HEARING ON THE ROCKET'S RED GLARE: CHINA'S AMBITIONS TO DOMINATE SPACE

HEARING

BEFORE THE

U.S.-CHINA ECONOMIC AND SECURITY REVIEW COMMISSION

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FIRST SESSION

THURSDAY, APRIL 3, 2025

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U.S.-CHINA ECONOMIC AND SECURITY REVIEW COMMISSION

WASHINGTON: 2025

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HEARING ON THE ROCKET'S RED GLARE: CHINA'S AMBITIONS TO DOMINATE SPACE

THURSDAY, APRIL 3, 2025

U.S.-CHINA ECONOMIC AND SECURITY REVIEW COMMISSION

Washington, DC

The Commission met in Dirksen Senate Office Building, Room 430, and Webex at 9:30 a.m., Commissioner Michael Kuiken and Commissioner Cliff Sims (Hearing Co-Chairs) presiding.

OPENING STATEMENT OF COMMISSIONER MICHAEL KUIKEN HEARING CO-CHAIR

COMMISSIONER KUIKEN: Good morning.

Today, we examine a critical threat, China's rapid advancements in both its civilian and military space programs. We must understand what this means for U.S. national security, technological leadership, and global influence.

What is happening in China's commercial and military space industry follows a similar and familiar pattern. We have seen it with semiconductors, with Huawei, with solar panels, with batteries, electric cars, and with biotech.

China is following its proven playbook. It is systematically building a manufacturing and R&D infrastructure to iterate rapidly and seize dominance in space.

China observers routinely talk about China's civil-military fusion. Let's be clear-eyed. China is pursuing a whole-of-nation approach to compress decades of American and European space innovation into just a few years, positioning it to leapfrog ahead.

China has fueled its space ambitions through all of its familiar illegal and gray zone tactics -- cyber theft, deceptive joint ventures, forced technology transfers, talent recruitment programs, academic espionage, lawfare, hostile takeovers, and strategic acquisitions that ultimately relocate technology to Chinese soil.

During our recent "Made in China 2025" hearing, Dr. Drew Endy warned that we have 1,000 days to not lose in biotech. The same urgency applies to space. We have no time to waste. Losing in space would mean surrendering our military advantage, economic opportunities, and the ability to set international norms.

Imagine an alternative history where America didn't lead in space. It is not science fiction, to say our world would look dramatically different.

The original Sputnik moment served as a catalyst for action. The space race with the Soviet Union defined the mid-20th century. Our competition with China in space will shape the 21st century.

Since the Commission's last hearing on this topic in 2019, China's space ambitions have become achievements. Their civilian space milestones are not merely symbolic. They are calculated moves to challenge U.S. leadership.

By 2030, China plans to land on the moon and return samples from Mars. By 2035, they aim to establish an operational Lunar Research Station. By the 2040s, China plans to expand its lunar base and explore beyond Mars and Jupiter. These are not distant dreams. They are concrete steps in a strategy to cement China's position as a global space power.

China's ambitions extend far beyond exploration. Their commercial space sector is booming. Once dominated by state-owned giants, China's commercial space industry expanded after 2014. The government opened the door to private investment. A new wave of companies has surged into the market. China's market has more than doubled, from 2019 to $268 billion in 2023, and are estimated to get to $900 billion by 2029.

China's companies are racing to deploy Reusable Launch Rockets and mega space constellations. They aim to crowd out U.S. companies and dominate space in the near term. China is already deploying cutting-edge quantum satellites while U.S. companies trail behind. Meanwhile, China's crude space station and ambitious lunar mission plans seek to challenge American leadership in human space flight, as well.

This is not about technological bragging rights. China's expanding space power poses real military and economic challenges. The PLA's counterspace capabilities are advancing, as well. Beijing's influence over the global space governance is growing, too. As Kari Bingen, a former Department of Defense leader and leading expert on space policy recently warned, "Our space sector, the U.S. space sector, has long been an advantage for the United States. We need to keep that advantage."

The United States cannot afford complacency. Our technological innovation, talent development, and military readiness are being tested.

Today, we'll hear from General Chance Saltzman, Chief of Space Operations for the U.S. Space Force. He will provide insights on the strategic stakes of U.S.-China competition in space, explain how the Department of Defense is preparing increasingly contested domain, and following General Saltzman, we will have a panel of experts to further explore issues related to U.S.-China competition in space.

So, before I turn it to my dear friend, Commissioner Sims, let me thank the witnesses for their testimonies today. Thank you to the Senate HELP Committee for allowing us to use this new and renovated, beautiful hearing room, and to Commissioner Sims for his shared interest in this important topic.

Commissioner Sims.

PREPARED STATEMENT OF COMMISSIONER MICHAEL KUIKEN
HEARING CO-CHAIR

Hearing on "The Rocket's Red Glare: China's Ambitions to Dominate Space"
April 3, 2025

Opening Statement of Commissioner Michael Kuiken

Thank you all for joining us today. I extend my gratitude to our witnesses for their expertise.

I appreciate the Senate HELP Committee for allowing us to use their hearing room. Today, we examine a critical threat: China's rapid advancements in space. We must understand what this means for U.S. national security, technological leadership, and global influence.

What's happening in China's commercial and military space industry follows a familiar pattern. We've seen it with Huawei. We've seen it with semiconductors. We've seen it with solar panels. We've seen it with biotech.

China is building a massive manufacturing capability to dominate space. Their goal is to bifurcate the world into their sphere and ours. China has built this industry by stealing and buying American and European intellectual property.

During our recent "Made in China 2025" hearing, Dr. Drew Endy warned that we have 1000 days to not lose in biotech. The same urgency applies to space. We have no time to waste.

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China's ambitions extend beyond exploration.

Their commercial space sector is booming. Once dominated by state-owned giants, China's commercial space industry expanded after 2014. The government opened the door to private investment. A wave of new companies has surged into the market. China's market more than doubled from $113 billion in 2019 to $268 billion in 2023. Beijing designated commercial space a "strategic emerging sector." Now, China's commercial space market is projected to reach $900 billion by 2029.

Chinese companies are racing to deploy Reusable Launch Rockets and mega-constellations of satellites. They aim to crowd out U.S. companies and dominate space in the near term. China is already deploying cutting-edge quantum satellites while U.S. companies trail behind.

This is not just about technological bragging rights. China's expanding space power poses real military and economic challenges. The PLA's counterspace capabilities are advancing. Beijing's influence over global space governance is growing.

The United States cannot afford complacency.

Our technological innovation, talent development, and military readiness are being tested. Maintaining U.S. leadership requires cutting-edge technology. We must ensure the United States and our allies shape the rules for space operations.

Today, we welcome General Chance Saltzman, Chief of Space Operations for the U.S. Space Force. He will provide insights on the strategic stakes of U.S.-China competition in space. He will explain how the Department of Defense is preparing for this increasingly contested domain. Following General Saltzman, a panel of experts will examine China's military and commercial space capabilities and their implications for the United States.

With that, I'll turn it over to my colleague and co-chair for this hearing, Commissioner Cliff Sims.

OPENING STATEMENT OF COMMISSIONER CLIFF SIMS,
HEARING CO-CHAIR

COMMISSIONER SIMS: Thank you, Commissioner Kuiken. General Saltzman, thanks for taking the time to come down and speak with us today.

The space race of the 20th century captured the imaginations and the ambitions of the American people. However, before NASA's Apollo 11 delivered "one giant leap for mankind," the Soviet Union's Sputnik 1 raised fears of the capabilities that could be unleashed by United States adversaries.

The question today is: Will the next "Sputnik moment" be "Made in China," or will the United States once again lead the way in the new space race? Now, as it was then, the country who wins this race toward the stars will likely also be the country who is this century's defining power here on Earth.

During my tenure in the Office of the Director of National Intelligence, under the leadership of then-DNI John Ratcliffe, space was made a priority intelligence domain, and Space Force was added as the 18th member of the U.S. intelligence community. That was just over 4 years ago.

Earlier this year, I helped lead the transition of administrations inside one of our intelligence agencies. As I got up to speed on various challenges and opportunities, I was struck by the progress the People's Republic of China had made in some of the critical technologies that will define the future, including in space.

China has become a peer competitor -- and in some areas, the world's leader -- in key technologies where they were not on our level just a few short years ago. According to ODNI's Annual Threat Assessment released last week, China has achieved world-class status in all but a few space technologies. This development has enormous geopolitical, economic, and military implications, which I look forward to discussing in today's hearing.

The United States -- our government, our private industry, and our people -- must have a sense of urgency to win Space Race 2.0. But we should also have the confidence of knowing that we have won before, and we are well positioned to win again.

The U.S. remains the global leader in launch capabilities. Our commercial space industry is the envy of the world -- no other country is catching rockets with chopsticks so they can be sent back out into space again.

The Trump administration has ambitious goals for the "Golden Dome" missile defense shield, whose success will demand continued innovation in space-based assets. We are going back to the moon, and God-willing, we will be the first country to plant our flag on Mars.

I look forward to the testimonies from our witnesses today as we seek to retain U.S. space superiority in the 21st century.

PREPARED STATEMENT OF COMMISSIONER CLIFF SIMS,
HEARING CO-CHAIR

Hearing on "The Rocket's Red Glare: China's Ambitions to Dominate Space"
April 3, 2025

Opening Statement of Commissioner Cliff Sims

Thank you, Commissioner Kuiken.

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PANEL I INTRODUCTION BY COMMISSIONER MICHAEL KUIKEN

COMMISSIONER KUIKEN: General Saltzman, I have this long introduction about you that I will forego reading and put in the record, and turn the microphone over to you. I will note that General Saltzman is a native of Kentucky and went to Boston University.

Over to you.

BIOGRAPHY OF GENERAL B. CHANCE SALTZMAN
CHIEF OF SPACE OPERATIONS, U.S. SPACE FORCE

General B. Chance Saltzman

Chief of Space Operations, United States Space Force

Gen. B. Chance Saltzman is the Chief of Space Operations, United States Space Force. As Chief, he serves as the senior uniformed Space Force officer responsible for the organization, training and equipping of all organic and assigned space forces serving in the United States and overseas. As members of the Joint Chiefs of Staff, the Chief of Space Operations and other service chiefs function as military advisers to the Secretary of Defense, National Security Council, and the President.

Gen. Saltzman is a graduate of Boston University and was commissioned in 1991. He has operational experience with missile and space systems, as a Minuteman III launch officer, and as a satellite operator for the National Reconnaissance Office. He also served as the first Chief of Combat Plans for the Joint Space Operations Center, and later, as Chief of Combat Operations.

Gen. Saltzman has commanded at the squadron, group, and wing levels including the 614th Space Operations Squadron and 1st Space Control Squadron at Vandenberg Air Force Base, California; the 460th Operations Group at Buckley AFB, Colorado; and the Aerospace Data Facility Colorado, Aurora, Colorado. Before serving in his current assignment, Gen. Saltzman was the Deputy Chief of Space Operations for Operations, Cyber, and Nuclear, United States Space Force, the Pentagon, Arlington, Va.

General Saltzman has not previously testified before the Commission.

OPENING STATEMENT OF GENERAL B. CHANCE SALTZMAN, CHIEF OF SPACE OPERATIONS, U.S. SPACE FORCE

GENERAL SALTZMAN: Well, thank you, Commissioner Kuiken, Commissioner Sims, Madam Chair, Mr. Vice Chair, to all the members of the Commission. Thank you for inviting me to testify today.

The space domain plays an increasingly vital role in making the modern American way of life possible. China's pursuit of its ambitions in the domain could present a powerful destabilizing force to our economy and our national security.

Today, more than half of the 16 sectors of critical national infrastructure depend on satellites. A third of our crops are grown using weather data form space. Internet and cellular service relies on satellites for optimization and resiliency. Modern transportation and logistics would be impossible without the Global Positioning System, and the timing signal it provides serves as the basis for digital finance and e-commerce transactions.

Undoubtedly, space underpins our nation's economic prosperity, but it also provides the backbone for our national security. Today's Joint Force is built and sized around the assumption that space will be there when needed. Setting aside the obvious examples, many of our most important weapons depend on GPS guidance to hit their targets, and the rapid collection and flow of data from space is the basis for the way we mass and maneuver fires in support of battlefield objectives.

Simply put, space matters more and more every single day, and a significant amount of our capability is built, sustained, and operated by the U.S. Space Force.

Unfortunately, we are not alone in recognizing the incredible strategic advantage offered by space. Over the lasts two decades, our competitors, China in particular, have invested heavily in counterspace threats: kinetic and non-kinetic weapons that can deny, degrade, or destroy our satellites. In 2007, I stood on the Operations Floor in the Joint Space Operations Center at Vandenberg Space Force Base, and I watched China test an anti-satellite missile for the first time.

Clearly, from a military perspective, Beijing understands that the space domain is a key enabler of long-range precision strike as well as information gathering and dissemination, which makes it foundational to the projection of national power.

In the near term, China's investments in reusable launch vehicles and on-orbit refueling represent an inflection point in space access that may result in China overtaking U.S. leadership in the domain. In the face of this competition, the Space Force was established in 2019, to reshape the way the U.S. projects power in space.

Armed services are unlike any other organization in Federal Government. They unify people, resources, and vision for one purpose: to contest and control geographic domains with military force. Their formative purpose is domain superiority, ensuring freedom of access for our forces, while denying the same to our adversaries. Just as the Navy is purpose-built to secure the sea lanes, the Space Force must stand ready to gain and maintain superiority in space.

In the process, the Space Force must confront a unique challenge. We are the first new military service in over 72 years, and we have had to ask ourselves fundamental questions that other services answered generations ago. Transforming into legacy thinking and processes we inherited from Air Force Space Command has been an enormous task, and I like to explain it like this.

In the past we operated like the Merchant Marine, and our focus was on efficiently

delivering services in a benign environment. But space has become a warfighting domain, and you do not ask the Merchant Marine to secure the sea lanes. For that you need a Navy. You need an organization devoted to controlling the domain so you can access it and exploit it. You need fundamentally different equipment, operational concepts, training, everything recontextualized through the lens of military readiness. In other words, you need a Space Force.

Other space agencies do incredible work, but they are not the Title X armed service entrusted with designing, developing, generating, and employing military force. We are.

We have made tremendous progress over the past 5 years, but the reality is that we still have a long way to go. Last year, the PLA's budget increased by 7 percent, with what I determined to be stable funding and stable requirements. Meanwhile, in absolute terms, the Space Force is shrinking. Dollars appropriated are less each year since 2023. Especially with regard to our newest and most vital mission, Space Control, we lack the force structure we need to execute our missions in the manner of our choosing.

As the Chief of Space Operations I will tell you that my primary focus is transforming the force into a warfighting organization. This means new equipment, new training, new operational concepts and doctrine. There is no single part of this effort that resolves the challenge. We cannot just focus on acquiring new technology. We must transform the entire enterprise. We must build the entire force and all its elements, people, and processes, because systems are useless without minds to direct them. Our Guardians are uniquely and specifically trained, educated, and experienced in space warfighting, but we have given them a heavy burden in defense of our nation.

Now, while I am speaking to you as a military service chief, the problem we face before us is not simply a military one. What is clear to me is that we must better understand, as a nation, the vital role that space plays in the health and welfare of our nation. And in the face of a competitor with capability to destabilize all of that, we must unify behind a whole-of-government approach that ensures the safety, security, and sustainability of the space domain.

Thank you for the opportunity to speak with you all today and share my thoughts and concerns on a topic I think will be the generational challenge of our times, and I am happy to answer your questions. Thank you.

PREPARED STATEMENT OF GENERAL B. CHANCE SALTZMAN, CHIEF OF SPACE OPERATIONS, U.S. SPACE FORCE

Testimony of General B. Chance Saltzman
Chief of Space Operations
United States Space Force

Submitted to the
U.S.-China Economic and Security Review Commission

Hearing on
China's Ambitions in Space

April 3, 2025, 10:00 AM

Commissioner Kuiken, Commissioner Sims, and distinguished Members of the Commission, thank you for inviting me to testify here today. The space domain plays an increasingly vital role in making the modern American way of life possible, and China's pursuit of its ambitions in the domain could present a powerful destabilizing force to our economy and our national security.

The Space Force was established in December 2019 in recognition of one key fact: space is a warfighting domain. In five short words, that phrase encapsulates a tremendous change that has taken place over the last two decades. When I began my career, space was a benign environment—a sanctuary from which we could

deploy game-changing services like positioning, navigation, and timing; satellite communications; weather monitoring; intelligence collection; and missile warning and tracking, just to name a few. Because launch costs were high, we aggregated capability into small handfuls of exquisite satellites, secure in the knowledge that they were remote and untouchable by adversary action. Over time, we came to depend on those satellites to the extent that most people forgot they were there, but while out of sight might mean out of mind, it does not mean unimportant.

Today, more than half of the 16 sectors of critical national infrastructure depend on satellites. A third of crops are grown using weather data from space. Internet and cellular service rely on satellites for optimization and resiliency. Modern transportation and logistics would be impossible without the Global Positioning System (GPS), and the timing signal it provides serves as the basis for digital finance and e-commerce transactions. Today, if you've checked for rain in the forecast, made a purchase with your credit card, or sent a text message, you have already called upon a satellite to make it happen, whether you knew it or not. Simply put, space matters more and more every single day, and the vast majority of our capability is built, sustained, and operated by the U.S. Space Force.

Undoubtedly, space underpins our nation's economic prosperity, but it also provides the backbone for our national security. Today's Joint Force is built and sized around the assumption that space will be there when needed. Especially since the creation of the Space Force, we have transferred increasing responsibility to military space operations. Setting aside the obvious examples, many of our most powerful weapons depend on GPS guidance to hit their targets, and the rapid collection and flow of data from space is the basis for the way we mass and maneuver fires in support of battlefield objectives.

As the military service responsible for space, the Space Force has a unique vantage point in these matters. Like the Air Force, the Army, or the Navy, our overriding purpose is to achieve domain superiority—to contest and control the space domain so that we preserve freedom of action for our forces while denying the same to our adversaries. Unfortunately, we are not alone in recognizing the incredible strategic advantage offered by space, and we cannot take space superiority for granted.

Over the last two decades, our competitors—China in particular—have invested heavily in counterspace threats: kinetic and non-kinetic weapons that can deny,

degrade, or destroy our satellites at will. In 2007, I stood on the Operations Floor in the Joint Space Operations Center at Vandenberg Air Force Base, and I watched China test an anti-satellite missile for the first time. I monitored the debris as they shattered a defunct weather satellite into thousands of small pieces, many of which we are still actively tracking today. In that moment, I knew that things had irrevocably changed—space was no longer safe.

Since that time, China's emboldened ambitions have only exacerbated matters. Their space program has become a source of pride—a linchpin in facilitating Chairman Xi's "China Dream." From a military perspective, Beijing understands that the space domain is a key enabler of long-range precision strike as well as of information gathering and dissemination, which makes it foundational to the projection of national power. As such, China has worked hard to bolster their own spacepower while developing the capability to defeat that of any nation that would oppose them. Today, China's operational fleet is second in size only to that of our own, and it continues to grow rapidly. In fact, just last October, China published a new Space Development Plan that lays out Beijing's intent to surpass the United States in the space domain and become the world's preeminent space power.

Advancement of China's Spacepower

China has been aggressively pursuing this objective for a decade, now. In 2015, it officially designated space as a new domain of warfare, overseen originally by the Strategic Support Force (SSF). In April 2024, China dissolved the SSF and established the People's Liberation Army (PLA) Aerospace Force, creating just the second independent space force in the world.

In the past ten years, China's on-orbit capability has grown by approximately 620%. As of October 2024, China claimed more than 1015 satellites in active service, and they are fielding more every year. For example, in 2023, China accomplished 66 successful space launches, placing 217 payloads into orbit with more than half performing intelligence, surveillance, and reconnaissance (ISR) missions. This brings the PLA to approximately 510 Earth-observing satellites with optical, multispectral, radar, and radio frequency sensors, vastly enhancing its ability to detect and track U.S. aircraft carriers, expeditionary forces, and air wings. In December 2023, China launched the Yaogan-41 remote sensing satellite into

geosynchronous Earth orbit (GEO), which allows persistent monitoring of U.S. and allied activity in the Pacific region.

Similarly, China has launched 36 G60 communications satellites to low Earth orbit (LEO), providing global internet connectivity and extending their digital reach. This represents the first tranche of a proliferated LEO (pLEO) constellation that will grow to 648 satellites by the end of 2025 and to 14,000 satellites by 2030, allowing it to compete with Western commercial pLEO constellations.

China's third-generation version of GPS, BeiDou-3, provides global, 24-hour, all-weather, high-accuracy positioning, navigation, and timing services. Even now, the PLA uses BeiDou to enable precision force movement and maneuver.

China also has executed three reusable spaceplane missions, all of which released unacknowledged objects. Additionally, in July 2021, it conducted the world's first fractional orbital launch of an intercontinental ballistic missile with a hypersonic glide vehicle, which flew the greatest distance (i.e., ~40,000 km) and for the longest time (i.e., 100+ minutes) of any PLA-developed land attack weapon system ever.

Needless to say, the ability to launch a payload, circularize its orbit, and return it to Earth at a time and place of the PLA's choosing without warning represents a grave threat to U.S. interests at home and abroad.

Taken as a whole, China's potent and expanding arsenal of space-based capabilities multiplies its combat potential many times over. In particular, the full deployment of a space-enabled targeting network means that China can hold U.S. and allied forces at risk with long-range precision weapons, preventing our forces from taking meaningful action before they even reach theater. The consequence of failing to mitigate this threat means military objectives will be tough to meet without unacceptable loss of American lives.

Growth of China's Counterspace Capability

Setting aside China's use of space to enhance their own forces, they have also taken steps to deny our own space-based advantage. Intelligence suggests the PLA likely sees counterspace operations as a means to deter and counter U.S. military intervention in a regional conflict. In particular, PLA academics stress the

importance of negating our ISR and communications satellites as a means to "blinding and deafening" our forces.

The 2007 missile I described before has since evolved into an operational ground-based system intended to target LEO satellites, which the PLA actively trains on today. Additionally, intelligence suggests that China intends to field weapons capable of reaching beyond LEO to destroy satellites in GEO at altitudes of up to 36,000 km. They may already have reached their goal because, in 2013, China launched a ballistic object that peaked at 30,000 km.

Aside from missiles, the PLA has fielded multiple ground-based laser weapons able to disrupt, degrade, or damage satellite sensors. By the mid-to-late 2020s, we expect them to deploy systems high enough in power that they can physically damage satellite structures. Moreover, PLA military exercises regularly incorporate radio frequency jammers against space-based communications, radars, and navigation systems. Intelligence suggests the PLA may be developing jammers to target a greater range of frequencies, including U.S. military protected extremely-high-frequency (EHF) systems.

In addition to terrestrial weapons, China is developing orbital "inspection and repair" satellites with the stated intention of performing on-orbit maintenance and cleaning space debris. In January 2022, we observed their ability to forcibly pull a derelict BeiDou navigation satellite out of position into to a graveyard orbit above GEO. These types of satellites are dual-use and can be counterspace weapons as well as on-orbit servicing tools. What matters is intent, but it's clear that the notion that China has the ability to capture enemy satellites is not science fiction—it is proven reality.

China's counterspace activities are supported by space domain awareness data provided by multiple SJ- and TJS-series experimental satellites. In recent years, we have observed these systems conducting unusual, large, and rapid maneuvers in GEO—tactics that have clear military applications. General Guetlein, the Vice Chief of Space Operations, recently testified about these activities, which we refer to loosely as "dogfighting in space." In other words, we believe this is training—a signal that Beijing is resolved to contest our spacepower through combat operations.

China's advancement in space technology, their stated desire to dominate, and Beijing's disregard for international norms for the responsible use of space make them an incredible danger to U.S. prosperity and security. By virtue of its physics and geography, space is inherently global so even regional conflicts, once they extend into the space domain, have the potential to quickly precipitate worldwide impacts. China's determination to deny U.S. spacepower in the Indo-Pacific could not only degrade of our military space-based capability, but it would threaten the satellites of our allies and commercial partners as well.

The Role of the U.S. Space Force

The consequences of such an outcome would be staggering. Setting aside the incredible harm imposed on governments and civilians, an attack on our satellites would significantly complicate the operations of the Joint Force. There is no good training for a day without space—we are not built for it, and we cannot work effectively around it. Space is an integral platform for force projection, and we must defend it accordingly.

The U.S. Space Force is actively pursuing capabilities to do exactly that. Space is a warfighting domain, and it is our purpose to defend U.S. space assets as well as to defend the Joint and Combined Force from space-enabled attack. As such, we organize, train, equip, and conduct space operations to achieve national military objectives. Our Guardians are uniquely and specifically trained, educated, and experienced in space warfighting, and they will secure our nation's interests in, from, and to space. Even so, with China's growing space capability, we face a monumental task.

First and foremost, our budget is not sufficient to produce the capabilities we need to achieve Space Superiority. Since our establishment, the majority of our budget growth has arisen from absorption of mission from other services, and much of our time and effort is spent on delivering services from orbit. As such, we are critically underfunded in the execution of our newest and most critical mission: Space Control. We need capabilities both to defeat adversary counterspace weapons as well as to deny, degrade, or destroy adversary spacepower—to "blind and deafen" as China describes it. Today, we do not have what we need to fight on our terms, and we cannot shift resources without impacting other missions. In short, new missions require new funding.

Next, we continue to struggle with overly restrictive space policy and outdated ways of thinking. Dating back to when space was a benign environment, much of our guidance and direction continues to frame space as a strategic resource rather than a warfighting domain. As such, we restrain ourselves from doing what is needful to avoid creating improper perceptions of "weaponizing space." In reality, space has been weaponized for at least two decades, and our slowness to absorb that reality has held back our progress. Additionally, we struggle with significant overclassification challenges, which impede us from sharing essential information across the Joint Force, with potential industry partners, and with allies and partners. While we have advocated strongly for increased authorities to reduce classification where reasonable, change has been slow and bureaucratic, with a continued emphasis on "need to know" rather than a more progressive "need to share".

