement from the NSC saying that there was no need for such concerns. So, there have

been views expressed by the US government on this particular ASAT test. If I may one more minute of your time. I know I'm taking a lot of time. I'm conscious of that.

Let's not be apologetic, when I say that this test was a demonstration of our technological capabilities, to defend and secure our wide-ranging interests in outer space. But, if I may add, the test was purely defensive in character and not targeted against any country.

As a major space-faring nation, we have made significant strides. A panelist, Samson, referred to the fact that we have been in this since the 1960s, very proudly doing a lot of things. You mentioned, the mars mission and other things. The human mission will be undertaken in some time to come.

We're very proud of whatever we have been doing. And we are, we remain opposed to the weaponization of outer space. India has not, will not resort to an arms race in outer space. Other countries might do so. We are not really into it.

We have been a consistent advocate of the importance of preserving outer space as a common heritage of mankind. We remain committed to maintaining outer space as an ever-expanding frontier of cooperative endeavor rather than conflict. Panelist Samson referred to some of the initiatives that we have undertaken, in this regard, in multilateral fora.

I, though at the risk of repetition, would like to state them all, because these are important things. As I said, India supports a substantive consideration of the prevention of an arms race in outer space within the multilateral framework of the UN.

We remain committed to the negotiation of a legally binding instrument and the prevention of an arms race in outer space to be negotiated in the conference on disarmament where it has been on the agenda since 1982, India has been an active participant in the group of governmental experts in the prevention of an arms race in outer space which conducted a session recently.

At the 73rd session of the first committee last year, India voted in favor of all resolutions submitted under the outer space cluster, including on the prevention of an arms race in outer space, which we also co-sponsored.

Further, if I could just...

Victoria: Just continue, basically...

[crosstalk]

Victoria: Guys, I had actually reached out to them on what was happening and...

[crosstalk]

Mridu: Further, practical measures, the prevention of an arms race in outer space, on no-first placement of weapons in outer space, as well as transparency and confidence-building measures in outer space activities.

What I'm saying is I'm laying out our official position. We're very clear about what we did. As I said, purely defensive in character, not directed at any particular country, we have our achievements to show off.

We have the confidence of the world. References were made to the 1998 tests and all that, because I would not like to conflate issues, but since those were mentioned, I'd also say that when the India-US civilian nuclear deal was signed we had the confidence of the world in terms of getting an NSG waiver also.

As far as the trust of the world is concerned, we have that with us. All I can say is we have the confidence of the world and as I said, we are willing to address some of these concerns. As I said, the debris thing, we made it very clear, low-earth orbit, less than 280 km, much lower than ISS and all that. Some of these concerns perhaps were out of place.

Brian: Sir, please wrap up. Please.

Mridu: Thank you very much.

Brian: Thank you. Do you have that question, Irene?

Irene: I do have a question. Why do you think that the United States and the international community response to the ASAT test was so muted or non-existent?

Victoria: Let me take first crack. Part of it is this concern that if we criticize other countries having ASAT test, that should the United States want to have one, we'll open ourselves up to that sort of criticism we're doing.

There is definite relation to our need for strategic partnership with India, to counterbalance China, and so probably concerned we don't want to lose that part of the triangle to counterbalance them.

The only countries that came out with official statements criticizing the Indians were Pakistan, China, and Germany, oddly enough, although Germany did it in a round-about way. It was at the Committee on Peaceful Uses of Outer Space and Legal Subcommittee.

Then basically they talked about the need to not to do sort of ASAT tests. I think they literally hashtagged India in their statement, but they didn't criticize officially India in it. That was the way they did it. I think it has to do a lot more with the complication of the political environment right now.

Dr. Hall: Yeah, so just to emphasize my perception on the US point. Yes, the original statement from Administrator Bridenstine what was very negative about it, and I think justifiably so, given his position as the head of NASA and with his own people on the ISS which is a very important international asset.

Then you saw as he walked back that statement after consulting with the White House. I think it's pretty clear that at a higher level of the administration they are trying to forge this strategic partnership with India.

A big part of that is, as you said, to counterbalance China. Then it looks like they made the decision not to upset that potential relationship over this one incident.

I can say, talking to the more rank and file people in the Department of Defense and the State Department, I get the sense they feel there should have been a stronger statement because they don't like the potential precedent it sets that it's OK to do this as long as you take some steps to make sure it was, what you might call, responsible.

Further countries might take it that as a model, and not all of them may be as technically capable or willing to limit the debris creation. It's pretty clear that in this particular case a decision was probably made that the broader partnership with India took priority over whatever impact this has on the space community.

Brian: There's no questions...Yeah, in the back, Thomas.