Looking Ahead

Beijing's ambitions in space represent an incredible threat to the rules-based national order. Because of space's strategic importance, it is highly likely that satellites will be some of the first casualties of any conflict between the U.S. and China. Because of space's global nature and its integration into almost every aspect of modern life, the consequences will be immediate and significant.

The Space Force was established to face this challenge, and we will continue to build ourselves into the service our nation needs. But this is not purely a military problem. Diplomacy can help set and communicate norms. We can invest in our space economy, growing commercial capability as a force multiplier and a resilient advantage. We must expand our space domain awareness to ensure our information meets or exceeds the knowledge available to our adversaries. And we in the Space Force will be there to support all of it with military force if necessary.

What is clear to me is that we must better understand, as a nation, the vital role that space plays in our day-to-day activities and to the health and welfare of our nation. And in the face of a competitor with capability to destabilize all of that, we must unify behind a whole-of-government approach that ensures the safety, security, and sustainability of the space domain.

Thank you for the opportunity to speak with you all today and to share my thoughts and concerns on a topic I think will be the generational challenge of our times. I am happy to answer any questions you might have.

PANEL I QUESTION AND ANSWER

COMMISSIONER KUIKEN: Thank you, General Saltzman. I appreciate that opening statement.

You were recently quoted as saying that China's growth in space was "mind-boggling." I have spent a lot of years working alongside general officers, and I rarely hear them use terms like "mind-boggling." It is usually sort of too hyperbolic. But I think you were trying to send a message with this.

So in your view, just give us your sense of that. And my follow-up question to it, so you can just roll them both into the same thing, is have we made similar mind-boggling investments in space? I think your opening statement sort of answers it, but I want to give you a chance to just sort of put the two things in perspective.

GENERAL SALTZMAN: Well, thank you for that, and you are right. I think that word was specifically chosen because I wanted to draw attention to the difference. And the way I would characterize it is I am looking at a government trying to invest in capabilities for its national security, something I have been doing for almost 35 years now. So when I see what it takes to enable the budget process, the requirements process, the working with industry, bringing in good ideas, transforming, and putting those capabilities in the hands of our operators, and I see how government does it, and then I look at what the PRC has been able to do, in relatively short order, in the last 10, 15, 20 years if you give them the full benefit of the doubt, I believe "mind-boggling" is a pretty good word to describe. It has been impressive. As I mentioned, it looks like stable, very focused funding. It looks like their requirements and their vision has not really wavered from what they have been trying to achieve, and they have very rapidly put this capability into operational use.

Compared to us, I would say that we are working through some of the policy considerations. We are working through a long-term vision. It took us a while to think through that we need a separate organization. I mentioned the PRC's ASAT test in 2007 that I got to witness firsthand. And I sometimes harken back and think of that as really a defining moment that really put us on a path to recognize that the domain was contested and that we might need a new organizational structure to handle that. That was 2007, and it took another 12 years before we decided to put the Space Force into being.

So we move a little more methodically in the U.S. government, and so that is why, in comparison, I see us on a slower learning curve with regards to contesting the space domain.

COMMISSIONER KUIKEN: That is helpful. Thank you. One of the things that the national security community is always sort of pressing on is having the center ratify the U.N. Law of the Sea Treaty. And as I was reading your testimony, this sort of analogy came to mind in thinking about space as the global commons, in a similar way that we think about the Law of the Sea Treaty.

How would you assess China treats space? Do they treat it similar to the way they treat maritime law and maritime norms? How should we think about that problem set?

GENERAL SALTZMAN: I think they are opportunistic. I think it is a good analogy. I think there is a lot about the maritime domain that we can learn from, the difference, of course, being we have had seafaring nations for millennia. And we have learned over the years, through trial, through error, through accidents, through wars what the rules of the road should be and how best to operate with a global commons that everyone can share, but also protect its own interests.

And we simply have only been in the space domain, thinking about it that way, since

1957. You mentioned Sputnik I. So I think we are still very early in the process of developing those rules of the road, and I think the PRC can best be characterized as taking advantage of that early domain and being opportunistic, and seeing what they can get away with, to some degree. And that is where I think we call on like-minded nations to talk about responsible behaviors in space, trying to set those norms so that we can call out aggressive or irresponsible behavior, more specifically.

COMMISSIONER KUIKEN: That is very helpful. One of the other areas that, you know, when people think about space they always think about outer space. They rarely think about all of the ground infrastructure and sort of associated supply chains that are involved in these things. How should we think about sort of ground infrastructure from our perspective, supply chain that supports it, and then how should we think about that in the case of China?

GENERAL SALTZMAN: Without the ground infrastructure to support satellites, satellites are just debris. They can't do their missions if we can't talk to them, if we can't pull the data down, if we can't receive the usefulness and the advantages that they offer. It requires a ground network to do that.

If you need any more evidence of that fact, look at one of the first attacks the Russians made against Ukraine. It was a ground cyberattack against a ground network of Viasat. So they had a counterspace capability executed through the ground network.

And so the networks, the ground infrastructure, is vital. It is part and parcel with how we do the space business. We can't live without it. That is why one of our major emphasis areas is the ground network, cyber protection, cyber defense of those networks, and we have to make sure we account for it.

The industrial base, the supply chains, equally critical because we are relying on our industrial base to push the technology, to push innovations. And if we don't have those solid supply chains that we can count on, that are assured, then we will suffer and fall further behind.

COMMISSIONER KUIKEN: You actually kind of got to part of my next question which was lessons learned from Ukraine. It sounds like one is the sort of importance of ground infrastructure. As we sort of think about a potential Taiwan conflict, or any other future conflict, how should we think about lessons learned from Russia-Ukraine?

GENERAL SALTZMAN: Yeah, I appreciate that. I certainly do always list that ground attack, making sure we understand that cyber defenses and how critical the ground networks are. So I certainly count that amongst the lessons.

The other big one for me, and this goes back to some comments I made in my opening statement, as a military service I have to present an entire capability of equipment, people, processes, concepts. That is what a military force is. And one of the things I observed -- and I will just say it is an observation at this point; it is hard to learn lessons in the middle of a conflict like that -- but one of the lessons is if you have exquisite technology, that is necessary sometimes to be effective, but it is not sufficient.

If you do not have the sustainment, if you do not have the operational concepts, if you don't have the practice of how the equipment works together with others, a combined armed approach, you are not going to be as effective. And I think we saw that in some of the Russian employment of their capabilities. They had a very capable military, but they didn't necessarily have the tail behind it, the sustainment, the operational concepts to work together to really take advantage of those technologies.

Therefore, I am very conscious of that. It is one thing to build satellites, to build the ground infrastructure, but if I am not also training the operators, making sure that our capabilities

are integrated with the broader Department of Defense, the Joint Force, it is not going to be as effective as it needs to be. So those operational concepts are also high on my list of priorities.

COMMISSIONER KUIKEN: Thank you, General Saltzman. I will turn it over to Commissioner Sims.

COMMISSIONER SIMS: Thank you, Commissioner Kuiken. General, what are some of the counterspace capabilities that you are most focused on? And when I am thinking about this question, one of the things I think that it is hard for the public to wrap their head around is, what does conflict in space even look like, and if that is where things went, God forbid, what are the implications here on Earth?

So one, help people, help us, understand what that looks like, and then second, what counterspace capabilities is China developing today that you are most focused on that would have implications for that?

GENERAL SALTZMAN: Thank you for that. I do feel like I spend a lot of time trying to educate people in this new domain of war. And I think the easiest way to think about it is if we can visualize or at least understand the effects that we gain advantage from space, the ability to surveil globally, whether it is weather data, whether it is intelligence information, whether we are surveilling the Earth to look for missile launches and the data that we provide, the ability to use satellites to our advantage is the reason we really want to be in space. It is to take advantage of it. And there are economic reasons, with communications, et cetera.

And so what war looks like is using weapons to deny an adversary access to those capabilities. So the PRC has built systems that can actually deny us the ability to use our satellites the way we want to.

So what I also describe is six basic categories of space weapons, and they are really divided into two parts. There are ground-based weapons and space-based weapons, and each of those areas has the same three kinds of weapons. There is directed energy, there is RF, like jammers, and then there is kinetic, and that is two things that run together to create some sort of explosion, some sort of destructive force. So kinetic weapons, directed energy weapons, and RF jammers. Those can be on orbit. Those can be on the ground, pointed up.

The PRC is investing heavily in all six categories. Right now we are not investing in all six categories. We are resource limited and we are trying to figure out which ones we could get the most utility out of early on. The reason you need all six categories is because they are all not best suited for all targets that you might try to hold at risk, and so we start to balance, are we trying to counter a low Earth orbit capability, or are we looking at a geosynchronous capability? Those would require different kinds of weapons. And are we trying to deny, disrupt, degrade, or, God forbid, destroy? What is the end effect that is really necessary?

And I will just conclude by saying we believe in responsible counterspace. Destroying something on orbit, as we have seen with the Chinese in 2007 and the Russians in 2021, the debris that is generated by a destructive force on orbit can be catastrophic for all of the users of the space domain. And so that is, I feel, the last resort and something that we do not want to create this long-lasting, hazardous debris field that can start to make the domain far less sustainable.

COMMISSIONER SIMS: So you said China is investing in all six of these categories but we are not. What are the categories right now that the U.S. is not investing in, that you feel strongly that we should be doing more in?

GENERAL SALTZMAN: I won't go into too many specifics on that, but I will say our initial energy -- and some of this is because of the technology readiness level in our industry -- is

mostly ground-based looking up to space. So in the RF jamming environment, for example, exploring those areas.

As you start to move to orbit, the technological threshold is a little higher, and so we have not put our dollars there initially. So we are more interested right now in ground-based capabilities.

COMMISSIONER SIMS: So you have done a good job kind of painting a picture of what conflict in space may look like and the different ways that that could play out. With that in mind, how resilient would you assess our current space capabilities to be in response to some of China's counterspace capabilities?

GENERAL SALTZMAN: I start that conversation by saying that it is an important imperative that the Space Force build an architecture that denies first-mover advantage. So if you will allow me, first-mover advantage is where, in a given conflict, the offense has an advantage over a defensive position, and in that condition you are incentivized to attack first. This happens periodically in the history of warfare, based on technology, whether the offense or the defense has an advantage.

Right now, in space, because of the way we have designed our architectures, mostly for a benign environment, orbits are very predictable, satellites don't have organic defensive capabilities. It is not hard to pick them out as targets, quite frankly. That gives the offense an advantage, that gives an incentive to strike first, and we have to try to deny that.

So I think that because the systems were designed when we were more like a Merchant Marine, back to my analogy, we weren't thinking about combat attrition. We weren't thinking about effects of an adversary. We were thinking about what is the cheapest way to do the mission, and how can we make those satellites last as long as possible. That is not a defensive posture. That is a utility posture.

So now we are actively trying to invest in changing that level of resiliency. One of the ways we are doing that is instead of using maybe four to six large, very redundant satellites in geosynchronous to perform missile warning, those four to six satellites might be easy targets to hit. But if we proliferate that mission across low Earth orbit, and use hundreds of satellites to perform missile warning instead of just a few geosynchronous satellites, you change the targeting calculus for an adversary. Now they have to raise the threshold of violence in space to attack a lot of satellites to achieve that same effect on the missile warning mission. That creates a level of resiliency when you raise that threshold.

COMMISSIONER SIMS: So one last question for you. I want to kind of zoom out some. I mentioned in my opening statement that I had kind of a 4-year gap in my consumption of intelligence around this, and I was struck when I came back in early this year by the progress that the PRC had made in some of the real critical technologies in the space domain certainly, but across the board.

I would be curious to hear your big-picture assessment of if the PRC continues on the trajectory that it is going and developing its capabilities, the United States continues on the trajectory that we are going in developing our space capabilities, how do you see that playing out?

GENERAL SALTZMAN: I don't like the curves that you have just kind of defined there. I don't like the slope of those curves. I think in the last few years one of the big changes that I think is noteworthy is we recognized, in 2007 and in the following years after that, that they were investing heavily in the counterspace capabilities, to deny us the use of our satellites. The bigger change in the last 10 years, I think, is now they have built this, what we called a "kill web," but

in essence it is a space-enabled targeting set of constellations, the ability to find, fix, track, target our terrestrial forces. That is what has grown most impressively over the last decades, hundreds of satellites used for this purpose.

So that means it is still necessary to protect our satellites, but that is not sufficient. Now we have to be able to deny the PRC, for example, the use of their satellites against our forces. That is a new mission set, and it really rounds out what we say it means to have space superiority, to use space control -- protect ours but also deny theirs. And that is what we are trying to invest more in.

COMMISSIONER SIMS: General, thank you for your testimony today. It has been very helpful. Thank you.

COMMISSIONER KUIKEN: Commissioner Brands.

COMMISSIONER BRANDS: Good morning, General. Thanks for being here. This first question is sort of an extension of the question that Commissioner Sims just asked. It sounds like from your written testimony and your answers here that you think China is fairly well-advanced on its trajectory to become the world's preeminent space power, which is their ambition.

Could you just sketch out in a little bit more detail, what are the implications of China achieving that status for the United States, in peacetime and then in conflict?

GENERAL SALTZMAN: Well, and I think it is worth mentioning, too, that I am still pretty satisfied with the U.S. Space Force. I want to say that, and I hope that sounds understated, because we are still an amazing military space organization. We just have a much broader set of missions than what we see the PRC focusing on. They are very clear in that they have a Western Pacific mindset. They are able to husband their resources around all of the capabilities in that area. We have much more global reach, more global concerns. So it is their focus that has allowed them to be most dangerous and so fast in putting those capabilities together.

But I also try to be pretty clear in saying that the modern battlefield has to account for the space domain. If we can't continue to protect our use of the domain, and we can't deny an adversary, it is going to be tough to meet military objectives in any of the other domains. We are not a joint force, a multidomain force just because it sounds good. We are a multidomain force because we have to be. That is what it is going to take for modern battlefield success, and I think that when we see the space domain being contested by a potential adversary, we have to be able to respond to meet them head-on.

COMMISSIONER BRANDS: And to borrow Commissioner Kuiken's analogy, we hear and we see a lot about unsafe and unprofessional Chinese behavior in the air and the sea domains, in particular. Do we observe similar things in space, and then what is your perspective on that?

GENERAL SALTZMAN: Nothing was more irresponsible than destroying a satellite at 500 kilometers altitude. You know, the Fengyun satellite they destroyed in 2007, we are still tracking debris from that explosion, here 18 years later. That debris causes hazards to our astronauts on the ISS. We have seen conjunctions with the ISS up 14-fold in the last 10 years. That was an incredibly irresponsible event, and I think there is large consensus that that is true.

Then what we are seeing is operational demonstrations of capabilities that could also be used for purposes beyond what they state they are using them for. I am talking about like the grappling arm, the ability to grab a satellite and pull it out of its operational orbit. This clearly has concerns for us if it was used that way.

So we are watching operational tests of categories of weapons like weapons-class satellites, and that is concerning.

The last thing I will add is concern to the magazine depth, that we call it. How many missiles are they buying? How much are they stockpiling in order to conduct these anti-satellite engagements? And again, a pretty staggering development.

COMMISSIONER BRANDS: You mentioned in your written testimony that the United States and Space Force, in particular, are constrained by essentially an outdated space policy, that is based on the assumption of space as a relatively benign environment rather than an increasingly contested environment that it has become. I wonder if you could expand a little bit on that, and just say, what are the areas in which you think U.S. policy has become most deficient, and what would be the changes necessary to make us more competitive?

GENERAL SALTZMAN: Yeah, no, and I want to be clear on this, too, because I wouldn't characterize this as a policy debate came to the front, it was deliberately considered, and we chose the wrong policy. I don't characterize it that way. I characterize it as, to some degree, space has been a little bit out of sight, out of mind, literally out of sight, out of mind. And so it just hasn't risen to the level where serious policy considerations need to be adjusted. We need to adjust our policies.

Every time a particular policy, whether it is testing capabilities or putting resources into a particular kind of capability, when those rise to the right level, generally we can get people to acknowledge, yeah, this is probably a good idea. It is just still a low priority in terms of the policy regime to even take a look at.

And so I just feel like we are lagging in the importance of establishing declaratory policy and establishing the kind of policies we need to move fast.

COMMISSIONER BRANDS: Thank you very much.

COMMISSIONER KUIKEN: Commissioner Friedberg, our favorite Princeton Tiger, is beaming in from Princeton today.

COMMISSIONER FRIEDBERG: Thank you very much, and General, thanks very much for your testimony. It is very informative.

I wanted to ask you about how we might assess overall the balance in space. It seems that you are describing a situation in which both the United States and China are trying to secure their own ability to use space, including in wartime, and if they need to, to deny it to the other side.

How would you assess where we and they stand in those categories? So our ability to secure space for ourselves, to deny it to them, and the same two categories for China.

GENERAL SALTZMAN: Yeah, again, it sounds like I am parsing my words. I am just trying to make sure that we are careful in these oversimplifications. And the word "space race" gets thrown around quite a bit. I get asked often, "Tell me about the scorecard. Tell me where the balance sheet is on their side versus our side," or "Who is ahead in the race?" And I just try to resist those, because, as you would imagine, it is far more nuanced and far more complex than that.

A race implies a very simple set of rules that everybody understands, and somebody is ahead and somebody is behind, and you cross the finish line and you can determine who the winner is. That obviously is not how you build readiness to contest a domain or continue to use a domain. It is far more nuanced than that. To say that one person is ahead or the learning curve is faster, these are all very nuanced and, to some degree, overly simplistic assessments.

But I understand why the question is asked. You know, if we are behind we want to invest more. Are there things we could change if we think on balance we are not where we should be?

And so I think that we are still in the midst of a transformation from developing systems

that are suitable to a domain which we think will be contested in crisis or conflict, and one that we took advantage of for decades, that was largely benign and immune to these sorts of activities. So we are still in the middle of that transformation.

Today we are better than we were yesterday, and my goal is that every day we continue to progress in our readiness and the development of the kind of capabilities that will be resilient when it has to perform in what is becoming a more contested and congested domain.

It is about speed. It is about what you are comfortable with. And I will just tell you that my job as a service chief is really to never be comfortable. I am continuously thinking of the worst case scenario. I am cynical when I look at the nature of the world and how it is progressing. That is my job is to be that kind of military planner, be ready for our worst day. So I am not the most objective person to say where we should be or not be. But I just want to leave you with the fact that this is a complicated set of scenarios. We have to continue to invest, to transform us so that our capabilities are capable, given that we know the domain is going to be contested and congested, and increasingly so going into the future.

COMMISSIONER FRIEDBERG: Thank you. Let me just press down on this a little bit more. If I understood you correctly, in your written testimony you suggest that the United States is currently excessively self-constrained in its ability to develop offensive capabilities, so to deny space, if necessary, to China. Is that an accurate reading?

GENERAL SALTZMAN: I think the self-constrained is because we have to make decisions based on resourcing and prioritization of those resources. And so could we reprioritize and put more money against space capabilities? Yes. So in the sense that the budget I have is the one I have to build the Force with, that is a form of self-constraint.

I will tell you that I believe we have more left unfunded than we have funded. I think the new missions that have been given to the Space Force, we still haven't developed the size and set of capabilities necessary to perform those new missions, as I mentioned Space Control being first and foremost in those new missions that we have been given.

So with new mission requires new resources, and if you do not get those new resources, then your ability to accomplish those new missions is going to be delayed as you try to put the fielded force into being.

COMMISSIONER FRIEDBERG: So if we are not where we should be, in your view, with regard to our capacity to deny space to China if we needed to do so, that is more a matter of resources than policy?

GENERAL SALTZMAN: I think so. Like I said, my experience is that once the policies rise to the right level and they are actually deliberated, generally the logic carries the day. But if you don't have the resources to buy the things and then request the testing, the policy issue doesn't rise to the right level.

COMMISSIONER FRIEDBERG: Okay. Two questions. One is, I think, a short one, and one maybe longer that we can continue. But regarding the ground-based elements of our Space Forces, who has the responsibility for defending those?

GENERAL SALTZMAN: The short answer is everybody that owns those capabilities. That is a little too broad, probably. For instance, I have cyber forces that are required to protect the mission networks associated with my space capabilities, so that falls to the service to do the cyber defense of its own critical networks. So each of the services has those. I won't speak for the other agencies across the U.S. government. But I think, in general terms, if you have a network, you have to make sure that it is cyber safe, cyber compliant in accordance with the standard set.

COMMISSIONER FRIEDBERG: And finally, to the extent that you can talk about this, do you envision, or do we envision in our planning the likelihood that a conflict in space would be protracted, that it wouldn't be over with the first and second shot, but it might go on for days, weeks, months?

GENERAL SALTZMAN: I have played war games that it ends quickly and has been protracted. It kind of depends on. It is hard to separate escalation from the escalation that is occurring in the other domains. So if the particular scenario escalates rapidly on land, then it rapidly escalates in support of that in space. If it plays out more slowly, then it is protracted, and you get into a one-versus-two-versus-three kind of a situation.

But it has the ability to play out quickly, or it could be more protracted if that was the way the other domains were escalating.

COMMISSIONER FRIEDBERG: Thank you very much.

COMMISSIONER KUIKEN: Thank you, Commissioner Friedberg. Commissioner Miller.

COMMISSIONER MILLER: General, we are very appreciative of you being here today, so thank you very much. There is a lot to be worried about in your testimony, but I think the scariest thing for me was you mentioned that while China is neck-and-neck with the U.S. in space planes it is far ahead of the U.S. in quantum satellites. And you break down the trajectory since 2016, when China released its first quantum satellite, in 2022, coordination with South Africa and Russia, and you end by noting that the United States has yet to launch its first quantum satellite with a Boeing-led launch plan for 2026.

Why are we behind here? Is this a lack of government support? Is it a lack of policy focus? Is it a lack of public-private coordination? What do you see here, and how can we fix it?

GENERAL SALTZMAN: Yeah, I am a little bit tactical on this one, which is to say I can tell you the realities of why we don't have more capability than we have, but I am not sure what the root cause is behind why we don't have it, and it comes back to resources. If we have the dollars to invest, to develop the technology, to put the launches together, to put the demonstrations together, to learn rapidly, to build operational capabilities, then I think we understand the kinds of shortfalls or opportunities we have that we would invest in. Without those resources, I can't obviously progress the technology.

So the real question is why do we not have the resources, and I think there is not one simple answer to that. It is a myriad of prioritizations and focus and other constraints that have been placed on the budget.

So I would hesitate, from my position, to say why it is that the Space Force doesn't get more resources to invest in these, but I think the tactical answer is with more resources would come more technology development faster.

COMMISSIONER MILLER: And one of the things that we do as a Commission is recommend actions to Congress. Do you have any specific recommendation to Congress about the quantum satellite? This is something that if something is not top of mind you are welcome to submit this to us later. But is there anything that we can direct Congress' attention to this in a way of maybe narrowing China's advantage here?

GENERAL SALTZMAN: I have to remind myself of this all the time. I think pretty near term. If I get a budget tomorrow, what will I spend the money on? What is the first best thing I can do to make the Space Force more ready today than it was yesterday? But I have to fight the urge to stay in the present and think about some of the longer-term visions. I think quantum is one of those examples. We have to invest in the science and technology, continue to develop

things that we don't completely understand, what is the best use of it. This is going to require experimentation campaigns, a campaign of learning. These are long-term goals.

So continual investments, saying, hey, a portion of our money should be done in these S&T early development projects because we are not sure exactly how it is going to pay off. So I have to keep reminding myself to invest in those things that have more of a long-term payoff and not get so fixated in the what can I deliver in the next year or two.

So that is how I am doing it. But that means you have to defend something in the budget process that you can't really articulate what the payoff is going to be. That is an education process, to say I can't tell you what the return on investment is, but I think we should continue to invest in it. I think we should continue to learn here. And in tight fiscal environments that becomes tougher to defend.

COMMISSIONER MILLER: Understood. One of the areas in which you speak about the Chinese narrowing the advantage with us is reusable launch rockets. I think your testimony notes that experts are predicting that Beijing will be competitive, or Chinese companies will be competitive with SpaceX by 2030. And you mention new and innovative approaches, including something that resembles a maglev train with the electromagnetic pull. Can you tell us a little bit about that?

GENERAL SALTZMAN: I can't speak technically about those particulars. I can say that having watched the military space organizations and industry work for the last 30-plus years, the reusability of rocket launch systems has done two things. One is it has made things a lot cheaper to put on orbit, which means we can just envision, maybe it is better if we do this mission from orbit rather than try to do it in one of the other domains. That was a little bit cost prohibitive before. We have less cost prohibitions now that the cost per pound to orbit is lower. That is one.

And second is that has created a market, because now there are more entrants into space. The industry has expanded. That has created assembly lines and procurement lines of scale that we didn't envision decades ago. Having a constellation of thousands of satellites is mind-boggling from where I started in this business. We thought in terms of one and two, and exquisite satellites, procurement chains, and economies of scale didn't exist. Now it does.

I think the U.S. is taking advantage of that. We are still the world's leader in launch. As soon as those reusability capabilities start to be used in other countries, they will start to catch up and be able to use space for different missions and in different ways, in more resilient ways.

If I could, just one additional thing. One of the things that sometimes we don't think about with these mega-constellations is the replenishment rate. Because of the way they are designed, because of the small satellite market the way we build them, we don't expect them to last very long. You know, we used to build satellites for 20-year life spans. Now we are thinking more in the 5- to 7-year time frame. And while that might be a little bit more expensive when you have to account for the replenishment capabilities, what it offers you is a chance to refresh the technology on a much faster time cycle.

We are still using technology from the '70s on orbit today to do some of our missions, because it was designed, because the satellites are still lasting. So our ground architecture has to account for those legacy technologies that are still on orbit. If you are replenishing on a 5-year cycle, you can keep that technology current, and as the industry expands you can continue to take advantage of that, especially since replenishment is so much cheaper. Those are going to be game changers globally.

COMMISSIONER MILLER: I see I don't have much time, but let me lob one last question, continuing on this relative advantage theme. You talk about GPS and then how

BeiDou, which is the Chinese satellite system, was recently created, and you say, "GPS capabilities are now substantially inferior to those of China's BeiDou."