Thomas: Hi. Thanks so much for hosting this panel discussion. We really appreciate it. I have a question from a comment that Victoria made, and I'm hoping the whole panel can respond to. You mentioned that Indian defense officials have mentioned that this will not be a one-off test, and other developments across the counter space spectrum could lead to further demonstrations.

I wanted to ask about...if we could hypothesize together, if there were to be a non-kinetic successful anti-satellite test, what would be the role in the political environment? If there is a role for the technical community in bouncing up the published data from the Air Force, but also independent private data, what is the use of that in a situation where no debris is created at all?

Brian: Victoria and Ankit, you guys want to comment on what future follow-on tests might look like and if there's a BMD versus ASAT?

Ankit: Yeah, I'll talk a bit about the BMD angle. Look, the BMD program isn't going anywhere. They've just said that they've completed Phase I.

With Phase II, I'd expect to see intercepts occurring at similar altitudes but, of course, with suborbital targets, that's debris is less of a concern. Obviously, it's much more difficult for the United States to criticize India when we regularly do missile defense tests here.

That kind of testing is, I think, going to happen. What'll be interesting is if and when we do get data on the kinds of interceptors that are used, and specifically the kill vehicle. We have very good pictures and data from this last ASAT test.

I'll actually be curious to see how much of the technology that was used for the ASAT test actually survives this testing cycle and makes it into the future of India's BMD efforts indigenously.

Brian: Just quickly on that, Ankit, you talked quite a bit about your hypothesis which says there's quite missile defense in a satellite testing, and that tops the technology is very related.

I want to impact a little bit and ask the question, if it is more about missile defense than anti-satellite, why did they chose to test it in a satellite mode, given they probably could have gone after a suborbital target and not generate the debris?

Ankit: Again, I can only hypothesize about why they chose not to do a ballistic missile defense test. The DRDO video, I believe, talks about multiple modes for the interceptor, which raises the question of what are those other modes?

Given that we know that it's a Prithvi Defense Vehicle Mark II, which is a ballistic missile defense interceptor, it's pretty reasonable to surmise that the other mode is kinetic intercept of a ballistic missile defense of a missile reentry vehicle.

The reason I think they chose to do this...India has apparently had this capability for a few years now. There was an interview with the former chairman of DRDO, Dr. Saraswat, and he talked about how the previous government didn't have the political will to move forward with an anti-satellite test at the time. The factors could have been multiple.

The general nature of India's application to things like the Nuclear Suppliers Group hinged on India demonstrating a certain level of responsibility, internationally. Maybe conducting anti-satellite tests back then would have made less sense.

Now, the political environment has changed. The geopolitical environment has changed with the United States, especially, so perhaps they chose to push away with that.

There of course might be simply technological imperative to do this -- that certain people inside DRDO have probably always wanted to demonstrate anti-satellite capability.

It's also one of those boxes you tick in joining the superpower club -- that you do ballistic missile defense. You do anti-satellite. Like Victoria said, you do directed energy and a variety of other things...co-orbital.

Will the Indians move ahead and do other things? We've heard it from DRDO that they are working on several other kinds of technologies, so maybe this was about ticking that anti-satellite box, but of course I think the core technology will be much more useful in a ballistic missile defense context.

Brian: Victoria, anything to add?

Victoria: Yeah, just a couple things. One, they may be working on EMP, but essentially that's a nuclear weapon. They're going off in orbit, I sincerely hope they do not try to test that capability and we'll just assume that they have it.

In terms of the role of data, I think it's really interesting, because it's very difficult to ascertain intent. You don't really know what other countries' plans are, particularly if countries do not have national space policies or strategies. You can turn on [indecipherable 00:57:39] . You just have to look at the testing and guess from there.

I think the role for the commercial SSA sector is to help increase transparency and awareness of what's happening in orbit space activities. That way, you won't necessarily get intent, but you'll be able to have better clarification as to what's going on and you go from there.

Brian: Bob, following up on that, I was going to ask you the question. You talked quite a bit about analyzing data produced by the US military, these TLEs. Where do you see the role for the sort of

independent commercial analysis and where is commercial data to validate these sorts of events? How is that shaping up and where is that going?

Dr. Hall: I would say there's a few aspects to that. When people talk commercial SSA, a lot of times, the conversation is a conflated conversation between data and processing. There is a large or growing community of data providers.

The other side of the equation is you need processing. The commercial SSA processing is what allows you to really distill or pull out finer detail of what's going on in orbit. For example, when you look at the TLEs, the US Air Force is presently using technology that's a few decades old from an orbit determination standpoint for a long and sordid history.

That only gets you so far when you start to watch what modern satellites can do, particularly when you're talking about rendezvous and prox ops, and you're trying to watch these close-in behaviors.

The other thing that commercial SSA can do is provide a layer of transparency or attribution that the US DoD cannot provide. When a commercial entity, such as the ComSpOC or others, can lay on the table, "We just saw this. We just saw that," the US -- the State Department, for example -- doesn't have to divulge the capabilities of US sensors, US processes, to say what it saw. The analogy is with the commercial overhead imagery providers.

When we see North Korea preparing for a launch, for example, we don't use US national assets and lay a photograph on the table and say, "Hey, North Korea, what are you doing?" We can lay an image from commercial overhead assets and say, "Hey, what are you doing?"

Commercial SSA has the same analog here -- that we can help with that attribution. Speaking of that attribution, we've seen China be very aggressive in this area. By aggressive, I mean very aggressive test cycles, where they take satellites that are technology demonstrators -- clearly could be dual-use -- but they do all kinds of testing where they do extreme rendezvous and prox ops tests.

Which, again, they could claim it's for scientific purposes. It's for refueling, it's for servicing, it's whatever -- but it could just as easily have military purposes. I can't tell you that intent, but I can tell you what they're doing.

To go back to the original question -- if India were to continue with further demonstrations like co-orbital, they would be seen. The full intent would not be able to be determined. It could be a co-use-type thing.

Brian: Yeah.

Audience Member: I want to pull back a little bit and look at the bigger international picture. I mean, China, a few years ago, did a satellite test which was actually much nastier than India's -- at a higher altitude. They put out thousands of pieces of debris that'll be descending through LEO for the next century.

If we keep doing this, somebody's going to screw it up royally. If country P and country I and country K and so on all feel like "Well, they...I got to do an anti-satellite test too," something bad's going to happen. How can we internationally stop that, or can we internationally stop that?

Brian: Victoria, do you want to take a first crack?

[laughter]

Victoria: I've got the answer. No. That is a concern. That's the whole idea behind you don't want nuclear weapons proliferate because at some point someone's going to find a good way to use them. Same thing with ASAT testing. At some point someone's going to screw up, or they're going to want to use it.

The problem we're into is that a lot of the international discussions get bogged down in the whole, "Should it be a treaty or should it be a non-legally binding measure?" and then they get bogged down on what the biggest threat is.

It's really difficult to move ahead, because they've been cycling through the same arguments, I would say, for the past two decades, at least. Same thing over and over and over again. We co-host a conference in Geneva, every year, the Conference on Disarmament, which is part of the UN. It discusses space security measures.

Every year there's someone talking about no first placement, PPWT -- the same answers that have not yielded any kind of solutions. But in my mind there is a ray of hope. There have been some discussions about how can we do TCBMs in other ways, and the idea of having guidelines, maybe, for ASAT tests, which is not ideal, but at least it's recognizing that it may be happening, and so we want people to do it in a responsible manner.

That has been brewed about as a possible way in which we could maybe move the conversation ahead a little bit, the idea that you have tests at a low altitude, that you let people know that's happening and you'd be pretty transparent about it.

That may be one way to avoid having these concerns in the future. That's a baby step, but there has been indication that it may get some major power support at some point. Obviously this would not happen now it'd probably [indecipherable 01:03:30] discuss, it may be 5 or 10 years from now, you may see something come.

That's the nature, unfortunately, of the international system. It just doesn't move that quickly. But that's also how you build consensus. I think it's very important to build consensus, because otherwise countries don't feel like they have buy-in. If they don't have buy-in, they're not going to follow the agreements.

I would also argue that oftentimes countries, they don't have to do it just with the UN. They can make a unilateral decision -- "These are our guidelines. If you want to have ASAT tests, here's the rules that we're going to follow."

Other countries can take on from there. I would encourage space powers to start thinking about the way they can demonstrate responsible use of space and being a responsible space actor. They may be unilaterally making these announcements, and we can maybe build upon that from there.

Audience Member: I'll just add a specific note on that. The country that I have most concern about is probably Russia. They've been developing the Nudol, and that's probably a candidate for testing. They haven't done a kinetic, hit-to-kill, anti-satellite test.

Now that that Indians have done it, the Russians see themselves as a superpower, and they have been more comfortable with toeing the edge of international norms, let's say, over the past few years.

I'm hoping that we can get to that before the Russians decide to conduct the test, but that's probably the country that I've the most concern about right now.

Dr. Hall: Along those lines, back in 2007 China did the test. Obviously we can't know what they were thinking, but it seemed contemporaneously as if they were surprised by the world reaction. Maybe you take that and indirectly you say, "Maybe they didn't have a greater understanding of what the results of their test would be." That's a lot of assumptions in there.

Subsequent to that, and I think, Brian, you guys have reported this, there were events follow-on of that program where the US has stated that they continued to conduct tests of that weapon system but they were not engagement tests. They were purposely near-misses -- perhaps because they'd learned their lesson and didn't want the ire on the world on them for the LEO population.