Is that just the reality now? Is there a software fix for GPS? Do we have to build a new system? Is this a place where we should be placing our dollars versus some of these other priorities you are talking about? How do you think about GPS versus BeiDou, in terms of your priorities?

GENERAL SALTZMAN: It is about when it was developed and for what purpose it was developed. Again, ours was developed, the basic concept was developed decades ago. We were not thinking about benign, contested environments with our GPS signal. So the architecture is just not designed to support that.

We are, as quickly as possible, trying to mitigate that with new launches. The 3F satellites are an example that are a step order, a step function better in terms of being able to operate in a contested environment. But we are still trying to re-architect that GPS architecture, based on the contested domain. That is not the way it was originally designed.

COMMISSIONER MILLER: Thank you, General.

COMMISSIONER KUIKEN: Thank you, Commissioner Miller. Commissioner Price.

CHAIR PRICE: Good morning and thank you, General Saltzman. This has been so interesting.

I want to go back to a question several of my fellow Commissioners have asked in different ways. Each time you answer I get a little bit more clarity in my mind on this.

You specifically have talked about funding, restrictive policy, and overclassification challenges. When you talk about the struggle with overly restrictive space policy and outdated ways of thinking, give me some examples.

GENERAL SALTZMAN: I think a good one you just mentioned is security classification. We have reached a point that I believe there is more state-of-the-world capabilities that we are protecting with classification that we used to reserve for state-of-the-art, if that makes sense. So when something is state-of-the-art you want to protect it because you have an advantage that maybe others don't. When something is to the point where it is state-of-the-world, everybody has it, so then security classification starts to be a hurdle that you have to clear to collaborate with others.

We have started the process of rewriting policy associated with our classification of space capabilities, but we are still developing it. We are still trying to figure out how you shift from classic need-to-know mindset to a more need-to-share, how do we collaborate. Sharing with industry partners, explaining to them the operational challenges at a classification level that they can manage is an example.

CHAIR PRICE: Okay. I am trying to get my head around that. So back to the role of the private space industry, working with you, the Chinese obviously have a different model. How do you see that relationship for us here in the United States and how does it differ? How does it give the Chinese an advantage or a disadvantage?

GENERAL SALTZMAN: Our acquisition process is pretty onerous in the United States, for a lot of good reasons. I will say over time we have learned lessons, and every time we learn a lesson about either a failure in acquisition or an oversight, misstep, we put documentation in place so that that doesn't happen again. And over time that makes working through our acquisition process cumbersome. And in order to be fair and good stewards of taxpayer dollars, we have to go through a lot of process to put a contractor on contract to deliver a capability.

So I am not necessarily saying that is right, wrong, or indifferent. I am just saying that is

what it takes to happen.

If we wanted to go faster we have started to explore authorities and different kinds of policies that, you know, middle tier acquisition or other transactional authorities that step aside from the traditional acquisition in order to go faster. Separating software development out of what is traditionally around a hardware acquisition process is another example.

We have got work to do to take full advantage of that, with congressional oversight on top of it, and with the way we do resourcing to have money that we can shift between programs.

I will give you another example. When you hear industries sometimes talk about the need to fail fast -- in other words, try something, it doesn't work, you shift to another approach -- this is not comfortable in the U.S. government. Failure means taking the money away, not let me try something different sometimes. So how is it that the U.S. government incentivizes failing fast? I don't know that we have figured that out exactly. That is one of those areas.

It is hard to get the U.S. government to innovate. I am trying to figure out what are the policies and incentive structures that can align to that goal.

CHAIR PRICE: Thank you. Yeah, and I think that is why we have privatized so much of this, is because they can then fail fast. You use the Merchant Marine analogy and also the need for defense of our commercial industry that is in space. The industry, what kind of role are they playing in helping you think through ways that they can avoid conflict or work with you better?

GENERAL SALTZMAN: Well, wherever we can, we try to include members of industry directly in our operations. We have a commercial integration cell out at Vandenberg, where we have operators of satellite systems that are embedded with our military operators. So we have good exchange of space domain awareness data, for example, what matters, how close is too close, how do we manage the RF spectrum to avoid issues or unintentional interference. So there is good collaboration there. We invite industry partners into our war games to help us think about future concepts and what might be useful or not useful.

I think it has become clear to at least the industry partners that I deal with that if a crisis occurs or a conflict occurs in space, you can't really get out of the battle zone. You can't get out of the battlefield. I like to use a picture of Ukrainian airspace right now, and you just see a nice gap where commercial airlines avoid that airspace at all costs because it is dangerous. That is going to be hard to do when orbital mechanics are in play, and you can't really get out of the domain. You can't get out of the war zone if a war extends to space.

So they are very incentivized to help us with that. So they do that through operational concepts. For example, we feel like if we can make it harder to attack a satellite in space then it raises the threshold where a nation might consider using an attack into space. Maneuver on orbit is one of the ways that you could create resiliency. If a satellite can maneuver away from a missile, then why would you shoot a missile at it, if you know you can't hit it because it has the ability to maneuver.

Well, our satellites are not really designed to maneuver, and maneuvering is something we are very conscious about doing, because there is a limited amount of fuel and you run the satellite out of gas and now its mission isn't possible. But if you can refuel those satellites on orbit, now suddenly you can maneuver with less regret, and maybe you can start to become more resilient to be able to defend yourself against an attack, and then that reduces the probability of the attack.

And so we do feel like industry understands some of the operational challenges and trying to explore technologies that might help us overcome those.

CHAIR PRICE: Thank you very much. That is all I have.

COMMISSIONER KUIKEN: Thank you, Commissioner Price. Commissioner Schriver.

VICE CHAIR SCHRIVER: Thank you, Mr. Chair. General, let me add my thanks for being here today and sharing your testimony, and thank you for your long, distinguished service to our country.

I am not somebody who could claim to have any expertise in space, but I have been a China watcher for a long time. And it seems to me when China gets very good at something very quickly, usually you find foreign capital, often U.S. capital, you find foreign technology, oftentimes U.S. technology, witting or unwittingly making it to China, and you find a lot of nefarious activities on the part of the Chinese, theft of intellectual property and the like.

So I am wondering if you want to sort of react to how much we either wittingly or unwittingly contributed to this, but really more to what we do about it. And the important question is, are there things we can do to thwart further advancement of Chinese and PLA capabilities or have they already sort of gone past an inflection point where they have absorbed everything and they are going to indigenized everything and be good enough on their own that thwarting them is sort of beyond our capabilities.

GENERAL SALTZMAN: Well, I am certainly not an expert on that. I feel like I should be asking you questions so that I get smarter about this.

I will generally say that we understand that that is what happens, and theft of our capabilities is something we take very serious. And so as we start to envision an acquisition strategy for a capability, we actually evaluate the entire supply chain. That work is done. Who is in the companies? Who are the subs to those companies? Where do they get their parts? Where are they manufactured? All of that is evaluated, to make sure that that process is assured, and we don't have anything sneaking into our systems that might come from somewhere that we are not fully tracking.

So I think on the supply chain side that is already a known issue and there is a lot of attention given to make sure that we protect ourselves in that acquisition process on that.

And then secondly, you start to map out the networks that are involved in a full lifecycle of a system, from its early conceptualization, the science and technology that is done, the design work, the risk reduction, all the way through building the system, fielding the system, and sustaining the system.

The mapping of the networks is unbelievable, and the number of contractor networks that are connected. Obviously that is a large cyber surface that can be exploited by a country like the PRC that has a tremendous capability. So we had to go to great lengths to try to make sure that those networks are secure, that we monitor them, that we protect them. We have cybersecure standards that we try to make sure are employed at all stages of that. But as you go down that spider web of networks you get to contractors that we start to lose control over those networks.

So that is a concern that I think we all largely understand is out there and that we need to attend to, and we try to do as much as we can to eliminate that surface area.

VICE CHAIR SCHRIVER: Thank you for that answer. That is very helpful. Another thing, just being a longtime China watcher, it strikes me that, particularly after the first Gulf War and the early '90s, the Chinese would refer to us as a technological paper tiger, and they talk about how reliant we had become on certain technologies, and space was always included in that description. And then they go and they sort of duplicate, and in some cases maybe even exceed where we are in that.

So it strikes me that as they develop this more complex kill chain and seek to have persistent surveillance, and then ultimately link that to shooters, that they are also, themselves,

creating vulnerabilities. Perhaps this gets into the more sensitive areas, but would you generally agree with that? Would you comment on the vulnerabilities in their kill chain as they develop and acquire these new capabilities in this domain, and are we doing enough to exploit that and take advantage of it?

GENERAL SALTZMAN: This is a military conundrum that we all study. Everything you use that creates a strategic advantage can quickly become a strategic vulnerability. That is the nature of it. The more you rely on something, the more devastating it is when it is taken away from you.

So this is just about a balanced approach. When we use the word "resiliency," that is what we mean. So even though we might be reliant on something, we have created the conditions where we mitigate its potential for becoming a strategic vulnerability. That is the actions behind making something resilient. So it is addictive, because you want those strategic advantages, even if you recognize that there could be vulnerabilities, and you start to convince yourself that you can mitigate those because this is such a tremendous advantage.

I see the PRC falling prey to that exact mindset. Hey, there's such a strategic advantage here, it is worth the risk, and now we just have to attend to the risk. That is not going to go away.

The last thing I will say along those lines -- and again, this is that military mindset -- when you see yourself being dependent on something, there is something natural that says, "I don't want to be dependent on anything. I want to be able to organically do my mission without depending on anything."

We are not structured to have that mindset about space. I used to say that space was kind of the icing on the cake. It just made everything a little better. But now the analogy I use is it is more like the eggs in the batter. You cannot extract it out. We are in there. The force design counts on that.

So this idea of what would you do without space is like saying what would you do without air? It just is no longer a part of this. So that means we are fully committed to making sure we can protect against those vulnerabilities so we can continue to leverage the strategic advantage.

VICE CHAIR SCHRIVER: Thank you. I guess I have a minute left. This may not be quite sufficient for the question I am going to ask but I will do it anyway. It struck me that if we have the CNO here, Chief of Staff of the Air Force, Chief of Staff of the Army, and we were talking about China, at some point early in the conversation they would have mentioned partners and allies. And unless I missed it, I don't think that I have heard that. And maybe that is because we are sort of so prominent in the space and our allies are so far behind.

But I am wondering if you could address cooperation with partners and allies in this greater competition with China in the space domain.

GENERAL SALTZMAN: The reason we haven't talked about it is because I made a gross error in not talking about it. This is important. In fact, I had three lines of effort when I came into the job a couple of years ago, and that third line of effort is we have to partner to win. And I meant that broadly -- allies, partners, and industry. Because we are not going to have the resources. We can't take on this mission as fast as we need to without using allies and partners.

So when I talked about denying first mover advantage, when I talked about creating a more deterrent posture, a more resilient posture with our space capabilities, one of the elements of that is leveraging our allies and partners. And we have done that to some success, and all of those successes are breeding other successes.

If a satellite is owned and operated by several countries, if the PRC wants to attack it they

have to say, "I am willing to attack three countries." I believe, again, that raises that threshold of concern, and they might think about it rather than it just being a U.S.-only, we are in conflict with the U.S., and so I am going to attack the one.

But it also is capacity. We gain capacity without having the burden of all the costs associated with it. So cost sharing and information sharing and mission sharing is also a part of our force design. Satellite communications is a perfect example. During peacetime we need far less communication capabilities than we do in a crisis or a conflict . Rather than buying all that I am going to need for conflict and hold onto that organically during peacetime, I say, "No, I'm going to have this network of partners, and when we fight as a coalition, because we expect to, then I will gain their capacity, as well." So I pay attention to their force design and how they are using their capabilities so that I don't buy something redundant that I don't need to.

What we are trying to do is pull their concepts into our force design so we can make good fiscal decisions but understanding that we are going to partner in conflict, we can account for those capabilities in our exercises and operations.

So they are critical to our success, and we think about them all the time.

VICE CHAIR SCHRIVER: Thank you.

COMMISSIONER KUIKEN: Thank you, Commissioner Schriver. Commissioner Stivers.

COMMISSIONER STIVERS: Thank you, General, for being here today. In your testimony you described how satellite navigation is absolutely integral to battlefield operations. It is my understanding that BeiDou satellite system has been integrated across 1.4 billion mobile phones in 140 countries. In response to Commissioner Miller's question you talked about the technological differences and challenges between BeiDou and GPS. But can you describe the threat that U.S. and our allies and partners face from the expansion of BeiDou to so many countries internationally, in terms of the total expansion of BeiDou.

GENERAL SALTZMAN: It is an interesting question because it is about the narrative. Is about who are you partnering with. It is about how do you align. And if we think about this as this is the PRC narrative versus maybe more of a U.S. narrative, if there are more customers aligning, they want to use BeiDou, and they become transactionally aligned to that country, does that cause us strategic concern.

I think it is question worth answering. I don't know that I have all the necessary information to make that assertion. But I like countries that are using the same standards as us. I like them that are building interoperable equipment to the way we are going to use them in crisis and conflict. Those are our closest partners. And so when I see about partners aligning on the other side, it just makes me a little concerned. But I don't know enough about the actual expansion to be able to comment beyond that, but I think it is a good question to ask.

COMMISSIONER STIVERS: Okay. Thank you. In your testimony you called for additional resources for space control. You mentioned six categories. But is there a line item that you would say is the top priority? You mentioned it is difficult to shift between missions because it always takes away from something else that is important. But in terms of your justification to Congress, your budget requests, what is the top priority and does that align with the previous budget requests?

GENERAL SALTZMAN: Yeah, all of my top priorities are being addressed in some line item. There is not a huge line item that is just below mine. It is more about the resources to go faster and to develop more capacity in each of those areas. And so that is what I try to emphasize.

I believe we have all of the basic categories covered. I just don't have the resources to go as fast as I think industry can go, or as I think we need to go. That is number one. And then two is, it is one thing to have a singular, demonstrated capability. It is another to have it operationalized with the capacity to actually achieve an operational effect.

So speed and capacity are more the concern than any one item that is not being funded.

COMMISSIONER STIVERS: So it is more of just a general request for more funding for space control and not a specific category or line.

GENERAL SALTZMAN: Yes, sir, but I will make one caveat to that. As I talk about the transformation from a Merchant Marine to a Navy, one of the things we have to be able to, because we don't have combat experience -- thankfully, my operators don't have combat experience in space. Therefore, we practice all of our tactics on simulators. Our simulators don't current have the level of fidelity to accurately reflect the threats that they are likely to face. And so I am trying to rapidly increase the capacity of our modeling and simulations. So think ranges. Think simulators where our operators sit down and practice their tactics against a replicated threat.

Pretty low fidelity right now. I am trying to raise that game so that we can practice and understand that our tactics will work, or maybe they won't work and we need to revise them, and give the operators that practice before they get into the crisis. That is one area that I think we have a lot of room to expand, that we are not currently doing.

COMMISSIONER STIVERS: Okay. Thank you. That's all for me.

COMMISSIONER KUIKEN: General Saltzman, we have gone through everyone, and I think we just have a couple other questions for you, and then we will probably give you back some time in your day.

You talked about quantum. And as I was listening to you, one of the former Commissioners always talked about how this Commission sort of tries to look over the horizon and think about issues that are in that long term that you were talking about. Quantum communications is one of them. That was the only one that you sort of highlighted.

Are there other areas where we should sort of -- it is sort of weird to say over the horizon when we are talking about space -- but look over the horizon in terms of technological development, capabilities, et cetera?

GENERAL SALTZMAN: So let me not answer your question but maybe offer something that I am kind of hoping will help in the long run. I am trying to stand up Futures Command, and the reason I need a Futures Command is because I am not sure exactly what 2040 and beyond looks like. I am not exactly sure what the threat environment looks like. I am not exactly sure which technologies will be used against me, which technologies I might be able to take advantage of for operational use. And I need a focused group that is able to both just do the thinking that is necessary to leverage industry, to leverage our science and technology community, to leverage the interagency -- What is NASA working on? What are some of the other civil sectors know? What are they working on that has been useful? -- and pull that together and truly describe, in real detail, what that future operating environment looks like.

That then, I believe, will allow me to create a specific demand signal back to industry, back to the science and technology community, and say, "This is what I am trying to accomplish, and these are the technologies that we think need to be rapidly developed."

So while I can't sit here and say this is a technology that I think we have really got to invest in, what I am trying to do is build a more fulsome process by which we will routinely identify what those technologies are, and make sure there is a very objective demand signal back

to the people that can deliver them.

COMMISSIONER KUIKEN: That is really helpful. Thank you. Your Merchant Marine-Navy analogy has really sort of stuck with me here. As I was thinking about it, one of the things I remember when I was still with Leader Schumer was just how many entities across the Federal Government have roles to play in space. You know, NOAA has roles. NASA has roles. You obviously have roles. The intelligence community, as well.

In your opening statement you talked about sort of this whole-of-nation approach that China takes. We haven't really looked at the sort of civ-mil fusion or lack of fusion in the U.S. government or how we are organized with respect to space.

Are there any ideas that we should sort of think about in that area, to maybe revitalize the way that we are organized, as it relates to space?

GENERAL SALTZMAN: I think one of the things that we are trying to do, and I mentioned Futures Command, looking at what are the missions that we are going to be asked to perform, as technology is changing, as we can move different missions from maybe what was done in the airborne environment to what could be done in the spaceborne environment.

There is going to be a roles and missions discussion. We have kind of evolved the roles and missions between military space and IC space, civil space, R&D space that NASA kind of focuses on. We have evolved to that point, but I don't know if based on the new security environment we really crystalize who is responsible for what and define that in terms that we can say because I am responsible for this, these are the resources I am going to need. We are kind of backing into it, to some degree.

So a level of formalization of those responsibilities probably the next step. Okay, we stood up an organization for military space. Now we need to clearly define what those roles and responsibilities are, or even establish a process by which we will evaluate new missions as they are developed, to make sure we give them to the right organization.

COMMISSIONER KUIKEN: That is helpful. And then Commissioner Schriver got me thinking about international institutions. The only one I could think of off the top of my head was ITU. And then the only treaty I could think of is the Space Treaty. How should we think about this ecosystem if China has little regard for these institutions or sort of historic legal documents?

GENERAL SALTZMAN: Yeah. You know, those are the two that are in the forefront. I am sure there are others that are behind that. But I think this goes to the point where we are still maturing the community of practice, the community of interest internationally, that is going to address the challenges that come up in the space domain. So I think just recognizing that we have work to do, that we have to document these approaches is key.

Do we need an international group to do it? Maybe. You mentioned the PRC doesn't really follow those, but that doesn't mean they can ignore them. And sometimes the most important thing you can do to attribute aggressive, irresponsible behavior is define what responsible behavior looks like. Then it becomes clearer that somebody has violated it. And even if they are willfully violating it, at least the international community can comment on it from the same basic standard that has been established by like-minded, spacefaring nations. And if that number is 190, and there are 2 nations outside of that, well then, that says something. And I think that gives us the power across the international community to apply additional pressure when somebody specifically acts irresponsible, based on the defined responsible behaviors.

COMMISSIONER KUIKEN: Thank you. Commissioner Sims.

COMMISSIONER SIMS: Thank you, Commissioner Kuiken. You know, I was thinking, General, as you were talking about the need to increase the fidelity of your training platforms,

that we may lose a lot of things to the Chinese but if we lose at video games, I don't even know what we are doing at this point. America is not losing at video games, Commissioner Stivers. It is not going to happen.

I remember the first term of the Trump administration, sitting in the private dining room off the Oval, where the President was meeting with the NASA administrator, and pressing him on going to Mars, like really getting after it, like, "Man, we have got to go." And I think we have made a lot of progress certainly in that since then, and it is starting to feel a little more within reach.

What are the implications. What are the implications of the race to Mars for some of the things that we are talking about today?

GENERAL SALTZMAN: If I understand the basic concept, having just looked at it as an amateur -- seriously -- the launch infrastructure that is going to be required to put vessels headed towards Mars at the right tempo to sustain the effort, it is pretty impressive. It is going to be a large effort.

Our current launch infrastructure is being stressed to capacity. I did a little basic research, which means I googled it, how many launches did the USG execute in 2010, so 15 years ago. It feels like yesterday for some of us. There were only about 15 launches, 14 came out of Cape Canaveral and the Kennedy Space Complex, 14 launches. This year we are going to do almost 100 -- I think 93 are scheduled – seven, eight times as many launches. Same infrastructure. Same basic infrastructure. Same basic manning levels to support.

It is time to revisit the launch infrastructure as we think about what it would take to actually go to the next level of space exploration, space utilities, how much we are going to put on orbit for national security. We have got to build and commit to an infrastructure to support that.

That is not always the fun stuff. Nobody likes to do the foundation work when they just want to remodel the kitchen. But that is critical work that has to be done, and it is not going to be cheap. But these are big rockets that are going to require new space launch complexes to make sure we can handle it.

COMMISSIONER SIMS: One last question I had for you. You have gone into so much today that has been incredible, so thank you again for your testimony. If you had one message for the American people about this topic, and then related to that, if you had one message for Congress about this topic, what would those be?

GENERAL SALTZMAN: What I always try to educate the general public on is they don't recognize how much space capabilities affect their everyday lives. It is why I started my kind of oral statement by saying your online banking, your Amazon shopping, paying for gas at the pump, your direct deposit into your bank account, not to mention Google Maps getting you to the store, the fact that the food was put in the store because farmers are able to use GPS and weather data to grow crops.

I mean, it is so integrated into our American way of life that I want them to understand that if we don't have those space capabilities, generally the way you live your life will change very dramatically. And because of that, we have to have an organization that protects those capabilities out there.

So that is what the Space Force does. It protects the American way of life. And it just sounds so, you know, throw the cape over the shoulder, but I believe it. There is so much about it that is important, and we have to protect it.

And then what I would say to Congress is once they recognize that, which I think they

generally do, I just ask why the Space Force is shrinking in size, that that's a disconnect that is really hard to square, how much more important space is becoming, how much more we feel like our national interests require us to defend, and then why is the Space Force shrinking.

COMMISSIONER SIMS: Thank you.

COMMISSIONER KUIKEN: Commissioner Friedberg, I see you have your hand raised.

COMMISSIONER FRIEDBERG: Yes. Thank you very much. General, I wanted to come back to this question of self-restraint to make sure that I understand what you mean. In your testimony you say we continue to struggle with overly restrictive space policy, and you go on to say, "We restrain ourselves from doing what is needful to avoid creating improper perceptions of weaponizing space."

Could you be a little more specific about what it is that we are restraining ourselves from doing that you think we ought to do?

GENERAL SALTZMAN: Yeah, I think the first thing is just the way we talk about space as a warfighting domain. I have tried to be as maybe provocative as possible, just in the testimony today. I am not afraid to say offensive capabilities. I am not afraid to say defensive capabilities. I am not afraid to say disrupt, deny, degrade. But I am conscious of the fact that 10 years ago, I would have been in serious trouble, with my bosses, with Congress, the media would not understand that.

It is a radically different environment now because we recognize how critical it is, and we recognize what our adversaries are doing to try to deny us those strategic advantages. And as a military service, I think it is understood that my job is to figure out how to use military force to protect our interests.

Without the Space Force you don't have those kinds of conversations. You have the oblique conversations. It is important to us. We will take all prudent actions to protect our interests. We talked in parables, to some degree, about protecting and defending our space interests.

I think that has changed in the narrative, but our policies have not all caught up with it. So the ability of one industry partner to talk to another industry partner at a classification level that both can be in the same room, we haven't caught up with that yet. Our ability to perform on-orbit testing or on-orbit tactics validation, we haven't caught up with it yet. We still have to go to very high levels of approval to do some of the basic thing that you would think are just normal operations -- testing, tactics development, training. We do that all in simulation, not in actual live practice. We don't practice on live assets very often, because of policies that are in place.

And I just think we can, as we start to change the narrative around dealing with a contested domain, we just need to catch up all of the policies so that they are consistent. And this is not to say that we are not catching up. It is just about work that we have to do.

COMMISSIONER FRIEDBERG: Commissioner Schriver asked you a question about U.S. cooperation with allies with regards to operations in space. I wanted to ask you if you could comment on cooperation between China and Russia. Russia is, of course, one of the original spacefaring nations. Does it still have something useful to offer China? To what extent are those two countries cooperating in peacetime? Is there any suggestion that they might cooperate in wartime?

GENERAL SALTZMAN: Yeah, again, I am paid to think of the worst case scenarios, and so I always think about what I our two most capable potential adversaries are teaming together, and it is not a pretty picture. I don't think that is something that anybody would choose to be on the opposite side of that war game. It just creates complications.

So yes, I do think it is possible that they will collaborate. I do think that the PRC has developed such a need for space capabilities that the idea of irresponsible behavior by anybody else is starting to affect the way they see the space domain, as well.

It used to be that you would argue that only the U.S. really took full advantage of space and others didn't need it as much, so it became a vulnerability. Now I think the PRC, for example, certainly needs to use the space capabilities to accomplish what they want to accomplish, and the idea of a destructive satellite -- they did not like the 2021 ASAT test by the Russians either -- this is irresponsible behavior, and I think they see it could potentially jeopardize the way they want to use space.

So I do think there is a balancing there between the two, but my job is to think about the worst case scenario, and that is where they collude to work against our national interests.

COMMISSIONER FRIEDBERG: And are there capabilities that Russia has developed over the years that China doesn't yet have, which would be useful to China?

GENERAL SALTZMAN: I don't know if there are any capabilities that the PRC has not developed. The Russia nesting doll, that was our explanation for the satellite that released a satellite that released a kinetic kill vehicle. That is an interesting technology that is very hard for us to track, because of the size, because of when it occurs, the flexibility of it. So that is a Russian capability that we pay very close attention to. We think it is very destabilizing. Our Space Domain Awareness capabilities are still maturing to the point where we can avoid that kind of operational surprise.

So those are capabilities that I have to pay close attention to.

COMMISSIONER FRIEDBERG: Thank you.

COMMISSIONER KUIKEN: Thank you, Commissioner Friedberg. Commissioner Stivers.