From a debris standpoint this is maybe a progression, where India said, "We're not going to do what China did. That was pretty high. We're going to stay way low, and we're going to try and design as the stuff comes in."

Just apples to apples -- way better test design, the intent was there. I would say the debris analysis shows it's not always so simple, and we do have debris. Unlike the China tests that's not going to be up there for a century, perhaps, but still.

The hope would be that -- again, I was trying to not get into policy -- but, if there was a stronger world reaction to this to say, "OK. This was better, but still not good enough," that might drive us all to not having further tests on our own.

Victoria: Just building on...China was surprised by criticism in 2007 because it was not the first time they had tried to do it. They had done it several times prior and didn't get any kind of response, so I think they were legitimately shocked by how vehement it was protested.

Along those lines you guys talked about this was actually the second time India had tried to do it. They'd tried the first time in February.

Brian: To clarify that, to things there. One, I think there's the debris environmental impact question, and then there is the proliferation of the technology question. I think you can address some of the environmental impact question by talking about ways to responsibly test an ASAT -- lower altitude, do it in ways that minimize the creation of the debris.

But then you're effectively saying it's OK to develop the technology and you're OK with the technology proliferating, which then raises concerns, "Is someone then going to go out and use it in a future conflict?" and the use of it, it's not going to happen at 300 kilometers, because there's no military targets that low. It's going to happen higher, and it's going to have much more dangerous consequences.

As far as the prospects for an agreement, as Victoria laid out, unfortunately right now the major powers are talking past themselves. Past each other. Russia and China are pushing for a treaty to prevent placing

of weapons on orbit base as a way to hinder US space-based missile defense but at the same time allowing them to develop their ground-based anti-satellite weapons as a return against the US.

The US, for the last several years, maybe longer, has been saying no to any sort of agreement. They just want voluntary measures. Voluntary guidelines, that's what they want to talk about.

There are a few people -- notably Doug Loverro, former OSD Director of Space Policy, who has come out and said the US should be pushing for a narrow agreement that talks about banning this kind of kinetic testing of anti-satellite weapons.

In general you would think that the US government would be behind that, because they have the most to lose, but there is still a strong contingent in the US government that does not want to limit freedom of action. They want to keep their options as open and as wide-open as possible. Unfortunately, even if that means everyone else gets to do the same thing.

I have not seen that dynamic shifting yet in the US government to where the DOD and the IC will be supportive of limiting, bringing a ban. One can hope that at some point, they might. Until that happens, the US is not going to probably be a leader on this.

The question is, "Is there another country out there that's going to be willing to propose something other than the PPWT that deals with a narrow issue like this, and then try to rally support for it?" I haven't seen any indication that it'll happen yet, but it might. Not sure.

Victoria: Brian, you forgot the Code of Conduct.

Brian: Yes, the Code of Conduct. Voluntary. Bruce, and then I'll go up here.

Bruce MacDonald: Hi. Bruce MacDonald, the Johns Hopkins, SAIS and Federation of American Scientists. The question, first, a specific question, and then a more general question. Specific question is, Douglas Loverro, did he do that speech or congressional testimony here he said he would favor the narrow thing you just described? Are you aware?

Brian: He wrote it in an article in the space review I think a year and a half ago or so within a few months after he left. He's talked about it. The context was what principles should the US be pushing for in future space governance initiatives.

Bruce: OK. Thank you. Now, my question primarily to Ankit, but any of you. I would agree with your analysis about the objective for the Indian ASAT test, primarily being Pakistan. It seems to me that there could be an important secondary thing that China would be relevant as well.

It was announced in a recent government publication or sometime back that China may have won semi-operational BMD-based. I wondered if because of the growing strategic competition between China, India, that India might want to at least put a little uncertainty into China's mind with the test. They could always maybe expand to a second site.

In other words, not that that was the primary objective, but that might be a non-trivial secondary objective of the ASAT test. Also, thank you all for your presentations that I found very informative.

Ankit: Thanks for that question.

With China and Indian BMD, one thing I will say is that given just the numbers, the sheer ability of China and the People's Liberation Army rocket force, China poses a saturation challenge, and that there are just so many targets.

Even if India could create that kind of a doubt in the minds of the Chinese leaders and military planners, it would require a significantly larger BMD force than currently exists in India. Given Pakistan's limitations, it's much more useful there.

I believe the base you're talking about is [indecipherable 01:12:05] , which is actually not that far from the Indian border. That's what the Chinese actually do there hit-to-kill interceptor test using the DN-3 system.

Bruce: Wouldn't it be true though that a limited BMD would mitigate the option of a limited signal sending nuclear strike against India? That might put more of a challenge. They agree all out. They would have at least constrained China a little bit on nature including to send one or two nuclear weapons, but it's nothing to send a hundred.