COMMISSIONER STIVERS: Commissioner Friedberg stole my question on Russia, but I would like to focus a little bit more on that. Has China particularly provided space technology or operative support to Russia in the war in Ukraine?

GENERAL SALTZMAN: I don't have any details on that.

COMMISSIONER STIVERS: Okay.

COMMISSIONER KUIKEN: General Saltzman, thank you very much for being here today. I really appreciate your testimony. Your staff was excellent to work with in setting this up, so I really appreciate that, as well. And we look forward to staying in touch.

GENERAL SALTZMAN: Great. Thank you very much.

PANEL II INTRODUCTION BY COMMISSIONER CLIFF SIMS

COMMISSIONER SIMS: Our next panel today will examine a broad range of issues including China's military space capabilities, civilian space activities, and commercial space industry, and implications for the United States in the ongoing space competition.

We will start with Dr. Brien Alkire, Senior Operations Researcher at RAND Corporation. Dr. Alkire will analyze China's space capabilities that challenge U.S. space sovereignty.

Next, we will hear from Mr. Blaine Curcio, Founder of Orbital Gateway Consulting. Mr. Curcio will provide an overview of China's commercial space industry growth and evaluate its domestic and international policies shaping the future of its commercial space sector.

After that we will hear from Ms. Victoria Samson, Chief Director of Space Security and Stability at the Secure World Foundation. Ms. Samson will discuss China's efforts to strengthen space cooperation with other countries as well as its positions on space governance in multilateral forums.

Then we will welcome Mr. David Cavossa, President of the Commercial Space Federation. Mr. Cavossa will assess how the U.S. commercial space sectors are performing in relation to China.

And finally, we will hear from Mr. Andrew Cox, President of Fourspoke. Mr. Cox will assess China's rapid space advancements and what it means for U.S. national security.

Thank you all very much for your testimony today. The Commission is looking forward to your remarks. I ask that you all keep your remarks to 7 minutes, and Dr. Alkire, we will begin with you.

OPENING STATEMENT OF BRIEN ALKIRE, SENIOR OPERATIONS RESEARCHER, RAND

DR. ALKIRE: Commissioner Kuiken, Commissioner Sims, other members of the Commission, thank you very much for this opportunity to participate in the panel today.

China's leaders seek preeminence in space as an important component of a strong country, a source of national pride, and key to a prosperous nation. People's Liberation Army writings from 2013 describe space capabilities as strategically important for winning what they call "informatized wars," and since that time, China has designated space as a warfighting domain, evolved its organization for space warfighting twice, and grown its space encounter space capabilities at what General Whiting called "a breathtaking pace."

In the past 8 years, China has increased the number of satellites for intelligence, surveillance, and reconnaissance by a factor of 6, which includes a 17-fold increase in the number of commercial satellites for that mission. China is the only country to operate a synthetic aperture radar satellite in geostationary orbit, which provides China with a persistent day-night, all-weather capability to surveil large naval units transiting the Indo-Pacific region.

China has also increased its number of communications satellites by a factor of 12, including the recent launch of 72 Project SatNet satellites into what will eventually be thousands of satellites to function as China's Starlink.

China has expanded its launch industry and accelerated its launch pace, and is prioritizing a tactically responsive space launch capability that leverages several of its new mobile, solid-fueled vehicles provided by a combination of China's established state-owned enterprise space companies as well as newer entrants, albeit with several launch failures for those newer entrants.

China has made similar progress in other space mission areas, and like the U.S., China is working to field space architectures that leverage resilience methods, such as the proliferation method associated with U.S. Starlink and Chinese Project SatNet.

With regards to counterspace, China has an operational direct descent anti-satellite missile system for low Earth orbit that the PLA trains to operate, and China likely has efforts underway to field a similar capability for the higher orbits. According to the Defense Intelligence Agency, China has ground-based laser weapon systems and a wide range of electronic warfare capabilities. China also has increased capability for on-orbit inspection and repair satellites, and low Earth orbit and in geostationary orbit, that demonstrated complex maneuvers, and those capabilities could have dual use for counterspace operations.

For instance, a repair satellite that is equipped with a robotic arm could be used to deliver irreversible attacks on satellites by permanently damaging their components or reversibly attack satellites by reorienting the satellite and temporarily taking it off of its mission. And conceivably, this kind of satellite could also be used for defense against similar attacks.

Hence, China potentially has a wide range of counterspace or dual-use capabilities that can flexibly be used for offense or defense, with reversible or non-reversible modes of attack spanning multiple orbital regimes. This provides the People's Liberation Army commanders with flexible tools for crisis and escalation management.

So why is China fielding these types of counterspace capabilities? It is fielding them because it perceives the U.S. as having high dependence on space for joint warfighting. But interestingly, there is growing evidence that China itself has growing dependence on space capabilities for joint warfighting, which is evident by the rapid increases in the space capabilities that we have seen.

China depends on space capabilities to monitor the U.S. posture in the Indo-Pacific region. At a time of war, China would depend upon space for targeting with its missile capabilities and assessing damage of those attacks. China likely depends on space to enable broad-range long-range fire capabilities in multiple domains.

China may have less incentive to escalate warfare to space if the People's Liberation Army needs to preserve the space capabilities that it depends upon for its joint warfighting and if the People's Liberation Army believes the United States can hold those capabilities at risk.

I make three observations about how the U.S. should respond to these developments.

First, this panel is about China's ambitions to dominate space. I think space dominance narrowing focuses attention on threats to satellites. I think the U.S. should take a broader approach that holistically considers threats but also includes careful consideration for U.S. and Chinese dependencies on space for joint warfighting. What are the key dependencies that each side depends upon, and when during the conflict? Are there alternatives in other domains? What are the battlefield effects, and what are the expected responses of holding Chinese satellites at risk? The U.S. should seek to preserve the space capabilities it relies upon for the joint war fight and to hold at risk the space capabilities that China relies upon to achieve its military objectives.

Second, systems that increase U.S. resilience challenge the People's Liberation Army's preferred approach to warfighting. The United States should continue to acquire space architectures, or services from commercial space architectures, that leverage methods of enhancing resilience, including proliferation and diversity methods. For instance, the U.S. should enhance the resilience of architectures to provide positioning, navigation, and timing services.

Third and finally, I recommend equipping U.S. military commanders with capabilities that can be used to defend satellites that lack adequate resilience measures and flexibly hold at risk the capabilities that China is highly dependent upon for joint warfighting. The U.S. is going to need robust capabilities for space domain awareness and command and control, since they are foundational for space operations, and indeed those appear to be priorities today. Thank you.

COMMISSIONER SIMS: Thank you, Dr. Alkire. Mr. Curcio.

PREPARED STATEMENT OF BRIEN ALKIRE, SENIOR OPERATIONS RESEARCHER, RAND

Testimony

BRIEN ALKIRE

The Expansion of China's Military Space and Counterspace Capabilities and Implications for Space as a Contested Domain

CT-A3951-1
Testimony presented before the U.S.-China Economic and Security Review Commission on April 3, 2025

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The Expansion of China's Military Space and Counterspace Capabilities and Implications for Space as a Contested Domain

Testimony of Brien Alkire[1]
RAND[2]

Before the U.S.-China Economic and Security Review Commission

April 3, 2025

China's leaders see preeminence in space as an important component of a strong country,[3] a source of national pride, and key to a prosperous nation.[4] People's Liberation Army (PLA) writings from 2013 describe space capabilities as strategically important for winning what the PLA calls *informatized wars*.[5] Since that time, China has designated space as a warfighting domain and has been "growing its military space and counterspace capabilities at breathtaking pace."[6] My testimony today will describe recent developments and the trajectory of Chinese space and counterspace capabilities, changes to how China organizes for military space, factors that may affect the risk of warfare escalating to the space domain, and recommendations

[1] The opinions and conclusions expressed in this testimony are the author's alone and should not be interpreted as representing those of RAND or any of the sponsors of its research.

[2] RAND is a research organization that develops solutions to public policy challenges to help make communities throughout the world safer and more secure, healthier and more prosperous. RAND is nonprofit, nonpartisan, and committed to the public interest. RAND's mission is enabled through its core values of quality and objectivity and its commitment to integrity and ethical behavior. RAND subjects its research publications to a robust and exacting quality-assurance process; avoids financial and other conflicts of interest through staff training, project screening, and a policy of mandatory disclosure; and pursues transparency through the open publication of research findings and recommendations, disclosure of the source of funding of published research, and policies to ensure intellectual independence. This testimony is not a research publication, but witnesses affiliated with RAND routinely draw on relevant research conducted in the organization.

[3] Howard Wang, Gregory Graff, and Alexis Dale-Huang, *China's Growing Risk Tolerance in Space: People's Liberation Army Perspectives and Escalation Dynamics*, RAND Corporation, RR-A2313-2, 2024, p. 2, https://www.rand.org/pubs/research_reports/RRA2313-2.html.

[4] Headquarters Space Force Intelligence, "Space Threat Fact Sheet," U.S. Space Force, February 21, 2025, p. 1.

[5] See "Research on Joint Operations" ["联合作战研究"], National Defense University Press, 2013. *Informatized warfare* refers to warfare conducted with enhanced battlespace awareness and capability to communicate and share information with military units, which can be enabled by space capabilities.

[6] Headquarters Space Force Intelligence, 2025; Stephen N. Whiting, "Fiscal Year 2025 Priorities and Posture of United States Space Command," presentation to the Senate Armed Services Committee February 29, 2024, p. 6.

for shaping the trends in directions favorable for U.S. national security. I begin with a discussion of recent trends in the development of China's military space capabilities.

Recent Trends in China's Military Space Capabilities

There is evidence that, similar to the U.S. military, the PLA has increasing dependence on space for joint warfighting,[7] and this dependence is reflected in the rapid growth of its space capabilities. In the past eight years, China has increased the number of satellites for intelligence, surveillance, and reconnaissance (ISR) by about a factor of six, which includes a 17-fold increase in the number of commercial ISR satellites, increasing ISR capacity and improving revisit rates.[8] These ISR satellites provide the PLA with the capability to assess U.S. force posture in the Indo-Pacific region, track and target U.S. naval assets, and target and assess the outcomes of missile attacks on overseas bases where U.S. forces may be operating, among other military uses. China also operates the only synthetic aperture radar satellite based in geostationary orbit (GEO) which likely provides China with day-or-night, all-weather, persistent imaging capability for surveilling U.S. Navy assets operating in the region.[9]

China increased its number of communication satellites by a factor of twelve over this time frame. A national priority for China is to develop a megaconstellation of communication satellites to function as "China's Starlink," and this effort is called Project SatNet.[10] China launched 72 Project SatNet satellites into low earth orbit (LEO) as part of a constellation of 648 planned by the end of 2025, with thousands planned by 2030.[11] Project SatNet is distinct from other Chinese initiatives to build a megaconstellation, such as another effort called G60,[12] and is almost certainly intended for some military use.[13]

China's BeiDou satellite system achieved full operational capability in 2020 and provides position, navigation, and timing (PNT) services for civilian and military applications, as well as a communications and command and control capability, from satellites in a variety of orbits. It is owned and operated by the civilian China National Space Administration.

[7] Corey Crowell and Sam Bresnick, *Defending the Ultimate High Ground: China's Progress Toward Space Resilience and Responsive Launch*, Center for Security and Emerging Technology, July 2023, p. 9, https://cset.georgetown.edu/publication/defending-the-ultimate-high-ground/.

[8] The trends in space capabilities provided in this section are primarily based on the counts of military and commercial satellites from Todd Harrison, "Space Data Navigator," American Enterprise Institute, undated, https://spacedata.aei.org/. Estimates can vary by source. For an alternative characterization of the trends, see Headquarters Space Force Intelligence, 2025.

[9] Clayton Swope, "No Place to Hide: A Look into China's Geosynchronous Surveillance Capabilities," Center for Strategic and International Studies, January 19, 2024.

[10] Howard Wang, Jackson Smith, and Cristina L. Garafola, *Chinese Military Views of Low Earth Orbit: Proliferation, Starlink, and Desired Countermeasures*, RAND Corporation, RR-A3139-1, 2025, p. vi, https://www.rand.org/pubs/research_reports/RRA3139-1.html.

[11] Headquarters Space Force Intelligence, 2025.

[12] Wang, Smith, and Garafola, 2025, p. 30.

[13] Wang, Smith, and Garafola, 2025, p. 29.

From 2017 to 2021, China launched a new constellation of early warning satellites into GEO. China has also made impressive strides in enhancing its capabilities for space domain awareness (SDA), which includes satellites but also ground infrastructure, such as radar and telescope systems, many of which are located in foreign countries.[14] SDA allows military forces to plan, integrate, execute, and assess space operations, including counterspace operations.[15]

China also has a reusable space plane.[16] The mission of this space plane is probably similar to the mission of the U.S. X-37B,[17] though its mission capabilities may be more limited, since its payload capacity is likely far below that of the X-37B and its flight tests have demonstrated lower levels of endurance than the X-37B.[18]

China has expanded its launch industry and accelerated its launch pace. In 2022, China began construction on a new launch complex on Hainan Island and built sea platforms that support launch.[19] China had around 70 launches in 2024, compared with 150 launches for the United States.[20] Regarding reliability, a report from 2023 notes that China's Long March–series rockets had six failures to achieve orbit in 284 attempts from 2013 to 2022, in contrast with two failures in 279 attempts by the United States over the same period using a combination of Delta IV, Atlas V, and SpaceX Falcon 9 rockets.[21] In August 2024, China attempted to launch 18 communication satellites into LEO on a liquid-fueled rocket; however, the upper stage broke apart during the launch and created more than 50 pieces of debris, posing a risk to satellites in LEO below 800-km altitude.[22] China is prioritizing a tactically responsive space launch capability that leverages several of its new mobile, solid-fuel launch vehicles for this capability, provided by a combination of China's established space companies and newer companies.[23] However, the newer companies had few launches and high failure rates (five failures out of 11 launches as of 2023).[24]

The PLA typically acquires whole systems that are manufactured or integrated by state-owned enterprises (SOEs) that fall under the State Administration for Science, Technology, and

[14] China maintained ground sites for space capabilities in six countries in 2019, a number that increased to "more than a dozen countries" by 2023 (Cate Cadell and Marcelo Perez del Carpio, "A Growing Global Footprint for China's Space Program Worries Pentagon," Washington Post, November 21, 2023).

[15] Joint Publication 3-14, *Space Operations*, Joint Chiefs of Staff, August 23, 2023, p. xiii.

[16] Andrew Jones, "China's Secretive Reusable Spaceplane Lands After 267 Days in Orbit," *SpaceNews*, September 6, 2024.

[17] For recent information about the X-37B, see U.S. Space Force, "United States Space Force Launches Seventh X-37B Mission," press release, December 30, 2023.

[18] Wang, Smith, and Garafola, 2025, p. 40.

[19] Crowell and Bresnick, 2023, p. 18.

[20] The primary source for this section is Crowell and Bresnick, 2023.

[21] Crowell and Bresnick, 2023, p. 21.

[22] Andrew Jones, "Chinese Megaconstellation Launch Creates Field of Space Debris," *SpaceNews*, August 8, 2024, https://spacenews.com/chinese-megaconstellation-launch-creates-field-of-space-debris/.

[23] Crowell and Bresnick, 2023, p. 2.

[24] Crowell and Bresnick, 2023, p. 23.

Industry for National Defense, and the PLA rarely acquires a complete system manufactured by a privately owned company.[25] SOEs China Aerospace Science and Technology Corporation and China Aerospace Science and Industry Corporation or their subsidiaries dominate China's space industry. However, as mentioned, newer companies are also entering the market, and they are primarily focused on launching smaller payloads to LEO. Interestingly, GeeSpace, a subsidiary of China's largest automaker Geely, is fielding a LEO constellation to provide navigation services with centimeter-level accuracy for Geely-manufactured autonomous vehicles,[26] and this company represents a new entrant that may be able to provide PNT services to the PLA as an alternative to BeiDou.

China has made significant progress with orbital inspection, repair, and refueling capabilities. In 2022, China's Shijian-21 space debris mitigation satellite docked with a defunct BeiDou satellite and towed it into a graveyard orbit.[27] In February 2025, China's Shijian-25 satellite refueled a BeiDou satellite in GEO.[28] As I discuss later in my testimony, these capabilities could also be used for counterspace weapons.

Similar to the United States, China is leveraging methods to enhance the resilience of its space architectures to hostile actions (such as counterspace attacks) or adverse conditions. For instance, the proliferation method used by the U.S. Starlink and Chinese Project SatNet enhances resilience by deploying large numbers of the same payloads or systems of the same types to perform the same mission.[29] Another example is the diversification method, which uses different orbits, systems, or commercial, civil, or international partners to support the same mission in multiple ways. BeiDou employs satellites in different orbits (in contrast, the U.S. GPS employs satellites in medium earth orbit). Progress on resilience is nascent for both actors, but I would expect to see this trend continue because of its potential benefits.

The focus of my testimony is on China's military space and counterspace capabilities. However, it is worth mentioning a few key advancements in civilian space. China is excluded from the International Space Station as a likely result of a congressional amendment from 2011, known as the Wolf Amendment, that prohibits the National Aeronautics and Space Administration (NASA) from cooperating substantially with its Chinese counterpart without express prior authorization; China operates its Tiangong space station instead.[30] China has ambitions to land humans on the moon by 2030; in summer 2024, China's unmanned spacecraft

[25] Eli Tirk, "Sichuan Tengden Technology: Privately Owned, State Sponsored," China Aerospace Studies Institute, November 2022.

[26] Resilient Navigation and Timing Foundation, "Commercial Chinese LEO PNT Launching in 2020—Spacewatch Global," March 5, 2020.

[27] Andrew Jones, "China's Shijian-21 Towed Dead Satellite to a High Graveyard Orbit," *SpaceNews*, January 27, 2022, https://spacenews.com/chinas-shijian-21-spacecraft-docked-with-and-towed-a-dead-satellite/.

[28] "China Achieves Space Refueling Technology: A New Era of 'Space Equality' Dawns," *The Nation*, February 24, 2025, https://thenationonlineng.net/china-achieves-space-refueling-technology-a-new-era-of-space-equality-dawns/.

[29] For a formal treatment of resilience methods, see Joint Publication 3-14, 2023, p. III–4.

[30] Daisy Dobrijevic and Andrew Jones, "China's Space Station, Tiangong: A Complete Guide," Space.com, updated August 15, 2023, https://www.space.com/tiangong-space-station.

returned samples from the far side of the moon.[31] China positioned a relay satellite at a Lagrange point to enable communications with its lunar landers for this mission.[32] In March 2021, China and Russia agreed to a memorandum of understanding to build an International Lunar Research Station as a scientific experiment base on the lunar surface or orbit that would be open to all interested countries and international partners.[33] By July 2024, China indicated it had reached agreements with ten countries to join it and Russia in the effort, with the aim of having a basic station by 2035 and an extended station by 2045.[34] A report published in 2024 concluded that there was limited expectation at that time for military activity on the moon surface or the cislunar region between the earth and moon.[35]

Recent Trends in China's Counterspace Capabilities

In 2007, China demonstrated a direct ascent anti-satellite (DA-ASAT) missile capability for kinetic attacks on satellites in LEO, and China now has an operational ground-based system that the PLA trains to operate.[36] In 2013, China launched a ballistic object to an altitude approaching GEO,[37] and this may be an indication that China will eventually field a DA-ASAT capability for satellites in higher orbits.[38]

China's orbital inspection and repair satellites in GEO, such as the Shijian-21 and Shijian-25, are potentially dual-use as military weapons with flexible capabilities.[39] For instance, a grappler on a repair satellite could be used to irreversibly attack a satellite by permanently damaging satellite components or to reversibly attack a satellite by reorienting the satellite to temporarily take it out of mission. Conceivably, the same type of satellite could also be used to defend a satellite from attack by another repair satellite equipped with a grappler. Similarly, China demonstrated complex maneuvers with experimental satellites in LEO in 2024 that a top U.S. Space Force general characterized as rehearsing "dogfighting" maneuvers; the maneuvers

[31] Leonard David and Lee Billings, "China Makes History with First-Ever Samples from the Moon's Far Side," *Scientific American*, June 25, 2024, https://www.scientificamerican.com/article/china-returns-first-ever-samples-from-the-moons-far-side/.

[32] Science Informed, "A New Era of Space Exploration: The Battle for Lagrange Points," December 24, 2023, https://scienceinformed.com/a-new-era-of-space-exploration-the-battle-for-lagrange-points/.

[33] Rafi Letzter, "China and Russia Say They Will Join Forces to Build Moon Base," Live Science, March 10, 2021, https://www.livescience.com/china-russia-moon-mission.html.

[34] Andrew Jones, "China Wants 50 Countries Involved in Its ILRS Moon Base," *SpaceNews*, July 23, 2024, https://spacenews.com/china-wants-50-countries-involved-in-its-ilrs-moon-base/.

[35] Dean Cheng, *China and the New Moon Race: A Collection of Papers by Dean Cheng*, George Washington University, November 2024, p. 96, https://elliott.gwu.edu/china-and-new-moon-race.

[36] Headquarters Space Force Intelligence, 2025.

[37] Headquarters Space Force Intelligence, 2025.

[38] Defense Intelligence Agency, *Challenges to Security in Space: Space Reliance in an Era of Competition and Expansion*, 2022.

[39] Kristin Burke, *PLA Counterspace Command and Control*, China Aerospace Studies Institute, December 2023, p. 60, https://www.airuniversity.af.edu/CASI/Display/Article/3612979/pla-counterspace-command-and-control/.

involved three Shiyan-24C experimental satellites and two other Chinese experimental spacecraft, the Shijian-6 series satellites.[40]

According to the Defense Intelligence Agency (DIA), China has multiple ground-based laser weapons to disrupt, degrade, or damage satellites. Also, DIA indicates that the PLA routinely incorporates electronic warfare into its exercises that are intended to deny communications, radar systems, and PNT support to force movements and degrade precision-guided munitions.[41]

The wide range of counterspace capabilities and capabilities with potential dual-use provide PLA commanders with systems that can be used for offensive and defensive purposes, with reversible and irreversible modes of attack. These systems provide the PLA with flexible tools that are relevant for crisis and escalation management.

Recent Changes in China's Organization for and Operational Approach to Military Space

Following its designation of space as a warfighting domain, China organized its military space capabilities and military network operation capabilities under the Strategic Support Force (SSF)[42] as a service branch of the PLA in 2015.[43] There is uncertainty about which space and counterspace capabilities were operated by or under the control of the SSF, but it appears that many counterspace capabilities were not centralized under the SSF. For instance, it appears that the PLA Rocket Force and the SSF both operated the DA-ASAT capability, which was under the control of the Central Military Commission (CMC).[44] Also, terrestrial satellite communications jamming capabilities were operated by PLA services other than the SSF under theater commander control.[45]

In April 2024, China disestablished the SSF as a service branch.[46] The PLA is now organized into four services (Army, Navy, Air Force, and Rocket Force) and four *arms*, which are the Aerospace Force, Cyberspace Force, Information Support Force, and Joint Logistic Support

[40] Courtney Albon, "China Demonstrated 'Satellite Dogfighting,' Space Force General Says," *Defense News*, March 18, 2025, https://www.defensenews.com/space/2025/03/18/china-demonstrated-satellite-dogfighting-space-force-general-says/.

[41] Defense Intelligence Agency, 2022.

[42] The SSF was further subdivided into the Space Systems Department and Network Systems Department (see Burke, 2023, p. 5).

[43] Joe McReynolds and John Costello, "Planned Obsolescence: The Strategic Support Force in Memoriam (2015–2024)," *China Brief*, Vol. 24, No. 9, April 26, 2024, https://jamestown.org/program/planned-obsolescence-the-strategic-support-force-in-memoriam-2015-2024/.

[44] PLA Academy literature from 2000 to 2020 states that the decisions to use a kinetic space weapon, such as DA-ASAT, would be made at the CMC's Joint Operations Command Center and commanded from the Space Systems Department directly under the CMC. See Burke, 2023, p. 22.

[45] Burke, 2023, p. 12.

[46] McReynolds and Costello, 2024.

Force. The remnants of the space-related elements of the SSF are now aligned under the Aerospace Force, and the four arms are directly subordinate to the CMC.[47]

The PLA's operational concept for multi-domain warfare prioritizes striking key vulnerabilities in an adversary network information system of systems, with the belief that striking key nodes will severely hinder an adversary.[48] This operational concept would certainly apply to space warfare, and it suggests that the PLA would seek to identify key U.S. space dependencies for joint warfighting and hold the associated space systems at risk.

China does not recognize a distinction between commercial and military satellites; international law notwithstanding, China would likely treat civilian and commercial satellites supporting military operations as military targets.[49]

Factors That Could Affect the Risk of Escalating Warfare to the Space Domain

A report published in 2024 by my colleagues at RAND suggests that the PLA has grown increasingly risk tolerant in its approach to escalation in the space domain under Chinese Communist Party General Secretary Xi Jinping.[50] That report finds that the PLA's approach to deterrence and escalation in space prioritizes securing political objectives over avoiding conflict, and "Beijing could initiate conflict activities if it judged that the political risk of inaction exceeded the military risk."[51] Additionally, the PLA's threat perceptions tend to exaggerate U.S. capabilities, leading to assessments and responses that prepare for the worst possibilities.[52] These factors may increase the risk of escalating warfare to the space domain.

On the other hand, the tremendous growth in China's military space capabilities may reflect the PLA's growing dependence on space for joint warfighting. China may have less incentive to escalate warfare to space if the PLA needs to preserve the space capabilities it depends on for joint warfighting and if the PLA believes that the United States can hold those capabilities at risk. For instance, in a 2023 wargame of a defense of Taiwan scenario set in 2026, it was observed that

> [n]o players used direct-ascent weapons against adversary satellite constellations because of concerns about losing their own capabilities. It was a classic case of

[47] Gordon Arthur, "Why China Axed the Strategic Support Force and Reshuffled the Military," *Defense News*, April 26, 2024, https://www.defensenews.com/global/asia-pacific/2024/04/26/why-china-axed-the-strategic-support-force-and-reshuffled-the-military/.