Ankit: That's right. The only thing I'll say to that is that given what we know about China's nuclear doctrine, that practice would be highly unlikely for the Chinese to actually do in a conflict. That's just another limitation I see with that. But yeah, absolutely, the Chinese will take a note of this capability being developed in India.

Brian: Done here?

[pause]

Julian Lewis: Good afternoon. My name is Julian Kyle Lewis from the American University here in Washington. I'm also the associate director of the Office of Presidential Correspondence in 2011, President Obama.

I just want to clear up a few things and I have a question. As far as Pakistan is concerned, the way the United States deals with the country like Pakistan, we don't really trust them, but they're an ally.

A strategic partner in the region will say, "Hey, we'll let you tell the world that you have these nuclear warheads. We'll give you the cover for it even though we know what you do and don't actually have and India is actually aware of that." They've been trying to call Pakistan's bluff over the past course of however many months. That's point number one.

Point number two, with President Trump's space force, that's where my question's going to be, what he saw before he made that announcement, Russia let out a cube into space. What happened was a smaller cube came out of a larger cube and a smaller cube came out of this other smaller cube.

He saw that and he was just thinking, "Well, how would we defend if just a missile came out of one of those cubes at any given time because a cube has all of those different sides and angles? It could come from the top, at the bottom, at the left, at the right." That's what he saw. He was like, "Space force. We need a space force. Oh my goodness. How do you stop that?"

What I would like to know from anyone who wants to answer is what do you think about the progress of President Trump's space force over the course of the past year? Thank you.

Brian: You mentioned basically the satellite series, Kosmos 2519, 2521, 2523. You're talking about the Matryoshka satellites? Yeah, that was something we saw. It's not necessarily new. There had been multiple tests in the past.

There was a DARPA program, 2007, where two satellites separate in orbit and then rendezvoused, did an exchange of fuel and things. I don't quite think that was impetus for the decision. The space force debate long predates President Trump. It's been going on for 20 years or so.

The most likely reason why he came up with that is that there was a study, [indecipherable 01:15:37] study underway that was evaluating multiple different options for restructuring military space activities. One of which was a space force. In the midst of that study over the course of last spring, for whatever reason, he seized upon that as what he wanted to see.

Interesting that the actual policy proposal put forward couple months ago by the administration is not a "separate but equal" space service as he put it, but a corps underneath the Air Force. As to where that stands, it's in congress' hands at the moment because that change has to be authorized and funded by congress. It's being discussed as part of the FY20 budget discussions.

We'll see probably end of May, early June when the markup happens whether or not the initial mark includes a space force or not, and then whether or not they come to a budget agreement by October 1st, or unlikely. Probably won't be resolved until, I would say, late fall or early next year if the budget negotiation's gone that far.

The question...

Victoria: Actually...

Brian: I'm sorry. Go ahead.

Victoria: Just add a brief advertisement to my colleagues from CSIS. Do you guys want to talk about your documentary really quickly?

[pause]

Kaitlyn Johnson: Hi, I'm Kaitlyn Johnson and I'm associate director for the Aerospace Security Project at CSIS. We featured Victoria and several other experts talking about the history of the space force and this debate of national security space reorganization. It's called "Commanding Space -- The Story Behind the Space Force." It can be found at our website, aerospace.csis.org.

Victoria has the best line in the entire thing. I really recommend you check it out.

Victoria: It's very exciting. It's 18-minutes long to [indecipherable 01:17:38] .

[laughter]

Victoria: Not my line.

Brian: Another question out there? Yes? Over here, and then I'm going to...

Jay Gullish: Jay Gullish, US-India Business Council. Two separate questions.

One, I know there's clear desire for commercial space industries in both India and the United States to work together, figure ways out how to share technology, solutions and services. Does the ASAT test help hinder or is it completely neutral on commercial industry working together from the two countries?

My second question is later in the year, the US and Indian government have a space dialogue schedule on civil space. Proactively, what are some of the things the two governments can talk about to perhaps push the concept of space stability and how the two governments can both work together to enhance that?

Thank you.

[pause]

Dr. Hall: OK. I'll take a step for the first part.

On the surface, I don't see it affecting one way or other, the ability or the possibility of the commercial industries working together with the one exception -- and this is striking -- you're talking about how it really was a veiled BMD test.

If you're deploying and developing an ASAT weapon and you don't have the ability to track targets other than TLEs that are published by the 18th Space Control Squadron, you might want to look at that.

They're not necessarily target quality information. Your seeker has to be much more capable. If they're going to go down this path, they're going to need to build an indigenous SSA capability. You talked a little bit about it.

For a country that wants to go from 0 to 60 and doesn't have the five decades of Cold War experience and ballistic missile defense deploying global sensors, commercial is one way to jumpstart that development of indigenous SSA capability.