[48] Wang, Graff, and Dale-Huang, 2024, p. 18.

[49] Yool Kim George Nacouzi, Dwight Phillips, Krista Romita Grocholski, Igor M. Brin, Brian Dolan, Jonathan Fujiwara, John Hoehn, Kotryna Jukneviciute, Gwen Mazzotta, Jordan Willcox, Jonathan P. Wong, and Barbara Bicksler, *Operational and Policy Implications of Integrating Commercial Space Services into U.S. Department of Defense Operations*, RAND Corporation, RR-A2562-2, 2025, p. 66, https://www.rand.org/pubs/research_reports/RRA2562-2.html.

[50] Wang, Graff, and Dale-Huang, 2024, pp. 24–25.

[51] Wang, Graff, and Dale-Huang, 2024, p. 24.

[52] Wang, Smith, and Garafola, 2025, p. vi.

> mutual deterrence. In counterspace operations, both sides contented themselves with electronic warfare and dazzling. They also launched co-orbital attacks that would only unfold beyond the time scale of a Taiwan operation. While space is a critical warfighting domain, it was relatively static in these scenarios.[53]

It should be noted that an observation from one wargame is scant evidence of a trend.

Recommendations

This panel is about China's ambition to dominate space. Striving for space dominance narrowly focuses attention on threats to space capabilities. I recommend a more balanced approach for the United States that not only takes threats into account but also considers the specific U.S. and Chinese dependencies on space for joint warfighting. The U.S. military should seek to preserve the space capabilities that it relies on for the joint warfight and to hold at risk the space capabilities that China relies on to achieve its military objectives. This approach, I believe, will yield better insights into the priorities for spending on U.S. military space and counterspace capabilities.

Systems that increase U.S. resilience challenge the PLA's preferred approach to warfighting.[54] The United States should continue to acquire space architectures, or services from commercial space architectures, that leverage methods of enhancing resilience, including proliferation and diversity methods. For instance, the United States should enhance the resilience of architectures that provide PNT services.

The PLA appears to be pursuing a portfolio of counterspace capabilities that can flexibly be used for offense or defense and can deliver effects that are reversible or irreversible. These capabilities provide PLA commanders with powerful tools for crisis and escalation management. I recommend equipping the U.S. military with a similar set of capabilities. In particular, the U.S. military should be equipped with capabilities that can hold at risk the space capabilities that China is highly dependent on for joint warfighting; the U.S. military should also be equipped with capabilities to defend its own satellites that lack resilience features and that the United States depends on for joint warfighting. Robust capabilities for space domain awareness, and robust capabilities for command and control of space operations, are foundational.

[53] Mark F. Cancian, Matthew Cancian, and Eric Heginbotham, *The First Battle of the Next War: Wargaming a Chinese Invasion of Taiwan*, Center for Strategic and International Studies, January 2023, p. 115.

[54] Wang, Smith, and Garafola, 2025, p. vi.

OPENING STATEMENT OF BLAINE CURCIO, FOUNDER, ORBITAL GATEWAY CONSULTING

MR. CURCIO: Thank you very much to the Commission for the invitation. I am very proud and honored to be here.

Today I am going not talk about three main topics: the technology transfer and alignment of incentives across the entire government and China with regard to their commercial space sector; how this has impacted talent development and the proliferation of talent across the space sector; and finally, how national government policies are broadening the playing field where commercial companies are allowed to act within the Chinese commercial space sector.

Looking at technology transfer and the alignment of incentives across the whole of government, I would like to give an example of the Changchun Institute of Optics and Precision Mechanics in China's Northeast Rust Belt area of Jilin Province and Changchun city specifically. There is a company, Chang Guang Satellite Technology, Ltd., CGSTL. They are arguably the leading remote sensing company in the world. They have built and launched about 200 remote sensing satellites over the past 10 years. They operate a constellation of those satellites. They have had some interesting adventures with the Wagner Group, among other things, that have gotten them sanctioned.

This company emerged from this Institute of Optics and Precision Mechanics. This Institute of Optics and Precision Mechanics, they have a venture capital arm that has invested into this company and also invested into a number of other related companies, companies building optical payloads, companies building filters for these satellites, companies building a lot of other related equipment. And again, this Institute, which is allowing their technology to be transferred to commercial companies, is investing into these commercial companies.

It is also being supported by the province and the city of Chuangchun, so you have the incentives of the provincial government, the city government, the large Chinese Academy of Sciences Institute within this city, all aligned and trying to help this local company build remote sensing satellites and other related equipment.

And this is something that we have seen in other parts of China. There is the Harbin Institute of Technology, arguably the probably the third- or fourth-top university in China. They built the robotic arm on the Chinese Space Station, for example. They have similar spinoffs that they have invested into, and this is creating a very clear alignment of incentives across large parts of the subnational government. And this has impacted talented transfer because it has made it clear to typically young, entrepreneurial engineers or others that it is okay to make a commercial space company.

And so the second point, we have seen a dramatic change in the way that talent has been transferred from the state to the private sector. If we think about 10, 11 years ago, 2014, Document 60, let's say the starting point for commercial space in China, anyone in China at that time who knew how to build a rocket was working for a state-owned enterprise building rockets. And there was an example, in 2018, the first notable example of a commercial launch company, Landspace at the time, hiring a senior launch engineer, Zhang Xiaoping from the Xi'An Space Propulsion Research Institute. And at that time, the Xi'An Space Propulsion Research Institute, they were not amused at this. They tried to sue Lane Space. They tried to sue Zhang Xiaoping. They said, quote, "Zhang was most crucial to the development process and had irreplaceable talents, and argued that his departure could affect China's race to send people to the moon."

At the time, the rumor in China is that this decision of whether Zhang was allowed to go

to a commercial company went all the way up to President Xi Jinping, who again, rumors said as long as he stays in China he can do what he wants. Now, Zhang Xiaoping, as far as I know, is still working for Landspace, so he was not prohibited from making that move. But again, it was a big deal. There were a lot of articles written about it.

If we fast forward to today, there was an article a couple of weeks ago talking about which Chinese commercial launch company is the "Whampoa Academy of the Chinese space sector," Whampoa Academy being an academy where a lot of early leadership from the PRC and ROC was trained. And a couple of examples that this article mentioned, you have Shu Chang, the founder of OneSpace, was originally on the founding team at Landspace; Kang Yonglai, the former CTO of Landspace, went on to found Space Pioneer; in 2024, Ge Minghe resigned from Landspace to establish his own company, Xiandeng Aerospace; Huo Liang, who founded Deep Blue Aerospace, was an early employee at OneSpace; Chen Xiaojun, former CTO of OneSpace, left the company to establish his own company.

You get the point, the idea that top talent is no longer necessarily forced to stay within state-owned enterprises, and this has created a much larger pool and a much more diverse pool of people who are allowed, to a certain extent, to do what they want, as long as they stay in China, as the case may be.

In any case, the talent and the evolution of that talent has changed dramatically over the last 10 years, and it is a notable change.

The last point I would mention is that the central government has expanded the field where commercial space is allowed to play. China typically is a system where companies need to ask for permission rather than asking for forgiveness, so commercial space companies really don't act unless the government tells them you are allowed to do this thing. And if we think about an example like the "Chinese version of Starlink," for a long time no one really knew what that was going to look like.

In 2020, the National Development and Reform Commission, the NDRC, they added satellite internet to their list of new infrastructures, which is a list including things like industrial IOT and 5G and other digital infrastructures. That was the first sign that satellite internet was a big priority in China. But still, commercial companies really weren't allowed to enter this field, because it was still pretty nebulous.

In 2021, there was the establishment of China SatNet, which Brien referred to earlier. And SatNet is a fully state-owned enterprise. It was implied that only state-owned enterprises were going to do this. But for a couple of years, for a lot of different reasons, SatNet did not make a lot of progress. And so in 2023, we saw the Ministry of Industry and Information Technology publish a publication about the opening up of the satellite internet sector, which called for the "coordinated opening of the telecommunications business to private capital" and "to promote the reform of the satellite internet business in steps and stages." This occurred in October of 2023.

Within about 6 weeks, a second Chinese version of Starlink, this company, Shanghai Spacesail, raised about a billion U.S. dollars. They have since launched 90 satellites into low Earth orbit for communications. And this company is effectively a joint venture between the Shanghai government and the Chinese Academy of Sciences, but still it is not a national government company. It is a nominally commercial company. And the point being until the national government made this proclamation, that was not going to be allowed. So the government had progressively widened the playing field for what commercial companies are allowed to do.

And just the last couple of points, and this has extended now to cargo spacecraft, where we are seeing more national government support for that. It has expanded to other areas, as well.

I am over my time and will stop there, but thank you very much for your attention.

COMMISSIONER SIMS: Thank you. Ms. Samson.

PREPARED STATEMENT OF BLAINE CURCIO, FOUNDER, ORBITAL GATEWAY CONSULTING

USCC Hearing on "The Rocket's Red Glare: China's Ambitions to Dominate Space"

April 3, 2025

Written testimony of Blaine V. Curcio, Founder of Orbital Gateway Consulting

Testimony Before the U.S.-China Economic and Security Review Commission

Panel 2: Space as a Contested Domain: Expansion of China's Military and Commercial Space Activities

Witness topic: China's Commercial Space Industry and Supply Chains

1) How would you characterize the current status of China's commercial space industry, and what role does the central government play in fostering its growth and development?

I would characterize the Chinese commercial space industry as extremely vibrant, but in some ways also tenuous. It is vibrant because there have been multiple high-level government proclamations in support of commercial space over the past decade, giving provinces, cities, private VCs, and entrepreneurs support to establish commercial space firms. It is tenuous because these firms are, in many cases, struggling to put together a business model. This dynamic is largely due to the fact that support for Chinese commercial space, like many industries in China, comes from the supply side rather than the demand side: the Chinese government provides funding for space companies, they provide free land, subsidies for employees, etc., but they seldom provide contracts for actual goods and services.

The Central Government also plays a guiding role, publishing nebulous announcements about their support for space. This includes Satellite Internet being included in the National Development and Reform Commission's (NDRC) list of New Infrastructures, multilateral agreements specifying space cooperation (i.e. "A New Era of China-Africa Cooperation" from November 2021 mentioning space projects[1]), and vague pronouncements about opening up of relatively closed industries (i.e. the 2023 publication by MIIT of the "Opinions on Innovating the Management of Information and Communication Industry to Optimize the Business Environment", which called for orderly opening up of the satellite internet industry [2]).

2) Describe China's domestic policies at the provincial level that are shaping the future trajectory of China's commercial space industry.

Most provinces have some element of space in their medium-long-term development plans. This could be reflected in a 14th Five-Year Plan, development plan for developing "New Productive Forces", development plan for "New Infrastructures" (which could include satellite internet), or development plans that align with other national-level strategic policies.

Certain cities also have this type of policy. Taking Shanghai as an example, the city has:

[1] https://www.gov.cn/zhengce/2021-11/26/content_5653540.htm
[2] https://www.gov.cn/zhengce/zhengceku/202408/content_6966820.htm

a. 14th Five-Year Plan for Shanghai to Build a Science & Technology Innovation Center with Global Influence[3] (includes satellite internet and rockets)
b. 2022 Shanghai Action Plan to Create a Future Industry Innovation Highland and Develop and Expand Future Industry Clusters[4]
c. 2023 Shanghai Action Plan to Promote Commercial Space Development and Create a Space Information Industry Highland (2023-2025)[5]
d. Certain districts also have targeted subsidies. The Songjiang District of Shanghai (home to the G60 Industrial Base/SpaceSail constellation) published a list of targeted subsidies this week[6]:
    i. "Major Project" subsidies: Up to ¥5M for rented office space ¥10M for purchased office space, and up to 15% of a project's total fixed asset investment, to a maximum subsidy of ¥30M per project.
    ii. "Supporting Satellite Constellation" subsidies, providing one-time subsidies of 10% and 20% of launch and insurance costs, respectively of a single satellite, to a maximum subsidy of ¥2M per satellite and ¥5M per enterprise
    iii. "Supporting Production and Launch of Spacecraft", providing subsidies of ¥10,000 per kg of satellite launched to an annual maximum of ¥500,000 per satellite and ¥5M per enterprise.
    iv. "Supporting Joint Innovation Among Industries", offering subsidies of up to ¥10M per project at a rate of not more than 30% of the project total for "commercial space enterprises to form alliances with universities, research institutes, and upstream and downstream enterprises"
    v. "Support Creation of Technological Innovation Platforms", offering subsidies of up to ¥10M per project at a rate of not more than 30% of the project total for projects such as clean rooms, electromagnetic compatibility rooms, etc. For companies that open these test rooms to other enterprises, a maximum of ¥2M per year in subsidies will be provided at 5% of actual annual service income. Companies building infrastructure for testing, certification, simulation experiments, etc., can receive a subsidy of 20% of the fixed asset investment up to ¥5M
    vi. "Encourage Coordinated Development of Industries", providing subsidies of 5% for companies that purchase products or services of ¥10M or more from "upstream and downstream companies for their own operation", with a maximum subsidy of ¥5M.
    vii. "Encourage Acquisition of Access Qualifications", offering subsidies of up to ¥1M per certification and ¥5M per enterprise for getting certification

[3] https://www.ndrc.gov.cn/xxgk/zcfb/ghwb/202109/P020210910639035516208.pdf
[4] https://www.shanghai.gov.cn/nw12344/20221011/3c8c02700bfd400293faf955bc33e6af.html
[5] https://www.shanghai.gov.cn/nw12344/20231120/5e53f1fe1b1543f38a49153eb563cfbb.html
[6] https://mp.weixin.qq.com/s/hJ5tBfyAp7PZyYofk_lsXw

from entities such as the American Bureau of Shipping, Norwegian Classification Society, European Aviation Safety Administration, etc.

viii. "Support Expansion of Demonstration Applications", offering subsidies of up to ¥500,000 per application/use-case in areas such as agriculture, natural resources, transportation and logistics, etc.

ix. "Support Large-Scale Development of Enterprises", with a one-time subsidy of ¥1M based on "comprehensive development in terms of scale"

3) What is your assessment of China's domestic space talent, what factors are driving the development of its space talent?

China's state-owned apparatus, including CASC, CASIC, CETC, and the Chinese Academy of Sciences, are home to tens of thousands of competent engineers and researchers. The same can be said of their top space/aerospace-focused universities, e.g. Beihang University, Harbin Institute of Technology, Northwest Polytechnical University. For a long time, these employees had no other employment options beyond SOEs. Over the past 10 years this has changed radically as commercial space has emerged, and today, there is a vibrant ecosystem of talent moving between commercial companies. The movement and development of talent is increasingly being dictated by commercial forces, and it is easier than ever before to change company.

To take an early example, in 2018, Deputy Director of Rocket Design from the Xi'an Space Propulsion Research Institute Zhang Xiaoping was hired by commercial launch firm Landspace for a rumored 10x his previous salary. At the time, the Xi'an Space Propulsion Research Institute attempted to sue Landspace, describing in a leaked legal document[7] that Zhang was ""most crucial to the development process", had "irreplaceable" talents and argued that his departure could affect China's race to send people to the moon". At that time, the rumor in China was that the decision went all the way to the level of Xi Jinping, who allegedly said that as long as Zhang stayed in China, he could do what he wanted.

Conversely, a recent piece published by Chinese space industry blogger Hello Space asked "Who is the Whampoa Military Academy of China's Commercial Launch Sector" , referring to the military academy in Guangzhou that produced many of the leaders of early PRC and ROC. The article focuses on Landspace and OneSpace, two of the first commercial launch companies in China, and how they have been sources for talent for many of China's later-established launch startups. Shu Chang, Founder of OneSpace, was originally in the founding team of Landspace. Kang Yonglai, former CTO of Landspace, is the founder of Space Pioneer. In 2024, Ge Minghe resigned from Landspace to establish Xiandeng Aerospace.

Huo Liang, Founder of Deep Blue Aerospace, was an early employee at OneSpace. Chen Xiaojun, former CTO of OneSpace, left the company in February 2017 to establish Shenzhou . Chen's successor as OneSpace CTO, Wang Yudong, left the company in 2018 to establish Space Transportation. Space Trek founder Liang Jianjun was also an early employee at OneSpace, while

[7] https://www.scmp.com/news/china/society/article/2166233/how-chinese-rocket-scientists-resignation-started-nation-talking

former OneSpace propulsion director Shen Yongbin left the company to join Jiuzhou Yunjian as Technical Director.

4) What is the projected trajectory for the growth of China's commercial space industry, and which specific sectors (such as satellite manufacturing, launch services, or space-based technologies) are expected to see the most significant expansion?

Rapid growth due to the launch of the "Chinese version of Starlink". There are two main non-geostationary communications constellations likely to launch, namely "Guowang" (国网, lit: national net) and Thousand Sails (千帆). The former is fully central government-owned, and the latter is nominally commercial but financially backed by the Shanghai municipal government and Chinese Academy of Sciences. Both constellations will likely launch hundreds of satellites in the coming couple of years, with Thousand Sails likely to launch hundreds of satellites in 2025 (they currently have 90 on-orbit).

These constellations, and in particular Thousand Sails, are driving substantial industrial development of the commercial sector: those satellites need to get built, and they need lots of systems, subsystems, components, etc. They also need to be launched, and while up to now, all of these constellation launches have been done by Long March rockets, in the future they represent an important source of demand for commercial launch vehicles. They also need to be accessed from the ground, so we've seen a growing number of commercial firms, sometimes from outside the space sector, developing user and gateway terminals.

For at least the next several years, these two constellations will be the biggest driver by far for China's commercial space sector, largely because they represent two huge pots of Government money with strong political backing to be spent.

Other areas of likely expansion moving forward include meteorology. There are two major commercial meteorology constellations being deployed today, and both have ambitions for more satellites to be launched[8].

5) How does China's commercial satellite industry compare to that of the United States, particularly in terms of technological advancements, market scale, and international competitiveness?

There are similarities and differences across different sectors:

Communications

GEO: there are basically zero Chinese commercial firms building GEO satellites, this is unlike the US where Boeing, Astranis, and others build GEO. The reason in China is that most (effectively all) GEO satellite missions are China Satcom or other state-run missions, and the state-owned satellite manufacturer China Academy of Space Technology (CAST, aka CASC 5th Academy)

[8] https://chinaspacemonitor.substack.com/p/chinas-commercial-meteorological

makes GEO satellites pretty competently. The number of GEO launches from China remains relatively small, making the marginal demand that might be captured by commercial firms zero.

LEO: highly fragmented industrial base with some 10 companies trying to build LEO communications satellites. Since 2023, there has been consolidation around Shanghai Engineering Center for Microsatellites (SECM) and its JV subsidiary Genesat, with both entities building the Thousand Sails constellation. The other main force in the LEO satellite manufacturing space is the China Academy of Space Technology (CAST), who will almost certainly be the prime manufacturer of the Guowang constellation. All other LEO communications manufacturers are likely to fall into one, or both, of these larger camps, probably as system suppliers. For example, Galaxy Space, who has for some time been calling for their own constellation, will almost certainly be relegated to a provider of Q/V-band payloads and other communications products in satellites and ground equipment.

Remote sensing

China has a substantial commercial remote sensing industrial base, with CGSTL being arguably the most advanced remote sensing company in the world. The company is a spinoff from the CAS Changchun Institute of Optics and Precision Mechanics (CIOPM), established in 2014 with substantial financial and technology assistance from CIOPM and the government of Jilin Province/Changchun City. Since then, the company has built what they describe as Asia's largest remote sensing satellite factory, and has built and launched ~160 of their own satellites, as well as ~40 satellites for other customers. These satellites range from ~40kg in mass (most are this size) up to ~1 ton. Due to their technology heritage from CIOPM, CGSTL is highly vertically integrated, building their own optical payloads. The company has more recently (starting around 2020/2021) made a move into laser communications, typically for either inter-satellite communications or for free-space optical (downlinking large amounts of remote sensing data from space to earth).

Launch

China has a far "deeper bench" than the United States. While SpaceX is clearly far ahead of the most developed Chinese commercial launch company (likely Galactic Energy), and Rocket Lab is likely far ahead of the 2nd most-developed Chinese commercial launch company, China has some 50 commercial launch companies. The 5th most-developed Chinese commercial launch company is likely about as developed as their counterpart in the US. There are more companies in China developing next-generation rocket engines, 3D-printed rocket parts, and other upstream components, than there are in the US.

Other technologies

Laser communications is an area of emphasis in China, and there are at least 10 firms developing laser communications terminals. A handful of these companies have already launched laser terminals and are conducting tests on-orbit. I believe the industry is considerably larger than that of the US.

Relay satellites, with several commercial companies planning to develop relay satellites over the coming years, either in GEO or MEO.

Tracking, Telemetry, & Control (TT&C): there are at least 3 commercial TT&C companies in China that have served hundreds of satellites each. These companies are building out global networks of ground stations, and while they have run into some obstacles (most recently Emposat being denied entry into the Czech Republic[9]), they are growing quickly.

Meteorology. Since mid-2022, Chinese companies have launched ~70 "commercial" meteorology satellites. The two main projects are Yunyao Yuhang and Aerospace Tianmu, with both having recently been included in the China Meteorological Administration's weather monitoring datasets[10].

6) What obstacles, limitations, or vulnerabilities does China face within its commercial space industry, and how might these challenges affect its long-term competitiveness and growth?

The challenge of subsidizing supply, not subsidizing demand. The Chinese government at a national, provincial, city, and district level is more than happy to give commercial space companies free land, subsidized factories, subsidized labor, etc. They are less happy to give them contracts for products and services. This makes it easy for companies to grow, and in the long-run, it can make it cheaper for them to survive downturns, but it makes it hard for them to see real revenues.

SOEs remain a very powerful force in the sector, which can hinder commercial development. Today there is still no "Chinese version of SpaceX", i.e. there is no commercial firm trying to build very big reusable rockets. This is because, the bigger the rocket, the more directly firms are competing with SOEs, and the more directly firms are competing with SOEs, the more political hot water they could find themselves in. Bigger picture, the state still exercises a lot of control over what commercial space companies can and cannot do, which makes it hard for companies to confidently articulate their value proposition. As a result, Chinese space companies are notoriously vague in their business thrust; they claim to be able to do all things for all people, and pivot regularly. This is because ultimately, it's not 100% clear what they are or are not "allowed" to do.

International cooperation is a helpful case study when looking at the challenge posed by SOEs. China Great Wall Industry Corporation (CGWIC) has an effective monopoly over international space projects in China. A subsidiary of CASC that acts as a trading company, CGWIC is the international broker for Chinese launches, satellites, and other projects. While this monopoly has begun to erode in recent years, CGWIC remains a very powerful force. For Chinese companies trying to do business abroad, they need to go through CGWIC. I spoke with a representative of a Chinese commercial satellite manufacturer in around 2022, he was explaining that CGWIC-led projects go through ministerial-level. His example was, if Egypt buys a satellite from China, and the Egyptian engineer has a question or issue with the satellite post-launch, he or she needs to send that issue up through the Egyptian Ministry of Foreign Affairs (or similar), who then sends the issue to the Chinese Ministry of Foreign Affairs, who then sends the issue all the way down the

[9] https://www.euractiv.com/section/politics/news/czech-government-blocks-chinese-investment-over-spy-fears/
[10] https://www.cma.gov.cn/2011xwzx/2011xmtjj/202412/t20241231_6767359.html

ladder to the engineer within CASC or subsidiaries that can answer the question. The engineer then sends the answer all the way up the ladder to MoFA. The process can take weeks.

A final challenge is the arbitrary and uncertain nature of regulations in the Chinese space sector. Typically the government opens the sector in steps: for example, in 2020 Satellite Internet was added to the "New Infrastructures" list of the National Development and Reform Commission[11], in 2023 MIIT published the "Opinions on Innovating the Management of Information and Communication Industry to Optimize the Business Environment" [12], which included calls for **coordinated opening of the telecommunications business to private capital**, increasing support for private enterprises to participate in mobile communications resale and other businesses and services, **and promote the reform of the satellite internet business in steps and stages.** This provided a tailwind to satellite internet companies, but still does not give them full transparency about the government's plans. As a result, constellations such as SpaceSail have allegedly been told by the government that they will not get domestic market access for the foreseeable future.

7) Which critical minerals and rare earths are necessary for U.S space supply chains? Does the PRC hold leverage over any of these inputs? If so, what U.S. policy mechanisms are needed to alleviate this potential chokepoint?

I am not familiar with rare earths/minerals, and therefore do not feel qualified to answer this question

8) The Commission is mandated to make policy recommendations to Congress based on its hearings and other research. What are your recommendations for Congressional action related to the topic of your testimony?

1) We need a broader space industrial base. One of China's strengths vis-à-vis the US in commercial space is breadth: there are ~50 companies in China competing to be the "Chinese version of SpaceX". As we've seen in electric vehicles, Tesla took a big lead, but got complacent, and now BYD is making similar cars to Tesla at half the price. In the space domain, we put all our eggs in the SpaceX basket at our own peril. China, to their credit, seems to understand that a broad industrial base with many companies trying many things, and more importantly, competing with one another, leads to better outcomes.

2) We should provide different incentives for our space companies. The US Government and various entities therein have done well to give contract opportunities to commercial space, this is a helpful demand signal and helps companies to make rent and payroll every month. We should be doing a better job of providing financial and other indirect support on the supply side. Many large cities in the US have a problem with vacant office space. Is there a way to give companies subsidized or free office space to tinker with space technologies? There's a lot of open land in parts of the US. Is there a way to allow space companies (and frankly, companies in other industries) to make use of it for little or no money? There are many small towns that are seeing declining population. Is there a way for the Federal Government to offer subsidies, matched by these small

[11] https://www.gov.cn/zhengce/2020-04/29/content_5507396.htm
[12] https://www.gov.cn/zhengce/zhengceku/202408/content_6966820.htm

towns, to attract talent and cultivate industrial clusters? These are all things that China is proactively doing for commercial space, and while it has its drawbacks (wastefulness being one of them), it also creates a sort of "sandbox mode" whereby companies can experiment with new technologies and commercialization methods, and the downside risks if they fail are manageable.