Victoria: Yeah. Just building on that idea, one of the strongest, sharpest criticisms after the ASAT test came from the new space commercial actors who said, "We are not happy about this because the main effects are our ability to utilize it." Planet, for example, is one of them that said that. They often get their satellites launched by the PSLV.

Having said that, I don't know that they've changed their thinking using the PSLV. Maybe it just showed you unhappiness and we'll go on from there. It definitely was said that.

In terms of this US-India civil space dialogue, we keep harping on this. SSA is foundational to the use of space, whether it's civil space, security space, scientific space, commercial space, it is foundational. We really need to have a way to share information back and forth because as Bob has said, sensors can only do so much and our operators have very good information.

There should be a way in which you show information, so you have a better picture overall of what's being used in orbit.

Dr. Hall: In the case of Planet, they actually have a PSLV launch in April just days after they criticized India, which is very interesting.

Brian: Yeah, and in Planet's defense, I don't think they're going to pull a bunch of satellites of that time scale, particularly when the PSLV is one of the few options they have. That said, they were very serious about their concern about this. Other companies, not all have been as publicly adamant, but many have been expressing concerns.

Their concern is that this testing, that does create more debris. Any debris in low Earth orbit could impact their business models and their ability to do stuff in low Earth orbit and make money off of whatever the business model happens to be.

If there were more launch options other than the PSLV at this point in time, you might have seen a different response from companies expressing their concerns. But like the US, they made it a decision that, "We're not happy about this. The importance of us getting our satellites into orbit outweighs taking any action about it." There is a broader question here.

That is, how is this proliferation of counter space technologies that we talk about in our report and SSA talks about in their report, how is that impacting this commercial development of space? You have on one hand all this discussion of the trillion-dollar or more space economy and the commercial boom, and going on.

Then you have a separate discussion going on that is the proliferation via satellite technology and the satellite testing, and concerns about war extending into Space. There's not a lot of overlap that I've seen among those two communities and those discussions even though there probably should be. They impact each other. Hopefully, we'll find ways to bridge those discussions at some point.

[pause]

Jim Armor: Testing one, two. Jim Armor with Northrop Grumman. As a student or a victim of five decades of nuclear strategy and politics, this discussion makes my head hurt. I've heard it all before dozens of times.

To me, the most illuminating part of our discussion has been from Bob with the commercial capabilities to show some degree of attribution, transparency, tracking, and consequences of these activities in Space.

What I wanted to ask you, Bob, is is this a growth area in commercial business? Are more and more folks going to start investing in commercial Space situational awareness in a transparent way?

Furthermore, are you seeing the insurance folks roll in in a liability regime where you can attribute, "Oh, after this test, this part hit that satellite," and lawsuits or whatever ensue? Are you seeing anything like that evolving, Bob?

Dr. Hall: Let me try and go in order. Do we think this is some sort of growth area with regard to SSA and in this environment? I don't see the assent being a tremendous swinger here. The broader problem -- I alluded to it, I didn't foot stomp it -- there's a gap between what is published or tracked today, size-wise, and the size that an operator needs to be concerned with.

What I mean by that is, there's a small enough size that if you have a satellite get hit by that, it will damage your satellite. It may even completely disable your satellite. You'll have a dead satellite. It'll maybe go through it, produce very little debris. There's bigger and bigger pieces of debris.

You get to the point where you can have a piece of debris hit your satellite. It disables your satellite and it creates a debris field. Then, as we keep going up in size, it's higher than that that we get to the size of things that we, as humankind know about today, that we can measure with the sensors we have today.

If you have a business plan and you're putting up hundreds of satellites in a common altitude, there's that no-man's land where the thing is too small to be tracked but big enough to take out your entire business model. That is the Achilles' heel, I would say. Space Fence coming online should help close that gap.

There are other commercial capabilities being looked at that might help close that gap to drop the perceived line closer to the size-that-kills-my-business-plan line. That is a conversation that's going on. We haven't seen it completely hit the knee in the curve yet.

A lot of these large constellations remain on paper. We've seen one web has launched four or six satellites. We're still in the very, very early stages. As these constellations actually come to fruition that entire conversation is going to change rapidly.

The other question you had was about insurance. The attribution angle's an interesting one. We haven't talked too much about that. We have talked a lot about collisions, and insurance, and insurance companies, and their insured commercial owner-operators. What has to be tracked? What's the risk?

Is there a dynamic where the insurers would get to the point where they would almost demand or require that the insured does more to understand their environment? Insurance, it turns out, is a very funny game where sometimes it sounds like they want losses once in a while.

Sometimes we've had to scratch our head when we have these conversations with the insurance industry. That doesn't mean that they're looking for death, and destruction, and gloom. There's an interesting dynamic there.