3) Help close the information asymmetry gap. There are a lot of articles in Chinese press providing information about Starlink, SpaceX, and other leading American firms. Chinese firms are developing impressive technology, and best I can tell, there is not very much written about it. Last month we saw a piece in Chinese media doing a complete tear-down of a Starlink 3rd-gen antenna (photo at right)[13]. With the title "**I don't understand, I can't understand at all. After dismantling the third-generation Starlink terminal, I still can't understand the phased array antenna**", the author provides detailed images of various layers of the terminal. The article thanked a "Shenzhen Weiligu Radio Technology Company" (aka Shenzhen VLG Wireless, 深圳市维力谷无线技术股份有限公司) for providing the terminal and technical support.

4) Have a more unified and better-organized space strategy. For better or worse, China has a very unified and well-organized space strategy: the government makes policies and strategies in their Five-Year Plans and other documents, commercial companies broadly follow their lead, and everyone is more or less on the same page about who is in charge. As best I can tell, in the United States we have a billionaire entrepreneur trying to dismantle our space agency, everyone is trying to develop their own technologies, Starlink is not adopting standards for things like laser communications technologies, possibly as a way of cornering the market. No one has any idea who is in charge or what the long-term plan is, and the tail is wagging the dog with the private sector pushing the government to abandon Artemis in favor of Mars.

5) More encouragement for international cooperation. China has high-level nebulous concepts like the Belt and Road that provide guidance for companies to expand abroad. Having such concepts makes it easier for state-owned banks to justify loans for projects, and provides a signal to commercial companies to go abroad.

[13] https://mp.weixin.qq.com/s/XtL4Ano8fIXOLxekQqKySg

OPENING STATEMENT OF VICTORIA SAMSON, CHIEF DIRECTOR OF SPACE SECURITY AND STABILITY, SECURE WORLD FOUNDATION

MS. SAMSON: Thank you. Hearing Chair Price, Commission members, Commission staff, thank you for the opportunity to speak with you today. My testimony will focus on China's space diplomacy.

One must first understand the way the United Nations divides space. Civil space topics are discussed in Vienna, Austria, at the Committee on Peaceful Uses of Outer Space, or (COPUOS). Space security topics are discussed at the Conference on Disarmament in Geneva, Switzerland. China participates in statements at COPUOS that are titled "The G-77 and China." This group promotes technology transfer and ensuring that developing countries are not left behind in the use of space. It calls for equitable access to space, particularly low Earth orbit, regarding concerns about Western very large constellation, despite China having started launching two very large constellations of its own. Overall, China has a fairly consistent approach to COPUOS. It recognizes the importance of and need for space governance, and works to see that its domestic activities meet international norms.

As for space security, China and Russia argue that weapons placed in space pose the biggest threat and have proposed a weak and unverifiable treaty banning them. While the United States believes it is irresponsible actions and wants internationally recognized norms of responsible behavior to mitigate them. Most developing countries have tended to side with the Chinese and Russian position.

China and Russia consistently cite the United States calling space a warfighting domain as evidence that it is preparing for space war. While China and Russia frequently have similar positions in multilateral space security fora, they do occasionally diverge. Last year, reports emerged that Russia is developing a nuclear warhead that could be placed in orbit, which directly contradicts the Outer Space Treaty. In April 2024, the UN Security Council voted on a resolution on weapons of mass destruction in space, which affirmed obligations to the Outer Space Treaty. The resolution was vetoed by Russia. China abstained. When this resurfaced later as a UN General Assembly resolution, it overwhelmingly passed. Again, Russia voted no while China abstained.

There is another place where China and Russia have not been in lock-step. Russia pledged, in 2004, it would not be the first to place weapons in space. In 2014, the UN General Assembly adopted a resolution which encouraged all states to make this commitment. This has been followed annually by similar resolutions. China has voted yes on this resolution every year, and, with the exception of 2021, has also been a co-sponsor. However, it has not made this pledge.

Other issues shape China's approach to diplomacy and outreach, space resources and exploration, and counterspace capabilities. China believes the Outer Space Treaty is a cornerstone of legal framework on space resources, and wants COPUOS to aim for unified interpretation and applications of it. China does not oppose commercial missions, but wants to make sure that they do not negatively impact scientific ones.

The International Lunar Research Station is a Chinese and Russian initiative whose goal is the operation of a research station by the moon's south pole by 2035. Thirteen states have agreed to participate in it.

The United States has its Artemis Accords, which build on principles contained in the Outer Space Treaty and apply them to lunar space activities. Fifty-three countries have signed on

to the Artemis Accords.

These lunar governance frameworks can be competing or complementary, depending on how relations between the United States and China evolve and how the separate lunar programs fare.

When talking about China's counterspace capabilities, much is derived from Secure World Foundation's unclassified annual report that I edit, global counterspace capabilities, and open source assessment, the 2025 version of which was released today.

China has engaged in multiple tests of technologies and capabilities that either are offensive counterspace weapons or could be used as such. That said, it is unclear whether China intends to use its counterspace capabilities in a future conflict or whether the goal is to deter U.S. aggression. There is no confirmed public evidence of China using counterspace capabilities in current military operations.

One of the questions I was given was how to balance keeping the United States' technical edge while engaging with China. The United States is in the process of hollowing out its current scientific base by cutting funds for scientific research under the Trump administration's Department of Government Efficiency efforts. This is hobbling the United States' technological edge, and if continued will have consequences for the United States' scientific and technical base for decades. This disruption of Federal funds to the U.S. scientific research community will harm U.S. innovation and competitiveness.

There is a reason why the United States opted, post-World War II, to pour money into research. This was a way to ensure that the United States kept its competitive edge against Cold War rivals. By upending this, the United States is opening itself up to being bypassed by institutions supported with more stable funding sources, such as those being funded by the Chinese government.

The same thing is happening with NASA. There is a lack of clarity about policies and programs, loss of personnel, and disarray caused by reported plans to move NASA headquarters and distribute staff to other NASA research centers. Federal grants have also been pulled back from existing NASA programs. This weakens the U.S. civil space program, as this level of uncertainty challenges NASA's mission focus. Again, this leaves an opening for China's space program to take advantage of its predictable operating environment to leapfrog the United States.

There are opportunities for constructive space engagement with China on overlapping challenges. One is lunar radio communications for position, navigation, and timing, whose signals are fundamental for orbiting, landing, and surface operations. Engagements with China to avoid interference with each other's signals is crucial for mission assurance.

As U.S. satellite operators deploy and operate their constellation, the risk of potential collision with Chinese operators is growing. Bilateral sharing of information and coordination for operational safety is limited. On the moon, coordination channels will be needed to mitigate concerns about human safety issues, understanding of intent, and shared hazards of lunar dust.

There is one serious speedbump in the way of U.S.-China bilateral space cooperation -- the Wolf Amendment. Although there is little evidence that it has affected China's domestic policies, it has given Chinese officials a pretext to deflect criticisms about its lack of engagement onto the United States.

The United States has long been concerned about China's space programs. There are geopolitical issues, but China is a major space actor and cannot be ignored. While recognizing that China is a competitor, the United States can still benefit from finding ways to engage with China to maintain space stability and to promote responsible behaviors.

Thank you.
COMISSIONER SIMS: Thank you. Mr. Cavossa.

PREPARED STATEMENT OF VICTORIA SAMSON, CHIEF DIRECTOR OF SPACE SECURITY AND STABILITY, SECURE WORLD FOUNDATION

April 3, 2025

Victoria A. Samson

Chief Director, Space Security and Stability, Secure World Foundation

Testimony before the U.S.-China Economic and Security Review Commission

"The Rocket's Red Glare: China's Ambitions to Dominate Space"

Panel 2: Space as a Contested Domain: Expansion of China's Military and Commercial Space Activities

Hearing Chair Reva Price, commission members, and staff, thank you for the opportunity to speak with you today. I commend the commission for calling a hearing on this critical subject. My testimony today will focus on China's space achievements and diplomacy.

For the last several decades, the United States has been concerned about China's space programs and plans, in a dynamic which often reflects the larger US–China relationship. There is no doubt that the United States and China are engaged in a geopolitically competitive relationship, but there is also no doubt that China is a major space actor across all dimensions of space activity and it cannot be ignored. In an attempt to "constrain" China's space program, the United States has put in place laws and policies that end up harming itself while doing little to impede China's progress in space. While recognizing that China is a competitor, the United States can still benefit from finding ways in which to engage with China to maintain stability in the space domain and to proactively promote responsible space activities.

PARTICIPATION IN INTERNATIONAL FORA AND LEGAL REGIME

China is a signatory to the primary legal documents shoring international governance of space. It became a party of: the 1967 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (Outer Space Treaty) through accession in 1984; the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (Rescue Agreement) through accession in 1988; the Convention on International Liability for Damage

Caused by Space Objects (Liability Convention) through accession in 1988; and the Convention on Registration of Objects Launched Into Outer Space (the Registration Convention) through accession in 1988.[1]

It ratified the International Telecommunication Constitution and Convention in 1997.[2] China has been a member State of the United Nations' Committee on Peaceful Uses of Outer Space (COPUOS) since 1980.[3] It is also a member of the United Nations' Conference on Disarmament, which currently has 65 member states.[4] And it is a participating state of the Inter-Agency Space Debris Coordination Committee.

China is a participant in the Asia-Pacific Regional Space Agency Forum (APRSAF), which was established in 1993 to "enhance space activities in the Asia-Pacific region."[5] APRSAF holds annual meetings which are jointly organized by Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT), the Japan Aerospace Exploration Agency (JAXA), and the host country organizations.

It is one of the founding members of the Asia-Pacific Space Cooperation Organization (APSCO), which is headquartered in Beijing and started in 2008 as an intergovernmental organization. According to its website, "APSCO provides a cooperative mechanism for developing countries in the region to be able to mainstream peaceful use of space as a drive of development. By resource sharing in space science, space technology and space application, APSCO promotes multilateral cooperation to facilitate capacity building of its Members, including: Bangladesh, China, Iran, Mongolia, Pakistan, Peru, Thailand and Turkey; Signatory State Indonesia, [and] Observer State Mexico."[6]

One of three offices of the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER) is in Beijing (the other two are in Vienna and Bonn).[7] UN-SPIDER was established in 2006 under the UN Office of Outer Space Affairs (UNOOSA) and aims to help developing countries get access to space technologies in response to disasters.

China is a member of the Group of Earth Observations (GEO), an intergovernmental organization of 117 member states that says it is "dedicated to co-producing user-driven Earth Intelligence solutions." China has described itself as the GEO co-chair representing the Asia-Oceania Group of Earth Observations (AOGEO) and developing countries; in May 2023, the 6th

[1] "China," *Space Security Portal*, UNIDIR, last reviewed August 2023, https://spacesecurityportal.org/states/china; *Convention on registration of objects launched into outer space*, United Nations General Assembly, Nov. 12, 1974, United Nations Treaty Collection, status as of March 30, 2025, https://treaties.un.org/pages/ViewDetailsIII.aspx?src=TREATY&mtdsg_no=XXIV-1&chapter=24&Temp=mtdsg3&clang=_en#3.
[2] "China," *Space Security Portal*, ibid.
[3] Ibid.
[4] "Member States and non-member States," United Nations Office for Disarmament Affairs, accessed April 1, 2025, https://disarmament.unoda.org/conference-on-disarmament/member-states/.
[5] "About APRSAF," APRSAF, accessed March 31, 2025, https://www.aprsaf.org/.
[6] "About APSCO," Asia-Pacific Space Cooperation Organization (APSCO), accessed April 1, 2025, http://www.apsco.int/html/comp1/content/WhatisAPSCO/2018-06-06/33-144-1.shtml.
[7] "United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER)," United Nations Office of Outer Space Affairs, 2025, accessed April 1, 2025, https://www.unoosa.org/oosa/en/ourwork/un-spider/index.html.

annual AOGEO workshop, which China co-hosted, was held in Macau, China, with the theme of "Demand-driven Advancements in Earth Observation Technology and Application."[8]

To understand China's approach to space diplomacy, one must first understand the way that the United Nations has set up how the international community discusses space issues. Civil space issues are discussed in Vienna, Austria, at COPUOS, whose secretariat is provided by UNOOSA. Civil space issues are also discussed at the United Nations General Assembly (UNGA) under its Fourth Committee at the UN headquarters in New York, NY. Space security issues are discussed at the Conference of Disarmament in Geneva, Switzerland, as well as at the UNGA's First Committee at the UN headquarters in New York, NY.

CIVIL SPACE DISCUSSIONS

COPUOS meets in Vienna three times a year, roughly two weeks at a time: the Science and Technical Subcommittee (STSC) in February, the Legal Subcommittee (LSC) in March/April, and the Plenary in June. As of February 5, 2025, current membership of COPUOS is now 104 States and 56 permanent observers (including my organization, the Secure World Foundation).

China positions itself as a developing country in multilateral fora and strives to be seen as on the side of the global south and developing countries. And yet, China is a major spacefaring state, a major industrial and economic global superpower, is racing with the United States in a host of technological fields: a very striking dichotomy.

One of COPUOS' biggest accomplishments of recent years is the adoption in June 2019 of 21 voluntary Guidelines for the Long-Term Sustainability of Outer Space Activities (LTS guidelines).[9] This adoption was done via consensus, which meant that all 92 of COPUOS' then member states had to agree. The LTS guidelines were the result of a nearly decade-long process: in 2010, COPUOS established a Working Group on the Long-term Sustainability (LTS) of Outer Space Activities under its STSC, with the Working Group chaired by Peter Martinez (currently Secure World Foundation's executive director).[10] Four expert groups populated by experts nominated by member states were established to consider various aspects of space sustainability and come up with suggested guidelines that the larger Working Group could consider. The guidelines are grouped into four categories: policy and regulatory framework for space activities; safety of space operations; international cooperation, capacity-building, and awareness; and scientific and technical research and development. China contributed experts to all the expert groups and actively participated in the ensuing discussions. At one point in the negotiations, Russian intransigence nearly stopped the entire process. However, China broke

[8] "China," Group of Earth Observations, 2025, accessed March 31, 2025, https://earthobservations.org/partners/member-gov/china; "6th AOGEO Workshop highlights Earth observation innovations in Asia-Oceania," Group of Earth Observations, June 26, 2023, https://earthobservations.org/news/6th-aogeo-workshop-highlights-earth-observation-innovations-asia-oceania.

[9] *Guidelines for the Long-Term Sustainability of Outer Space Activities for the Committee on the Peaceful Uses of Outer Space*, United Nations Office of Outer Space Affairs, 2021, https://www.unoosa.org/documents/pdf/PromotingSpaceSustainability/Publication_Final_English_June2021.pdf,

[10] Peter Martinez, "The development and implementation of international UN guidelines for the long-term sustainability of outer space activities," Secure World Foundation Preprint Series PP 23/05, last update Oct. 30, 2023, https://swfound.org/media/207700/pp23_05_the-development_implementation-of-international-un-guidelines.pdf.

with Russia and reiterated its support of the process, generating enough momentum that the discussions were able to continue and eventually succeed.

Considering China's more recent efforts in civil space diplomacy, it frequently is part of statements at COPUOS that are titled as being those of "the G-77 and China" and in those statements, the representative states refer to themselves as "The Group." At the most recent meeting - STSC, held in February 2025 - this statement noted that in order to meet the objectives of the STSC, "it is important to concentrate our work in areas such as building and promotion of the technological capacities, transfer of technology and equipment favorable for developing countries, prevention and mitigation of natural disasters and scientific technological research in developing countries within the framework of international cooperation."[11] The Group also noted that it "considers it crucial that developing countries are not left behind or unfairly disadvantaged by exploration, exploitation and peaceful uses of outer space. The Group is of the view that space technology applications must translate into concrete benefits for developing countries. In order to achieve this goal, transfer of technology on favorable terms for developing countries, as well as associated capacity-building are of vital importance."[12] Very large constellations are referred to in regards to "the principle of equitable access to outer space, and in particular in the LEO", with no mention of the three very large constellations that China is planning (and, as of August 2024, China has started launching two of the constellations).[13] The Group pointed out "the need for developing countries to have access to technologies, equipment and methodologies for the measurement, monitoring and characterization of space debris and other space objects and calls for increased cooperation in addressing the issue of space debris."[14]

Capacity-building in order to ensure that developing countries have the necessary space subject matter expertise is a theme throughout these sorts of statements. Given how much space services and data are crucial to people globally, this is to be expected, and states are scrambling to develop the expertise to be able to develop space policies that can help spur indigenous space technological development. At the February 2025 meeting of the STSC, for example, it was noted that 60 countries have asked UNOOSA for technical support missions that would work to develop their national capacities. As well, the statement of the G-77 and China at the LSC in April 2024 noted that "capacity building and technical support in space law are fundamental tools that should be enhanced through international cooperation. Therefore, the Group calls for greater support by UNOOSA and Member States to foster both North-South and South-South cooperation to facilitate the sharing of knowledge and expertise in the fields of international space law, space policy, space economy and space diplomacy."[15] It also underlined that "particular attention be given to the interests of developing countries and that the

[11] *Statement of the G-77 and China during the Sixty-Second Session of the Scientific and Technical Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space*, Feb. 3-14, 2025, delivered by H.E. Laura Gil, Ambassador, Permanent Representative of Colombia, https://www.unoosa.org/documents/pdf/copuos/stsc/2025/Statements/2_G77_Statement.pdf.
[12] Ibid.
[13] Ibid.
[14] Ibid.
[15] *Statement of the G-77 and China during the sixty-seventh session of the United Nations Committee on the Peaceful Uses of Outer Space*, June 19-28, 2024, delivered by H.E. Laura Gil, Ambassador, Permanent Representative of Colombia, https://www.g77.org/vienna/wp-content/uploads/2024/06/G77-_-67-COPUOS-2024_all.pdf.

Committee should be strengthened in its role as the main platform for the exchange of information in the field of international cooperation in the exploration and use of outer space."[16]

Interestingly, given that China has a history of allowing for debris from launches to land on neighboring countries downstream and has had the core of its Long March 5B launcher do uncontrolled reentries, as it was not designed to be safely deorbited after launch, the statement included the assertion that "the Group encourages launching states to provide advanced, proper, prompt and adequate notification to other states specially developing countries, located along the drop zones of falling space debris, as applicable, to ensure that they are sufficiently prepared to mitigate and respond to such incidents. It is equally important to strengthen the capacities of developing countries in detecting and responding to falling space debris."[17]

The statement for the LSC announced its support of what eventually became the Action Team on Lunar Activities Consultations (at the June 2024 Plenary) and went on to say that "the discussions of aspects of space resources and any possible outcome must be in line with the principles enshrined in the Outer Space Treaty and other relevant UN treaties, especially the principle of non-appropriation of Outer Space, including the moon and other celestial bodies. The Group is of the view that any approach for the exploration, exploitation, and utilization of space resources should be equitable, constructive, collaborative, consensual, and most of all, does not leave behind or unfairly disadvantage developing countries."[18] Finally, in regards to the role of the commercial sector in space, the Group stated that "the developing countries shall not be excluded from the benefits of space exploration and their rights shall be taken into account in the discussion."[19]

During its national statements at the 2025 STSC, China announced that it is starting a China-Latin America space cooperation forum. It also said that it is improving its debris monitoring capabilities; is researching debris removal technologies and debris-resilient design of satellites; and is formulating national standards and engaging with the International Organization for Standardization (ISO) to align national with international standards. At this meeting of STSC, "Dark and Quiet Skies" (or DQS - the idea that the increasing number of satellites in orbit, particularly due to the rise of very large constellations, are impacting visual and radiofrequency astronomy and the general public) was added to STSC's agenda for the first time; China said that it supported this addition, noted that its astronomical community has developed and implemented standards for DQS, and asserted that governance of large constellations is crucial for the long-term sustainability of space. This is all fairly consistent with China's approach to COPUOS: that it recognizes the importance of and need for space governance, and is working to ensure that its domestic activities meet international norms or standards of behavior.

SPACE SECURITY DISCUSSIONS

The international space treaties do not establish many limitations on the potential weaponization of space. The 1967 Outer Space Treaty (OST) is open enough to allow for the development of counterspace capabilities, facilitating the increase of tensions in space. This has been an issue of concern for the international community for many years, and in 1978, it prompted the

[16] Ibid.
[17] Ibid.
[18] Ibid.
[19] Ibid.

emergence of the notion of a Prevention of an Arms Race in Outer Space (PAROS) during a special session of the UNGA dedicated to disarmament.

In an effort to carry out more specific efforts to keep the space environment peaceful and free of conflict, the UNGA adopted its first two resolutions on PAROS in 1981: one of which focused on negotiating a treaty aimed at banning the placement of any type of space weapons (particularly those that could target objectives on Earth) in order to "prevent the spread of the arms race to outer space," sponsored by the Eastern bloc.[20] The other resolution, sponsored by the Western European and Others Group, called for the Conference on Disarmament to work toward "an effective and verifiable agreement to prohibit anti-satellite systems."[21] These contrasting approaches created a schism in how countries perceived the biggest threats to space security and stability, and hindered political discussions on PAROS over the years. In fact, this division largely continues to this day: Russia and China have argued that deliberately designed weapons placed in outer space pose the biggest threat to space security and have proposed a new treaty banning them, while the United States and its allies believe that the biggest threat to space security are irresponsible actions.

Most developing countries have tended to side with the Russian and Chinese position: that weapons in space were the biggest issue, with the United States being cast as the main protagonist for the weaponization of outer space. Russia and China had the diplomatic upper hand because they had proffered a draft treaty on preventing the placement of weapons in space (even though it is a fairly weak treaty that focuses on a threat that is hard to define and lacks verification) and could portray themselves as at least attempting to help. For many years, the United States opposed the draft Russia-China treaty without offering any alternatives. As a result, the United States often found itself playing diplomatic defense on major votes on space security within the UNGA.

Although PAROS has continued to be a key agenda item of the Conference on Disarmament since 1982, progress has been further hampered by the stagnation of the conference, which must reach consensus on its agenda and has not been able to do so for three decades.

There have been some efforts within the Conference on Disarmament to discuss legally binding approaches to PAROS. In 2008, Russia and China introduced the draft Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects (PAROS Treaty).[22] This treaty's article II states that "States Parties

[20] UNGA Res 36/99, UNGAOR, 36th Sess, UN Doc A/RES/36/99, online: https://digitallibrary.un.org/record/27062?ln=en&v=pdf.
[21] UNGA Res 36/97, UNGAOR, 36th Sess, UN Doc A/RES/36/97, art C(4), online: https://undocs.org/en/A/RES/36/97.
[22] Russian Federation and China, Letter dated 2008/02/12 from the Permanent Representative of the Russian Federation and the Permanent Representative of China to the Conference on Disarmament addressed to the Secretary-General of the Conference transmitting the Russian and Chinese texts of the draft "Treaty on Prevention of the Placement of Weapons in Outer Space and of the Threat or Use of Force against Outer Space Objects (PPWT)" introduced by the Russian Federation and China, UN Doc CD/1839 (2008), https://digitallibrary.un.org/ record/633470?ln=en&v=pdf.

undertake not to place in orbit around the Earth any objects carrying any kinds of weapons, not to install such weapons on celestial bodies and not to place such weapons in outer space in any other manner; not to resort to the threat or use of force against outer space objects."[23] Criticized at the time for not having verification mechanisms, Russia and China released an updated version in 2014 that attempted to address those criticisms. While there were several amendments to the original text, the key topic of verification had not been included, with Russia and China stating that it could be negotiated as an additional protocol or some other type of verification mechanism after the treaty entered into force. However, other states did not find that option an appealing one, stating that they could not engage in a treaty when verification of compliance could not be ascertained; in addition, they were still concerned about the nebulousness of defining what a weapon in space would actually entail, as well as the possibility of stockpiling and breakout capabilities. The treaty is still in draft form.

The UNGA regularly establishes subgroups to investigate concerns on issues of interest and to make recommendations to the UN Secretary-General. These have proven helpful in terms of identifying key issues of concern but have not always had success in reaching consensus in their final reports.

One such group on space security issues created by UNGA was the Group of Governmental Experts (GGE) on Transparency and Confidence-Building Measures (TCBMs) in Outer Space Activities, called for in the 2010 UNGA Resolution 65/68. Then UN Secretary-General Ban Ki-moon created the GGE in 2011, and the group met three times from 2012 to 2013. During their discussions, the GGE members examined different categories of TCBMs, implementation and a proposed central point of contact for all space TCBMs. China was a member of this GGE, which was able to reach consensus on its findings and deliver a report to the UN Secretary-General in July 2013.[24]

Four years later, UNGA created another GGE via Resolution 72/250. This time, its mandate was to consider and make recommendations on substantial elements of an international legally binding instrument on PAROS, including, inter alia, on the prevention of the placement of weapons in outer space. Again, a Chinese nominated expert was a member of this group, which met twice — once in 2018 and once in 2019.[25] The members were unable to reach consensus on a final report, so no recommendations were created.

In December 2020, UNGA passed Resolution 75/36, which asked states to submit reports to the UN Secretary-General about the types of threats that they saw, identify behaviors that they thought were responsible or irresponsible, and share what they felt could be further

[23] Ibid.
[24] Report of the Group of Governmental Experts on Transparency and Confidence-Building Measures in Outer Space Activities, UNGAOR, 68th Sess, UN Doc A/68/189, www.unoosa.org/oosa/oosadoc/data/documents/2013/a/a68189_0.html.
[25] Report of the Group of Governmental Experts on further practical measures for the prevention of an arms race in outer space, UNGAOR, 74th Sess, Annex II, Agenda Item 98(c), UN Doc A/74/77 (2019) at 8–9, https://undocs.org/Home/ Mobile?FinalSymbol=A%2F74%2F77.

development and implementation of norms, rules and principles of responsible behavior, as well as how to reduce risks of misunderstanding or miscalculations regarding outer space. Over 30 countries (and some NGOs, including SWF) submitted their thoughts on this. Reading through them, one can see some commonalities emerge: that it is important to act with due regard and to avoid harmful interference; and that there should not be non-cooperative close approaches to other states' spacecraft, nor should states deliberately create long-lived debris.