Then, on top of that, take, for example, Intelsat 29e which just died last month. It was a three or four-year-old satellite which, guess what, was not insured. Operators often operate on the very hairy edge, from a profitability standpoint. The beginning of the mission and then that's it. I'm not going to insure the rest of the mission. The whole insurance question is a dicey one, I would say.

Brian: Sorry. I'm going to add on that. We did a workshop with several reps in the insurance community beginning of last year, I think, talking over the issue whether or not insurance could ever be incentive for responsible behavior. The short answer was, no, not in the short term. Some things change in the Space world, it could be. That report's available on the website.

To add on to something that Bob said, the insurance company, at least in the Space world, tends to also be lagging in that they look for historical data and metrics to drive their future investments. They're not, at least for the time being, not looking ahead to what might be coming in terms of how the metrics might be changing in the future.

There's no court cases. There's not lawsuits. There haven't been any actual damages in orbit that anyone's took anybody to court over. There isn't any motivation for them to start looking at that yet.

Victoria: I was going to say the exact same thing.

Brian: Sir?

Audience Member: Yes, I wanted to ask about what the debris field is made of? What are the materials in the debris field?

Dr. Hall: Off the top of my head, I don't think I can answer that. I'd have to consult with some people. I'm sure there's a lot of aluminum on the satellite. Beyond that, I couldn't speak to that properly.

Audience Member: Does that make a difference in how sustainable our debris field is or how it can be cleaned? Is anybody working on that?

Dr. Hall: Indirectly, it does, for example, that piece that I showed that's three years out. We've looked at a few different pieces. We're at the mercy, right now, of using the TLEs that the 18th has published for the debris population. There's detailed physical data that that process doesn't provide, for example, things about the ballistic coefficient, what have you.

We've done some reverse engineering on a few pieces and seen a significantly varying ballistic coefficient indicating a much more dense piece, which was the one that's going to take three years, as opposed to pieces that have a much lower ballistic coefficient.

The other thing is, we're dealing with, statistically, it's a fairly small population set, several dozen pieces. They say they have a couple hundred. I'm hoping that more of those get released. Of course, as we get further from it, some of them will reenter.

Brian: Part of the question is, what's working on to clean this stuff up? This particular case, even the pieces of this that did go as high as 2,200 or higher kilometers in apogee, the perigee is still down at 280 kilometers. They're going to reenter. Three years is longer than claimed but still relatively short compared to other things.

There's quite a bit of RND going on and technology development on debris removal in general, both government side and commercial side. The challenges is that, so far, no one's willing to pay for that development. The US government, for example, NASA has said that they're willing to do R&D up to TRL3, which includes paper studies and on-the-ground but no actual in-flight demonstrations.

The only in-flight demo that we know of so far was recently done by the European Union. The Remove Debris mission out of Surrey in the UK. They tested several different technologies that could, in the future, be used to remove debris. There's still this gap between the technology demos and having an actual capability to go do it.

I would say, earlier what Bob said about the large constellations, there is a chance that that might help spur the creation of that capability. If you've got a thousand satellites in a constellation, even at a five percent failure rate every three to five years, that's still a lot of dead satellites in your own orbit.

A couple of those companies are talking with other companies about a tow-truck kind of a service. That might help get the technology real. They're not going to pay to clean up after everybody else's debris, just their own. That might get us somewhere down the road. So far, most governments, including the US, have not prioritized any kind of funding for that capability.

[pause]

Nicholas: Nicholas [indecipherable 01:32:45] . My question is, do you think that the whole situation with India ASAT Test can pave the road for laser technologies to be used for, not necessarily tracking of orbital debris, but also taking down?

Brian: The question, you mean...

Nicholas: Do you think that the whole ASAT situation, what happened now, can pave the road for enabling and deploying laser technologies for orbit debris removal?

Brian: Laser?

Nicholas: Yes.

Brian: There are a couple of entities working on this. Primarily, a group in Australia that is developing technology to lase small pieces of debris in lower Earth orbit to slightly alter their orbit. Over repeated attempts, they can bring it down faster than it would normally otherwise do. I've heard they might be testing at some point this year. I'm not sure about that.

That was going on long before this test happened. Those particular technologies are looking at the much smaller pieces of debris, the less-than-10-centimeter sizes that Bob was talking about. The challenge there is that those pieces are not generally well tracked.

You have a challenge of how do you know they're there in order to be able to lase them, bring them down. I don't think this test is necessarily going to push that at all. It is still a relatively small population of debris compared to other things that have happened. It's certainly not going to hinder that development, I don't think.

Victoria: I think maybe what it does, it gives an incentive. This is not something we're talking about or an event that happened 10-plus years ago. It happened recently. It probably, very likely, is going to happen again soon.

It becomes much less a theoretical discussion, "Hey, it'd be nice to have [indecipherable 01:34:44] technologies." Be like, "Oh my gosh! People are testing ASATs. We need to have a way to handle that now."

Brian: Question, Ankit, for you. You mentioned this discussion you had on Twitter at some point over whether how much the timing the test driven by the election or not. In the video that came out after the test, if I recall, they said that the decision to start the program had started in 2014.

Then the decision for the test was made a year and a half or two years earlier. Can you unpack that a little bit and talk about how much, if any, of the time you might have been driven by the election or how much the role domestic politics played in all this?

Ankit: Yes, we have some evidence after the test that this is certainly being used in a political way. The prime minister, at one of his rallies shortly after the anti-satellite test, made a reference to having conducted surgical strikes on land, and air, and Space.

The surgical strikes were something that India did after a major terrorist attack in 2006 when it claimed that it had crossed the line of control to strike at terrorist launch pads in Pakistan-occupied Kashmir. The fact that that was compared to the anti-satellite weapon test at a political rally by the prime minister, imbued this whole test with a degree of political significance.

As far as the political assent and the decision to move forward with an anti-satellite test, what I've heard is that same thing. 18 months to two years in advance of the actual test occurring, the decision had been made, well ahead of the election schedule. The fact of the test does coincide with the actual electoral calendar.

In fact, when the test occurred and the prime minister announced it, the Indian electoral commission had to investigate the prime minister. India has a particular law called the Model Code of Conduct where members of the sitting government aren't meant to make major social, or economic, or other political announcements that can be seen as gaining an unfair electoral advantage.

They cleared the prime minister. He wasn't held culpable for making the announcement. Certainly, the politics, the opposition definitely seized on it as a bout opportunism. We can look at it in a way as India imbuing a degree of techno-strategic optimism right before the elections.

The end of February, the conflict with Pakistan, in my view, did not go particularly well for India. India lost a MiG-21 and a pilot. The narrative of a sweeping victory was not something that India enjoyed on the international stage, certainly.

Carrying out this anti-satellite weapon test a few weeks later is this major moment of national pride and optimism that we're now in this exclusive club of countries that can destroy a satellite. Part of it's there. The political assent does come a lot earlier.

I suspect we'll learn more about the factors within the Indian government that led to this as time moves on and we get a little bit more insight into national security decision making in Modi's first term.

Victoria: To add on to that, I think, you don't do this at the drop of a hat. You have to plan for it, obviously. My opinion is that definitely, the political situation had a lot to do with the timing. There was, as far as I can see, zero negative consequences for Modi for this test.

They did it. They did great. The only criticism I saw was that it hadn't happened earlier. In my opinion, they figure it was a win-win. You have the test. If it didn't work out, you say it's a missile events test and never acknowledge it.

If it worked out, great you can demonstrate your technological prowess and use it for elections. If you read articles about the Indian election and campaigns, every single one it's mentioned.

Brian: Any other questions out there? We're reaching the end here.

[pause]

Audience Member: Thank you very much indeed. Just a small point responding to Ankit's views on the fact that India was not being seen as having come out of that February thing well. February in Balakot strike and all if I understood it well. A minor point to highlight that, to give you a sense of what happened when Pulwama the terrorist strike happened on the 14th of February.

As I mentioned, you need to look at the reaction of the world in terms of major countries, almost 50-odd countries, much more, the entire world, coming out with a lot of criticism over the Pulwama terror strike. If you look at the US, you should see the statements coming out of bipartisan manner of a lot of members of the Congress here.

There were statements from the White House, statements from the State Department and all that. Then when Balakot happened on the 26th, you could see even there judging from the world reaction that there was this sense of the world that something like this, terrorism being used as an instrument of state policy simply cannot go on and on.

If I may inform you all, I'm sure all of you are aware of this, Masood Azhar, the chief of Jaish-e-Mohammed, the outfit which claimed responsibility for the Pulwama attack on 14th of February, has just been listed as a global terrorist by the UN Security Council's 1267 sanctions committee. I rest my case there. Thank you.

Brian: Any final questions at all about the India ASAT Test or where we're going? I do have one for Victoria. You'd mentioned where things stand in various multilateral discussions on Space security and peril sort of things.

One of the things we talked about in our report was the notion that India might decide to test to get ahead of some sort of ban on [indecipherable 01:40:52] satellite weapons or be grandfathered in. Do you think that this test having happened makes it more or less likely might eventually get to some sort of global agreement this should not be done?

Victoria: I think it makes us more likely. As I said before, the previous tests we had to talk about were over a decade old. Now we have a country demonstrating this technology and being willing to test it. It's no longer a theoretical discussion. It's something you need to actually deal with. Maybe there'll be a silver lining coming out of this.

Brian: Thank you very much. Please, join me in thanking our panelists.

[applause]