China's submission focused very heavily on PAROS: "Preventing an arms race in outer space is the precondition for safeguarding outer space security and ensuring peaceful uses of outer space, as well as one of the most prominent and pressing issues for the international community."[26] It outlined efforts that it felt states should undertake to ensure space security: concluding an legally-binding initiative (LBI) "at an early date" on preventing the weaponization of outer space; discussions of transparency and confidence-building measure (TCBMs) could supplement an LBI but cannot replace one; "equal rights of all countries concerning the peaceful uses of outer space should be respected and ensured;" and that different organizations of the United Nations should recognize each other's mandates while space governance discussions are being held.[27] It went on to say that the root cause for the weaponization of space and an arms race in space "is that a certain country sticks to the Cold War mentality, pursues unilateral military and strategic superiority in space and increases its attempts, plans and actions to seek dominance in space," highlighting the United States' description of space as a "warfighting domain," creation of the US Space Force and US Space Command, and "building up of a combat system in outer space" as "a bid to get ready for a space war."[28] The submission discussed vulnerabilities of space systems, due to missile defense, anti-satellite tests, and long-range precision attack systems. Listed as possible threats are the US' X-37B spaceplane, the docking of Mission Extension Vehicle (MEV)-1 with an Intelsat satellite, and the fielding of the Counter Communications System. It called for all countries to "ensure that their space behaviours are in line with international law and the principles governing international relations, which are the basic norms of responsible behaviour" and for the United Nations to create a " a second group of governmental experts or an open-ended working group on the prevention of an arms race in outer space, for which responsible behaviours in outer space could be included as one of the agenda items."[29] It noted that the "equal rights of all countries concerning the peaceful uses of outer space, particularly the interests of developing countries and emerging spacefaring countries, should be respected and ensured."[30] TCBMs listed that could be explored (en route to a LBI) include "no first placement of weapons in outer space; space security dialogue and exchanges on national space strategies, policies and intentions; cooperation on space debris mitigation, space objects collision avoidance, space launching notification and space facility visits; and seeking to reach bilateral or multilateral

[26] *Submission of China Pursuant to United Nations General Assembly Resolution 75/36*, China, for the Open-ended working group on reducing space threats through norms, rules and principles of responsible behaviours, May 13, 2022, https://docs.un.org/en/A/AC.294/2022/WP.9.
[27] Ibid.
[28] Ibid.
[29] Ibid.
[30] ibid.

arrangements."[31] And it asked for states to stop confrontation and interference in space, citing specifically R&D on space-based missile defense interceptors and stopping RPOs or other "space-based tests of technologies that endanger other countries' spacecrafts."[32]

Based on these submissions to UNGA Res. 75/36, the United Kingdom led a coalition of countries in sponsorship of UNGA resolution 76/231, which passed in December 2021, and which created an "Open-ended Working Group (OEWG) on Reducing Space Threats through Norms, Rules, and Principles of Responsible Behaviours." It met for four one-week sessions between May 2022 and August 2023. 70 countries participated in the discussions, plus civil society.

China's ambassador to the CD, Li Song, said at the first meeting of the OEWG in May 2022, "Preventing an arms race in outer space is the key precondition for peace, safety and the sustainable use of outer space" and that "the root cause of such an arms race is that the superpower attempts to dominate outer space."[33] He pointed at an unnamed space power driving this which "pursues a strategy of "space dominance" and declares outer space as a warfighting domain. It also established Space Force and Space Command, and merged commercial space enterprises into their space combat systems."[34] Amb. Li listed several principles that China felt that international discussions on norms of behavior should follow. The first was "safeguarding common and universal security" demonstrated by the superpower through "its commitment of not seeking hegemony and dominance in outer space."[35] The second was "persisting in preventing an arms race in outer space and intensifying the international efforts for the negotiation and conclusion of a legally binding instrument on PAROS;" as part of this, he encouraged countries to support the work of the CD and noted that as the first rotational president of the CD in 2022, "China facilitated the CD in reaching a comprehensive and balanced as well as clear and concise decision that established 5 Subsidiary Bodies. This provided a new platform for the CD to advance substantive work on its agenda items, including on PAROS."[36] Like every Chinese diplomat who speaks at the CD, he brought up the PPWT, saying that "Up to now, this is the only official proposal of a legally instrument on PAROS" and asserting that "Supporting the negotiation on PPWT represents a litmus test for being responsible for space security."[37] He acknowledged the United States' April 2022 unilateral commitment not to conduct destructive direct-ascent anti-satellite (DA-ASAT) missile tests, but decried them as "attempts to expand unilateral military advantages in the name of arms control."[38]

[31] Ibid.
[32] Ibid.
[33] LI Song, General Remarks by H.E. Amb. LI Song at the First Session of the Open-Ended Working Group on reducing space threats through norms, rules and principles of responsible behaviours, May 2022, https://documents.unoda.org/wp-content/uploads/2022/05/EN-Remarks-by-H.E.-Amb.-LI-Song-at-the-Space-OEWG.pdf.
[34] Ibid.
[35] Ibid.
[36] Ibid.
[37] Ibid.
[38] Ibid.

The third principle listed was that the "equal rights of all countries of the peaceful use of outer space, particularly the interest of developing countries and emerging space-faring countries, should be respected and ensured."[39] Again, we see China working to portray itself as the protector of the global south.

In regards to the role of the commercial sector in military space activities, he said that "commercial space institutions of some states have participated in military space activities on a large scale, which has accelerated arms expansion in outer space and blurred the boundary between military and civil activities," and called for states to fulfill their OST Article VI responsibility to authorize and provide continuing supervision of national activities in space in order "to avoid accidents and unconventional behaviors that may exacerbate confrontations and conflicts in outer space;" as well, he recommended that countries ensure that their commercial actors are thoughtful in their use of spectrum and orbits "so as not to undermine the rights of the developing countries to the peaceful uses of outer space."[40]

In general, China had a large role in the discussions at the OEWG. It pushed very heavily and consistently for the group to include LBIs such as it and Russia's draft PPWT in the discussions. This argument carried weight among much of the G-77, many of whom inherently prefer LBIs for topics of international concern. China did state that norms could be complementary to but should not replace LBIs. Most state participants in the OEWG agreed that international humanitarian law (IHL) / the laws of armed conflict applied to space and should be considered when discussing norms, rules, and principles of responsible behavior there. China was one of a very small handful of countries that argued that IHL should not be part of any discussion of how to prevent an arms race in space, saying that the focus should be on prevention. The other states who also made this argument were Russia, Iran, and Venezuela. China also continued to advocate for developing countries and emerging space actors' unimpeded access to space.

During the discussions, there started to be general convergence on many issue areas, including the importance of avoiding the deliberate creation of debris, the need for rules on actions (such as notifications or consultations) prior to conducting RPOs, and the value of TCBMs. However, the group did not not reach consensus on a final report of recommendations for norms of behavior; a chair's report was created that covered the topics discussed during the sessions.

Another GGE on a legally-binding instrument for the prevention of an arms race in outer space, including the prevention of placement of weapons in outer space, was created in the December 2022 UNGA Resolution 77/250; China was a co-sponsor of this resolution.[41] The 25 member states nominated experts to participate in the GGE; China was one of the member states and

[39] Ibid.
[40] Ibid.
[41] *UNGA Res. 77/250, Further practical measures for the prevention of an arms race in outer space*, UNGA, Dec. 30, 2022, https://docs.un.org/en/A/RES/77/250.

nominated an expert, who actively participated in it.[42] The GGE met once in 2023 and once in 2024, plus had an intersessional meeting to allow non-member states to give input to the process to work toward a consensus report.

The Chinese-nominated expert, Liang Guotao (Director, Arms Control Department of China's Ministry of Foreign Affairs), submitted a working paper to the second and final session, held in August 2024. In it, he iterated that space should be used for peaceful purposes and that "the extension of hostility among countries into outer space should be avoided."[43] He argued that the "goal of outer space arms control could only be achieved through legal means," and that "the existing international law is no longer sufficient to meet the needs of safeguarding outer space security," since it does not prevent the testing, placement, or use of conventional weapons in space, nor does it stop the use of force or threats.[44] Thus, he called for a LBI that would close what he called a "loophole," and said that "Only through legal means can we guarantee sufficient fairness, equal rights and obligations, and undiminished security of all States, which is difficult to achieve under non-binding voluntary norms."[45] Mr. Liang included a list of obligations for such an LBI; besides preventing the placement of weapons in space or the threat or use of force, it should call for compliance with current international law, have states provide continuing supervision of their nongovernmental entities in space, solve disputes peacefully through consultations, and when doing international exchanges and cooperation, "give special consideration to the needs of developing countries, actively provide technical assistance to them and strengthen capacity building."[46] He did list some TCBMs, including publishing information about national space policies, sharing information about activities (like launch plans or orbital parameters), site visits of space launches and facilities, and demonstrations of technological capabilities.

The GGE was able to come to a consensus on a report at its final meeting in August 2024.[47] The report discussed the evolving nature of outer space activities, threats and related capabilities, and noted that "the perception of threats may differ among States."[48] It considered vectors of threats as "Earth-to-space, space-to-Earth, space-to-space and Earth-to-Earth," as

[42] *Group of Governmental Experts on Further Practical Measures for the Prevention of an Arms Race in Outer Space,* United Nations Office for Disarmament Affairs, 2023, accessed April 1, 2025, https://meetings.unoda.org/gge-paros/group-of-governmental-experts-on-further-practical-measures-for-the-prevention-of-an-arms-race-in-outer-space-2023.
[43] Liang Guotao, "Working Paper for Group of Governmental Experts on Further Practical Measures for the Prevention of an Arms Race in Outer Space," GE-PAROS/2024/WP.1 – Advance Copy, March 22, 2024, https://docs-library.unoda.org/Group_of_governmental_experts_on_further_practical_measures_for_the_prevention_of_an_arms_race_in_outer_space_-_(2023)/GE.PAROS_.2024.WP_.1....pdf.
[44] Ibid.
[45] Ibid.
[46] Ibid.
[47] *Report of the Group of Governmental Experts on further practical measures for the prevention of an arms race in outer space*, Advance unedited version of the report adopted on Aug.16, 2024,https://docs-library.unoda.org/Group_of_governmental_experts_on_further_practical_measures_for_the_prevention_of_an_arms_race_in_outer_space_-_(2023)/GE-PAROS-2024-CRP.4.pdf.
[48] Ibid.

well as kinetic/non-kinetic and reversible and irreversible effects.[49] It went over historical UN discussions and efforts on space security, then went over the existing normative and legal framework. One point of contention was about IHL in the context of space. Some states felt it applied to outer space and regulated activities by all actors, and that discussing it did not legitimize the use of force. Others felt that it was not appropriate to discuss in the context of PAROS and that "any reaffirmation of the applicability of international humanitarian law to outer space legitimizes the use of force in outer space and an arms race in outer space."[50] This was a position that China has repeatedly held to. In regards to its mandate, the Group agreed that an LBI on PAROS should be: "practical, clear, scientifically and technically accurate, tailored to the specific objective of the measure under consideration and non-discriminatory; consistent with existing international law; and not adversely impact the national security, technological, economic or development interests of its States Parties."[51] The final report is very broad in nature and encompasses a wide range of elements: for example, the section detailing possible TCBMs included 12 different options. Most of the Chinese expert's recommendations were represented in some form in the final report, including a clause specifically on international cooperation and the particular needs of developing countries.

While China and Russia frequently have similar positions in multilateral space security fora - like promoting their draft PPWT, a preference for LBIs, resistance to talking about IHL in regards to space - they do occasionally diverge.

In February 2024, rumors emerged about a new ASAT capability that Russia was reported to be developing. This was later confirmed by USG officials to be a nuclear warhead being developed that would be placed in orbit and then detonate in space, with the ensuing EMP rendering satellites useless. The OST does not have a lot of language about military space capabilities, but its article IV is very clear that weapons of mass destruction (WMD) may not be placed in orbit;[52] if Russia were to put a nuclear weapon in space, that would be contrary to its treaty obligations. In April 2024, the UN Security Council (UNSC) voted on a draft resolution on WMDs in outer space, which was prepared by Japan and the United States and co-sponsored by 65 member states.[53] The UNSC resolution affirmed state parties' obligations to the OST's article IV. In its paragraph 6, it included a call not to develop nuclear weapons or any other kind of

[49] Ibid.
[50] Ibid.
[51] Ibid.
[52] *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies*, United Nations General Assembly, 1967, https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html.
[53] UNSC, Albania, Antigua and Barbuda, Argentina, Australia, Bahamas, Bangladesh, Belgium, Bosnia and Herzegovina, Bulgaria, Cabo Verde, Canada, Colombia, Costa Rica, Croatia, Cyprus, Czechia, Denmark, Djibouti, Estonia, Finland, France, Georgia, Germany, Greece, Honduras, Hungary, Iceland, Ireland, Israel, Italy, Japan, Kenya, Latvia, Lesotho, Liberia, Liechtenstein, Lithuania, Luxembourg, Marshall Islands, Micronesia (Federated States of), Montenegro, Netherlands (Kingdom of the), New Zealand, North Macedonia, Norway, Palau, Panama, Paraguay, Poland, Portugal, Republic of Korea, Republic of Moldova, Romania, San Marino, Singapore, Slovakia, Slovenia, Spain, Sweden, Timor-Leste, Türkiye, Ukraine, United Arab Emirates, United Kingdom of Great Britain and Northern Ireland and United States of America: draft resolution, UN Doc S/2024/302 (2024), https://undocs.org/S/2024/302.

WMDs specifically designed to be placed in orbit around the Earth, which does go beyond the limitation established in article IV of the OST. During the negotiations, Russia and China proposed an amendment, calling on all states to prevent the placement of any weapons in space, and to work toward the negotiation of a legally binding agreement on this issue; with a vote of 7 in favor, 7 against, and 1 abstaining, this amendment was not adopted.[54] The resolution overall was eventually vetoed, with a vote of 13 in favor, 1 against (Russia), and 1 abstaining (China).[55] China's vote is interesting because with Russia all but guaranteed to veto the resolution, China could have shown solidarity to Russia and also voted no, without it being the primary spoiler of the vote. Yet it did not.

This resolution resurfaced in the fall of 2024 - first, as a resolution for the United Nations' First Committee to consider, and then the full UNGA. UNGA 79/18, "Weapons of mass destruction in outer space," submitted by Japan, United States, and Argentina, again emphasized the "obligation of all States parties to fully comply with the Outer Space Treaty, including not to place in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction," and urged "Member States, taking into account article IV of the Outer Space Treaty, not to develop nuclear weapons or any other kinds of weapons of mass destruction specifically designed to be placed in orbit around the Earth."[56] It passed with a vote of 167-4-6; once again, Russia voted no on the resolution, while China abstained.[57]

Another place where China and Russia have not been in lock-step is the idea of no first placement of weapons in outer space. Russia announced in October 2004 its pledge that it would not be the first to place weapons in space, and called for other countries to pledge this as well. Thirty-one countries have made this same non-legally binding pledge.[58] This unilateral commitment has been multilateralized: in December 2014, the UNGA adopted Res. 69/32, which encouraged all states (particularly space-faring nations) to make a political commitment not to be the first to place weapons in outer space.[59] Similar resolutions have since been passed annually, with the latest having been adopted in December 2024 (UNGA Res. 79/20).[60]

[54] UNSC, China and Russian Federation: amendment to the draft resolution contained in document S/2024/302, UN Doc S/2024/323 (2024), https://undocs.org/S/2024/323.
[55] United Nations, "Security Council Fails to Adopt First-Ever Resolution on Arms Race in Outer Space, Due to Negative Vote by Russian Federation." Press release, April 24, 2024, https://press.un.org/en/2024/sc15678.doc.htm.
[56] UNGA Res. 79/18, "Weapons of mass destruction in outer space," Dec. 2, 2024 https://documents.un.org/doc/undoc/gen/n24/389/21/pdf/n2438921.pdf.
[57] "Weapons of mass destruction in outer space : resolution / adopted by the General Assembly," 2024, UN Digital Library, accessed March 31, 2025.
[58] "Multilateral Space Security Initiatives," Secure World Foundation, last updated Nov. 5, 2024, https://swfound.org/multilateral-space-security-initiatives/.
[59] Update author Robert Pemberton, "No First Placement of Weapons in Outer Space (NFP): National pledges and UNGA voting records," Secure World Foundation, last updated Nov. 21, 2024, https://docs.google.com/spreadsheets/d/1e91lEWkTF43k3CG6jQYLoUJeHROY03HAxP-T35eqqnA/edit?gid=1101016345#gid=1101016345.
[60] *No first placement of weapons in outer space : resolution / adopted by the General Assembly*, United Nations General Assembly, Dec. 2, 2024, https://digitallibrary.un.org/record/4068509?ln=en; Belarus, China, Cuba, Egypt, Equatorial Guinea, Eritrea, Kazakhstan, Mali, Nicaragua, Russian Federation, Sri Lanka, Syrian Arab Republic, Uzbekistan, Venezuela (Bolivarian Republic of) and Zimbabwe, *No first*

China has voted yes on this resolution every year and, with the exception of 2021, also was a co-sponsor of it. However, it has not made this no first placement pledge.

SPACE RESOURCES AND EXPLORATION

There are several other issues that shape China's approach to diplomacy and outreach: space resources and exploration, and counterspace capabilities.

International government and commercial interest in lunar presence, exploration, and utilization has increased in recent years. Five countries have successfully landed on the Moon: the United States, Russia, China, India, and Japan; additionally, last year brought about the first successful landing by a commercial actor. As of March 2025, the United States, India, China, and South Korea are operating active lunar missions, and at least nine countries have planned lunar missions over the next decade.[61]

Sustained human presence in space and on the Moon will require the use of resources found in space to support crew life and function. A major focus of near-term lunar exploration will be to verify the extent and usability of these resources. The United States, China, and India all have planned missions that would land near the Moon's south pole because of this interest in possible sources of water. Lunar regolith itself may prove to be useful for building lunar structures and habitats, while other lunar resources may have scientific, exploration, and commercial utility.

In 2022, COPUOS created a working group on the legal aspects of space resource activities, which is set to discuss these topics and provide recommendations in 2027. Furthermore, in June 2024, COPUOS created the Action Team on Lunar Activities Consultations (ATLAC), which is intended to provide consultative mechanism for landing site coordination and lunar dust mitigation, cislunar traffic, space resources, debris mitigation, and protection of sites of significant scientific interest and lunar heritage.

An increased tempo of activity on and around the Moon raises several governance and policy challenges. Measures must be developed to protect that while enabling future activities and use. As more operators function on the surface and in lunar orbit, there is an emerging need to develop space situational awareness (SSA) and space traffic coordination capabilities specifically for cislunar space. It is possible that the Moon may become a place for geopolitical competition, specifically between the United States and China, and military conflict may arise as a result. However, deconfliction of activities is going to be crucial.

Within the US national security space establishment, there are concerns about China's activities and ultimate plans for the Moon. Actions by China in Earth orbit and on land color perceptions of China's goals for and actions on the Moon. China aims to put humans on the surface of the Moon by 2030. In April 2024, the China Manned Space Engineering Office (CMSEO) announced that China remains on track to achieve this goal. In June 2024, China became the first country to bring lunar samples from the far side of the Moon. It has launched two relay

placement of weapons in outer space : draft resolution, Oct. 17, 2024, https://digitallibrary.un.org/record/4064506?v=pdf.

[61] Clayton Swope and Louis Gleason, "Salmon Swimming Upstream: Charting a Course in Cislunar Space," Center for Strategic and International Studies, October 21, 2024, https://www.csis.org/analysis/salmon-swimming-upstream-charting-course-cislunar-space.

satellites (Queqiao-1 and -2) to be able to communicate with equipment on the far side of the Moon.

Because of these concerns, it is helpful to understand how China thinks about space resources and how it is approaching lunar exploration. It submitted a working paper in March 2024 to the UN COPUOS' Legal Subcommittee about utilizing space resources.[62] It said that the Outer Space Treaty is the cornerstone for existing legal framework on this and that it wanted the COPUOS working group on space resources to work on getting unified interpretation and applications of the OST. China's perspective is that using space resources for scientific missions is within the framework of the OST; as for commercial missions, China is not opposed to them, but would like COPUOS to formally recognize it and discuss it further. It wants the COPUOS working group to develop principles to ensure commercial missions do not negatively impact scientific ones.

The International Lunar Research Station (ILRS) is a lunar exploration initiative led by China and Russia with a series of programs that are working their way up to the operation of a research station by the south pole of the Moon by 2035. In June 2021, China and Russia released the "ILRS Guide for Partnership" that provides details about the program's scientific objectives, mission phases, and guidelines for partnership. It outlines the Joint Working Group that will oversee the legal, scientific, and engineering aspects of ILRS. In 2023, China further described the intended creation of an International Lunar Research Station Cooperation Organization (ILRSCO) that would handle the cooperative aspects of the program.

There is not a separate document spelling out the principles of the ILRS but Chinese officials have included a list of their principles in some presentations.[63] These include: peaceful utilization; extensive consultation, joint contribution and shared benefits; various forms of cooperation; sharing scientific achievements; preserving lunar resources; and establishing a cooperation platform. Given the similarities between the activities planned under the United States' Artemis program and the ILRS (permanent installations, extraction and use of lunar water and mineral resources, and manufacturing on the lunar surface), and that the principles of the United States' Artemis Accords were pulled from the OST, which China has also signed, it is not surprising that there are some overlaps in the two sets of principles for lunar exploration.

The SWF public tracking sheet shows 13 states have signed on to participate in the ILRS: Azerbaijan, Belarus, China, Egypt, Kazakhstan, Nicaragua, Pakistan, Russia, Senegal, Serbia, South Africa, Thailand, and Venezuela.[64]

The Artemis Accords are a set of principles for lunar activities that was initiated by the United States and first announced in October 2020 with the signing by eight initial countries. The Artemis Accords are related to the Artemis program, a NASA-led initiative to return to the Moon

[62] *Submission by the Delegation of China to the Working Group on Legal Aspects of Space Resource Activities of the Legal Subcommittee of the Committee on the Peaceful Uses of Outer Space*, March 2024, https://www.unoosa.org/documents/pdf/copuos/lsc/space-resources/LSC2024/English_Chinas_submission_to_the_working_group_on_space_resources.pdf; Andrew Jones, "China outlines position on use of space resources," *SpaceNews*, March 6, 2024, https://spacenews.com/china-outlines-position-on-use-of-space-resources/.

[63] Wang Wei, "International Lunar Research Station," presentation given at "2024 International Workshop on Space Resources: Perspectives for Future Ecosystems," São José dos Campos, Brazil, Nov. 21-22, 2024.

[64] "Lunar Space Cooperation Initiatives," Secure World Foundation, last updated Jan. 23, 2025, https://swfound.org/lunar-space-cooperation-initiatives/.

and establish a permanent human presence there that lays the foundation to further exploration to Mars and beyond. NASA and the US State Department are co-leads for the Artemis Accords.

The relationship between the Artemis Accords and the Artemis program is often misunderstood. The Artemis Accords are a multilateral document in that all signatories sign on to the same document that was jointly negotiated by the eight founding members. Joining the Artemis program involves signing a separate bilateral agreement with NASA that outlines the contributions an Artemis partner will make and the benefits they will get in return.

The first Trump administration initiated the Artemis Accords, a nonbinding political commitment to allow for sustainable space exploration. Through the Accords, the United States seeks to secure commitments from other countries to follow several principles related to lunar (and other space) activities and interpret their implementation in a specific way.

The Artemis Accords build on the principles contained in the OST and apply them to lunar space activities. The Artemis Accords' principles address a range of topics, including transparency, interoperability, release of scientific data, resource utilization, safety zones, and heritage site protection. In 2023, the Artemis Accords partners started a series of working groups to discuss the specifics of how the principles in the Accords will be applied to their future lunar activities.

The SWF public tracking sheet shows that 53 countries have signed on to the Artemis Accords.[65] Only one - Thailand - has signed the Artemis Accords (in December 2024) and also joined the ILRS (April 2024). While it is not prohibited to participate in both efforts - at least on the United States' side; it is unclear what China's view of that is - it seems likely that countries will opt to do one or the other, setting up the possibility of competing lunar governance frameworks. These frameworks could also end up being complementary, depending on how relations between the United States and China evolve and how the separate lunar programs fare.

COUNTERSPACE CAPABILITIES

Much of this section is derived from SWF's annual report that I am the editor of, "Global Counterspace Capabilities: An Open Source Assessment," the 2025 version of which has been released as of this morning.[66]

China appears to be highly motivated to develop counterspace capabilities to bolster its national security. China is beginning to assert its regional political, economic, and military interests more strongly, and sees counterspace capabilities as a key enabler. Much has been written about how reliant the United States is on space capabilities to project global military power, and thus being able to counter US space capabilities is a key element of China's ability to assure its freedom of action and deter potential US military operations in its sphere of influence.

China has a sustained effort to develop a broad range of offensive counterspace capabilities. Over the last decade, China has engaged in multiple tests of technologies and capabilities that either are offensive counterspace weapons or could be used as such. China has also begun

[65] Ibid.
[66] Ed. by Victoria Samson, *Global Counterspace Capabilities: An Open Source Assessment*, Secure World Foundation, April 2025, https://swfound.org/counterspace.

developing the policy, doctrine, and organizational frameworks to support the integration of counterspace capabilities into its military planning and operations. That said, it is unclear whether China intends to offensively use its counterspace capabilities in a future conflict, or whether the goal is to use them as a deterrent against aggression. There is no confirmed public evidence of China actively using counterspace capabilities in current military operations, but operational testing has occurred.

China has conducted multiple tests of technologies for close approach and rendezvous in both LEO and GEO that could lead to a co-orbital ASAT capability. However, the public evidence indicates they have not conducted an actual destructive intercept of a target, and there is no proof that these technologies are definitively being developed for counterspace use as opposed to intelligence gathering or other purposes.

China has at least one, and possibly as many as three, programs underway to develop DA-ASAT capabilities, either as dedicated counterspace systems or as midcourse missile defense systems that could provide counterspace capabilities. China has engaged in multiple, progressive tests of these capabilities since 2005, indicating a serious and sustained organizational effort. Chinese DA-ASAT capability against LEO targets is likely mature and may be operationally fielded on mobile launchers. Chinese DA-ASAT capability against deep space targets (MEO, and GEO) is likely still in the experimental or development phase, and there is not sufficient evidence to conclude whether it will become an operational capability in the near future.

China is likely to have significant EW counterspace capabilities against global navigation satellite systems and satellite communications, although the exact nature is difficult to determine through open sources. Chinese military doctrine places a heavy emphasis on electronic warfare as part of the broader information warfare. While there is significant evidence of Chinese scientific research and development of EW capabilities for counterspace applications and some open-source evidence of Chinese EW counterspace capabilities being deployed, there is no public evidence of their active use in military operations.

China is likely to be developing directed energy weapons for counterspace use, although public details are scarce. There is strong evidence of dedicated research and development and reports of testing at five different locations, but limited details on the operational status and maturity of any fielded capabilities.

China is developing a sophisticated network of ground-based optical telescopes and radars for detecting, tracking, and characterizing space objects. Like the United States and Russia, several of the Chinese SSA radars also serve missile warning functions. While China lacks an extensive network of SSA tracking assets outside its borders, it does have a fleet of tracking ships and is developing relationships with countries that may host future sensors. Since 2010, China has deployed several satellites capable of conducting RPO on orbit, which likely aids in its ability to characterize and collect intelligence on foreign satellites.

Although official Chinese statements on space warfare and weapons have remained consistently aligned to the peaceful purposes of outer space, unofficially they have become more nuanced. China has recently designated space as a military domain, and military writings state that the goal of space warfare and operations is to achieve space superiority using offensive and defensive means in connection with their broader strategic focus on asymmetric cost imposition, access

denial, and information dominance. In 2024, China proceeded to disband its Strategic Support Force in favor of splitting up its responsibilities among three forces and putting renewed efforts into information service.

China's considerable investment in developing and testing counterspace capabilities suggest they see space as a domain for future conflicts, whether or not that is officially stated. That said, it is uncertain whether China would fully utilize its offensive counterspace capabilities in a future conflict or whether the goal is to use them as a deterrent against US aggression. There is no public evidence of China actively using destructive counterspace capabilities in current military operations, although it is likely they are using SSA and electronic warfare in at least some support roles.

CASE STUDY: RPOS BY FIVE SATELLITES

In December 2023, a Long March 11 (CZ-11) launched three satellites from a barge launch pad near Guangdong.[67] The three satellites - Shiyan-24C satellites (SY-24C 01, SY-24C 02, and SY-24C 03) were inserted into a Sun-synchronous orbit inclined at 97.3 degrees (at an altitude of 540 x 553 x 540 km). Their orbit was co-planar with SJ-6 05A and SJ-6 05B, two satellites launched in October 2021, via a Long March 4B (CZ 4B) launch vehicle from the Jiuquan Satellite Launch Center.[68] According to a USSF fact sheet, the five satellites started conducting RPOs from mid-March 2024 through the end of April 2024, at times separated by less than 1 km, and undertaking "two simultaneous proximity events at the same time." In September, SY-24C 02 and SY-24C 03 conducted three separate approaches, again under 1 km, with two being multi-day actions.[69] In December, SY-24C 03 and SJ6 5A came within "tens of meters" of each other five different times and with "associated relative velocities less than 10 cm/s;" this again was a multi-day event.[70] After that, the five satellites maneuvered to maintain a separation of over 100 km.[71] This is the operation that USSF officials have termed "dog-fighting in space."

We have seen Chinese satellites undertake RPOs with each other before but not to that number of satellites. Chinese satellites have approached the satellites of other countries, which we detail fairly extensively in our annual counterspace report. Russian and American satellites also conduct continued proximity operations to their own and to other countries' satellites, which we have documented in our report as well. It is challenging to determine if this Chinese capability of doing repeated, complicated RPOs is something that the United States does not have since we

[67] David Todd, "Two Chinese launches: Long March 11 launches Shiyan-24C trio while Long March 3B puts two Beidou navsats into orbit," *Seradata*, December 26, 2023, https://www.seradata.com/two-chinese-launches-long-march-11-launches-shiyan-24c-trio-while-long-march-3b-puts-two-beidou-navsats-into-orbit/.
[68] "SHIJIAN 6 05A (SJ-6 05A), 49961," *Kayhan Space Satcat*, Accessed February 21, 2025, https://www.satcat.com/sats/49961; "Space Threat Fact Sheet Annex," Headquarters Space Force Intelligence, February 21, 2025, https://nssaspace.org/wp-content/uploads/2025/02/20250221-S2-Space-Threat-Fact-Sheet-Annex-v1-RELEASE.pdf.
[69] "Space Threat Fact Sheet Annex," Headquarters Space Force Intelligence, February 21, 2025, https://nssaspace.org/wp-content/uploads/2025/02/20250221-S2-Space-Threat-Fact-Sheet-Annex-v1-RELEASE.pdf.
[70] Ibid.
[71] Ibid.

are learning about it from US commercial SSA companies, who are generally reluctant to discuss sensitive information about US military satellites.

My organization, the Secure World Foundation, includes RPO activities as a possible co-orbital counterspace capability in our report because the actions undertaken for RPOs are very similar to what would be done for a co-orbital capability. The latter would require getting close to the target satellite before undertaking any actions. However, RPO activities do not automatically equal co-orbital intentions. Proximity to another country's satellite might be sought after in order to listen to what it is listening to, listen to what it is broadcasting, image it, jam its communications, interfere with its optical sensors, release projectiles at a low speed, release projectiles at a high speed - or just do it to see if it can be accomplished.

BALANCING KEEPING THE US' TECH EDGE BUT ALSO ENGAGING WITH CHINA

The United States is in the process of hollowing out its current scientific base by cutting funds for many different kinds of scientific research under the Trump administration's Department of Government Efficiency (DOGE) efforts. This is hobbling the United States' technological edge and, if continued, will have consequences for the United States' scientific and technical base for decades to come. For example, the National Institute of Health has seen its funding drop by over $3 billion since Jan. 20 compared to grants issued during the same timeframe last year.[72] This decline is having consequences all across the United States' scientific research establishment. Over 2500 medical schools, universities, and other research sites in all 50 states receive NIH funding.[73]

This disruption of federal funds to the US scientific research community will have effects on US innovation and competitiveness. There was a reason why the United States opted post-WWII to pour money into scientific research: this was a way to ensure that the United States kept its competitive edge against Cold War rivals. By up-ending this funding model, the United States is opening itself up to being bypassed by institutions supported with much more stable funding sources, such as those being funded by the Chinese government.

The same thing is happening with NASA. There is a lack of clarity about policies and programs, concern about drawing executive attention, loss of personnel through Reductions in Force and other methods being done to encourage a sharp decrease in the number of its employees, and disarray caused by reported plans to move NASA headquarters and distribute staff to other NASA research centers around the country. Federal grants have also been pulled back from existing NASA programs. Casey Dreier of the Planetary Society has been maintaining a spreadsheet of documented cuts, finding as of March 27 that there were at least $48 million in

[72] Dan Diamond and Dan Keating, "Trump promised scientific breakthroughs. Researchers say he's breaking science," *Washington Post*, March 28, 2025, https://www.washingtonpost.com/politics/2025/03/28/trump-administration-science-research-cuts/.
[73] Ibid.

terminated grant awards ($26 million of which had already been paid out).[74] It is unclear the extent of the grant funding reductions, but it all leads to a climate of fear and uncertainty amongst NASA staff and scientists who depend on NASA funding in order to conduct their research. This does not strengthen the US civil space program but rather weakens it. NASA is challenged to focus on its missions while it is undergoing this level of uncertainty. Again, this leaves an opening for China's space program to take advantage of its predictable operating environment to leapfrog the United States' space program.

The Trump administration is using language from a November 2020 change in an Office of Management and Budget (OMB) regulation regarding federal grants. It said that a grant could be pulled if it "no longer effectuates the program goals or agency priorities."[75] In many of the documents released in support of Trump administration cuts, the statement "no longer effectuates agency priorities" is being used to justify the actions being undertaken to eliminate statutory programs.[76]

One real avenue for constructive space engagement between the United States and China is based on the reality that the United States and China will be the main lunar superpowers, and there are significant opportunities for constructive space engagement with China on overlapping challenges. One near-term challenge relates to lunar radiocommunications for position, navigation and timing (PNT).

PNT signals are necessary for the United States' lunar orbital and surface operations. They are fundamental for orbiting, landing, and surface operations. Avoiding signal interference between users of the spectrum used by PNT is critical, so engagement with China to avoid our interference with their signals is tied to the mission assurance of these missions. Likewise, China is keenly interested in their own lunar missions avoiding harmful radio interference. Additionally, PNT signals require standard time models to operate successfully, and are likewise assisted by a standard gravity model of the Moon.

The International Committee on Global Navigation Satellite Systems (ICG), established in 2005 under the umbrella of the United Nations, promotes voluntary cooperation on matters of mutual interest related to civil satellite-based positioning, navigation, timing, and value-added services. Coordination through the ICG on activities in the cislunar environment would assist American lunar ambitions and plans.[77]

[74] Hannah Richter, "Confusion and worry as DOGE cuts hit NASA: Terminated grants include efforts to get students and underrepresented groups involved in science," *Science,* March 27, 2025, https://www.science.org/content/article/confusion-and-worry-doge-cuts-hit-nasa.
[75] Carolyn Y. Johnson and Joel Achenbach, "These 5 words have killed millions in grants and advanced Trump's agenda," *Washington Post*, March 27, 2025, https://www.washingtonpost.com/science/2025/03/27/trump-federal-grants-research-cuts/
[76] Ibid.
[77] Interagency Operations Advisory Group, Joint ICG-IOAG Multilateral Cislunar PNT Workshop, https://www.ioag.org/SitePages/Cis-Lunar-Workshop.aspx. *See also* United Nations Office for Outer Space Affairs, Workshop on Cislunar Positioning, Navigation, and Timing (PNT), https://www.unoosa.org/oosa/en/ourwork/icg/working-groups/b/CislunarPNT2025.html.

There is one serious speed bump in the way of US-China bilateral space cooperation. In 2011, Congress passed the Wolf Amendment, named after then-Representative Frank Wolf (R-Virg.), who was concerned about China's treatment of religious minorities and possible intellectual property theft via hacking. While it does not officially preclude US–China bilateral cooperation in space, it requires the White House's Office of Science and Technology Policy, NASA, and the National Space Council to obtain certification by the Federal Bureau of Investigation (FBI) that no technical information with economic security or national security implications will be shared with China and that none of the entities involved have human rights violations; in addition, Congress and the FBI must be notified 30 days in advance of the activity. Although there is little evidence that the Wolf Amendment has achieved its goals or affected China's domestic policies, it has given Chinese officials a pretext to deflect criticisms about its lack of transparency or engagement onto the United States.

Both China's increasing deployment of large satellite constellations and its lunar ambitions have raised coordination and safety concerns within industry and other space stakeholders. As US satellite operators deploy and operate their own satellite constellations, the risk of potential collisions with Chinese operators is growing because the Chinese systems deploy through existing constellations and operate in orbits similar to existing systems. Bilateral sharing of information and coordination for basic operational safety is limited, and there is a need to improve engagement around space safety practices. US operators —and those from other partner countries—have established coordination and transparency practices amongst themselves; they are looking for options to exchange information with Chinese operators to do the same and thus formalize norms shaping space safety. On the Moon, concerns about the ability to respond in a timely manner to human safety issues, understanding of intent, and shared hazards of lunar dust, among other concerns, drive perceived need for coordination channels. Interoperability in key infrastructures will be crucial for safety reasons. There is a need for coordination and information exchanges between actors hosting humans on the Moon, which most likely will be the United States and China.

By isolating China from existing multilateral cooperative efforts in space like the ISS, the United States has pushed China to launch its own space station. Furthermore, this forced separation has allowed China to use its space program to create its own relationships with countries the United States has long deprioritized, particularly in Latin America and Africa. This has resulted in soft power advantages for China that have shown benefits in trade and diplomatic discussions

POLICY RECOMMENDATIONS

Working with the Trump administration, Congress should review and revise the implementation of the Wolf Amendment to increase NASA's engagement in space activities with China that support US national interests. Priority areas for engagement include basic space science and research, robotic space exploration, human spaceflight safety, lunar search and rescue, and increased data sharing on space weather and orbital debris.

The United States and China have shared interests in ensuring basic operational safety in the space environment, including both in LEO and in cislunar space (including the lunar surface). Establishing channels for information sharing, PNT compatibility, and promoting space safety practices can act to reduce the potential for misunderstanding that might lead to conflict while promoting stability in the operating domain that will support growth in space activities. This is particularly important in the context of national space traffic management and/or coordination initiatives. Dialogue of this type might be pursued in several ways, including: bilateral government-to-government discussions; informal civil society dialogues; and engagement in multilateral fora such as the Action Team on Lunar Activities Consultation (ATLAC) at UN COPUOS and in the ICG's Working Group on Lunar PNT (WG L).

Congress should work with the Trump administration to fund and carry out studies that systematically document and understand the structure and nature of the Chinese space ecosystem, how the industry is structured, the true relationships between the central government, the state-owned enterprises, and the private companies, the role of the provincial governments, how private capital operates in the Chinese space sector and how all of this relates to the space program priorities of the Chinese government. This will help increase understanding of the Chinese space sector. As well, an incredible amount of information exists regarding Chinese commercial space, and conversations with individuals in China reveal a great deal. More effort is required to collect and distill this information to better inform practitioners, policymakers, and investors. Congress should support increased USG efforts to produce and make accessible official translation of Chinese primary documents.

US government officials should refer to space as an "operational" domain rather than a "warfighting" domain. By referring to space as a "warfighting" domain, the United States has handed China an easy diplomatic win by allowing its diplomats and government officials to use that phrasing as evidence that the United States is the one increasing tensions and weaponizing space. Referring to space as an operational domain would be an acknowledgment of how the military needs to continue to operate in and through space, would be in line with how others refer to it (including NATO), but would not hamper US diplomatic efforts required to meet national security space concerns and goals.

Congress should support efforts by the United States to work with other countries to establish common understandings for what is considered responsible behavior in space, particularly for military activities that could cause misperceptions or increase tensions, such as rendezvous and proximity operations in orbit. The United States should use space situational awareness in order to help verify such actions.

The United States should continue to actively pursue the development of norms of responsible behavior and provide leadership in the development of international consensus standards and best practices to enhance the security, safety, and sustainability of space activities through engagement with the appropriate international and multilateral fora. One of the norms the United

States should continue to promote is the decision not to conduct destructive DA-ASAT missile tests.

Congress should support the continuation of the Artemis Accords in order for the United States to harness its leadership in space exploration to preserve the stability, safety, and security of the space environment and to support multilateral efforts to improve cooperative space governance. Given the increasing number and diversity of spacefaring nations, international cooperation is becoming ever more important to preserve the stability, safety, and security of the space environment. The Artemis Accords provide a valuable opportunity to use space exploration as a tool of diplomacy in support of the United States' objectives to promote the rule of law in space to ensure the safety, stability, and security of space activities. It also provides an opportunity to engage new, nontraditional partners in emerging space countries who are eager to be programmatically involved in the Artemis program. In this regard, the United States should continue to seek new signatories for the Artemis Accords and provide more tangible ways to link Accords signatories to Artemis Program participation as a way of solidifying partnership relationships and benefits.

OPENING STATEMENT OF DAVE CAVOSSA, PRESIDENT, COMMERCIAL SPACE FEDERATION

MR. CAVOSSA: Thank you, Commissioner Kuiken, Commissioner Sims. My name is David Cavossa, and I am the President of the Commercial Space Federation, or CSF.

CSF is the leading U.S.-based trade association representing commercial space. Our members represent multiple sectors of the space economy, including launch and reentry, remote sensing, spaceports, satellite coms, in-space awareness and manufacturing, commercial space stations, space situational awareness, and many more.

When we talk about the space race of the 21st century it is very different, as was noted by General Saltzman, as the previous space race with the Russians earlier. There is no one destination to win and no finish line. This must be a long-term, sustained expansion of human activity into space. It is critical for national security, economic security, and soft power diplomacy.

So how are we doing in this race, vis-à-vis China? The U.S. is still the global leader in space today, but the People's Republic of China is executing on their stated goal to catch up and overtake the U.S. by 2050. As I heard Commissioner Kuiken mention in his opening comments, China's ambitions have become their accomplishments in the last several years.

So how is China going to do this and overtake the United States? They are going to do it by taking advantage of an uneven playing field and not necessarily play by the same rules that we govern ourselves by. It is important to note there is no Office of Management and Budget, no Congress or appropriations process that China has to deal with today, especially their commercial industry or civil industry.

The PRC funds what the PRC wants to fund, and today that is space. Furthermore, the PRC has shown little respect for the environment, public safety, and space sustainability, or intellectual property for that matter. There are no independent regulators limiting the PRC or their commercial industry on what they can and can't do right now in space.

A key component of China's space ambitions is building up its domestic, state-owned and commercial space industry. Before 2014, space activity in China was only a state-owned enterprise. Ten years ago, the PRC opened the aperture and called for private investment in areas such as launch and satellite manufacturing.

In just 10 years, China has made tremendous progress in doing what they said they were going to do back in 2014. There are now multiple, non-government space launch enterprises in China, as has been noted, with six new reusable launch vehicles or rockets planned for maiden launches in 2025. China has also made significant investments in launch infrastructure, including the construction of two new launchpads over just the past 2 years.

On the satellite side, China is accelerating the buildout of two LEO broadband constellations, as noted. China has constructed at least seven new satellite manufacturing facilities in recent years, with the capability to produce thousands of satellites annually. By the end of 2024, China's filings at the International Telecommunications Union, or ITU, indicate plans for more than 150,000 satellites.

It is important to note that China's expansion into LEO has not been done with consideration for principles like space sustainability. In the last 20 years, China has launched more rocket body mass into low Earth orbit that will not adhere to the 25-year disposal rule than the rest of the world combined.

So our recommendations from the commercial space industry. I think we will continue to

lead as long as we thoughtfully implement policies that unleash the innovation of the commercial space sector. We suggest that the United States government set space as a national priority. The United States has recognized the value of investing in and unleashing industries of the future, like AI, semiconductors, and quantum computing, in order to maintain America's competitive edge. The space sector is that next critical industry of the future and in need of comprehensive U.S. focused policy.

Number two, the U.S. should continue to buy commercial solutions to the maximum practical extent, whether that be NASA, NOAA, the Department of Defense, Space Force, or any civilian or Federal Government agency.

Number three, the United States needs to continue to invest in civil space programs and NASA and its budget. NASA and Congress need to commit to sufficient funding for civil space exploration, space science, and a continued presence going after low Earth orbit, the moon, and exploration of Mars.

We need to commit to the ISS transition. NASA should aggressively move out on awarding and funding new commercial LEO space stations and allowing the U.S. to maintain a presence in low Earth orbit.

We must invest in Spaceport infrastructure resiliency. The Administration and Congress should make robust investments in spaceport infrastructure to increase U.S. access to space from multiple different locations across the United States, and we need to streamline and waive the regulatory requirements impeding that progress and that construction.

Number six, the U.S. should accelerate launch licensing reform. The Department of Transportation today, through the FAA, is the licensee for all space launch and reentry activity, and as the cadence for launch continues to increase, the licensing process has not kept up, and we need to reform it.

Number seven, we need to modernize remote sensing licensing reform. As noted earlier in this panel, China is moving very quickly on commercial remote sensing, and we need to keep pace here in the United States.

Number eight, we need to implement a mission authorization regime that allows the Department of Commerce to immediately start licensing missions that are not already licensed by other Federal regulators today.

And we need to, number nine, maintain our leaders in international fora.

In conclusion, the furthest humans have traveled into space since 1972 was last year, on a privately funded, privately crewed expedition called Polaris Dawn. The United States commercial space industry has the innovation and the talent to maintain America's leadership in space and dominance in technology. We just need a willing partnership from the U.S. government.

I thank the Commission for your attention and look forward to your questions.

COMMISSIONER SIMS: Thank you. Mr. Cox.

PREPARED STATEMENT OF DAVE CAVOSSA, PRESIDENT, COMMERCIAL SPACE FEDERATION

Testimony of Mr. David Cavossa
President, Commercial Space Federation
The United States–China Economic and Security Review Commission
"The Rocket's Red Glare: China's Ambitions to Dominate Space"
April 3, 2025

Introduction

Commissioner Kuiken, Commissioner Sims, and distinguished Members of the Commission, thank you for inviting me to testify on behalf of the Commercial Space Federation (CSF).

CSF is the leading U.S.-based trade association representing the commercial space industry. Our members represent multiple sectors of the space economy including launch and reentry, remote sensing, spaceports, satellite-based internet, in-space research and manufacturing, commercial space stations, space situational awareness, and more. CSF and its members are focused on expanding America's leadership in space by offering innovative – and often less expensive – solutions to U.S. government customers including NASA, the U.S. Space Force, and the intelligence community. In addition, CSF advocates for policies that will grow a sustainable space economy, the global value of which is already estimated at $570 billion[1] and projected to grow to $1.8 trillion by 2035.[2] The commercial space industry has created tens of thousands of high-paying engineering and manufacturing jobs in the United States and has invested billions of dollars across the country, revitalizing a domestic aerospace supply chain that had been in decline and unlocking new potential in space that will benefit us on Earth.

A New Space Race

Over the last few years, we have heard many of our civil and national security space leaders state or allude to the fact that the United States is in a space race with China. But what does this really mean? And why should Americans care?

To answer these questions, it's worth revisiting history. The 20th century space race between the United States and the Soviet Union ignited a massive U.S. government investment and effort in space exploration and technology development that ultimately landed Neil Armstrong and Buzz Aldrin on the lunar surface in 1969.[3] By 1972, the race was won, interest in human space exploration declined, and the Apollo lunar program ended a little more than three years after

[1] https://www.spacefoundation.org/2024/07/18/the-space-report-2024-q2/
[2] https://www.mckinsey.com/industries/aerospace-and-defense/our-insights/space-the-1-point-8-trillion-dollar-opportunity-for-global-economic-growth
[3] https://www.planetary.org/space-policy/cost-of-apollo

that first giant leap for mankind. Fortunately, the legacy of Apollo goes far beyond American boot prints on the Moon. The scientific discoveries and advancements resulting from space exploration propelled the United States to technology and economic dominance throughout the remainder of the 20th century. Private industry recognized the opportunity and value of space and developed new space businesses, first focused on satellite communications and later Earth imaging and launch services. Completely new industries like software engineering and computer sciences were born out of technologies and processes that needed to be developed to send humans into space, keep them alive, and get them home safely. The Apollo program also inspired thousands of young people to dedicate themselves to studying engineering, science, and computing – the workforce America needed to lead the world in high-tech fields.

The space race of the 21st century is very different. There is no one destination to win and no finish line. This must be a long-term, sustained expansion of human activity into space. It is critical for national security, technology dominance, economic growth, and soft power diplomacy. Yes, we need presence on and near the Moon, but also at strategic orbits like Lagrange Points and low-Earth orbit. There is no one space technology we need to dominate, but rather all of them – launch, operations infrastructure, remote sensing, satellite communications, in-space operations and mobility, and resource utilization to name a few.

So how are we doing vis a vis China? The U.S. is still the global leader in space, but the People's Republic of China (PRC) is executing on their plan to catch up and overtake the U.S. The PRC's stated goal is to make China a world leader in space by 2050 and a key competitor with the U.S. in space, for decades to come.[4] It's important to point out that the PRC is a centrally planned economy. There is no Office of Management and Budget, no Congress, no appropriations process. The PRC funds what it wants to fund, and its funding space. Furthermore, the PRC has no respect for the environment, public safety, space sustainability, or intellectual property. There are no regulators limiting the PRC's actions in space.

In 2019, this Commission put out a report with information on China's space ambitions. Many of the findings are still relevant and important scene setters today. For example:

- "China's goal to establish a leading position in the economic and military use of outer space, or what Beijing calls its "space dream," is a core component of its aim to realize the "great rejuvenation of the Chinese nation." In pursuit of this goal, China has dedicated high-level attention and ample funding to catch up to and eventually surpass other spacefaring countries in terms of space-related industry, technology, diplomacy, and military power."

[4] https://www.voanews.com/a/china-space-plan-highlights-commitment-to-space-exploration-analysts-say/7836873.html

- "China is taking steps to establish a commanding position in the commercial launch and satellite sectors relying in part on aggressive state-backed financing that foreign market-driven companies cannot match. China has already succeeded in undercutting some U.S. and other foreign launch and satellite providers in the international market, threatening to hollow out these countries' space industrial bases."[5]

Since the publication of the 2019 report, China has made significant progress in space. Recent activities include:

- Launch of the Tiangong space station, a three-module station continuously crewed since 2022. China recently announced plans to host an international crew member.
- Announcement of the International Lunar Research Station (ILRS), a partnership co-led by China and Russia, to enable long-term lunar missions in the 2030s. China anticipates landing crew on the lunar surface by 2030 and has made significant progress on the architecture including super heavy lift launch vehicles.
- In 2021, China became the second nation to successfully land and operate a robotic probe on Mars.
- In 2022, China demonstrated capability to dock with and maneuver an unresponsive satellite.
- In 2024, China became the first nation to land on the far side of the Moon and return samples.
- China has demonstrated multiple high-altitude launch and landing tests with liquid fueled reusable launch vehicles.
- Launches of satellite broadband communications constellation into LEO.
- China announced plans to launch a Mars sample return mission in 2028, returning samples in 2030.

A key component of China's space ambitions is building up its domestic commercial space industry. Before 2014, space activity in China was a state-owned and controlled enterprise. Ten years ago, the PRC opened the aperture and called for private investment in areas such as space launch and satellite manufacturing. This strategic shift was a direct response to the innovation happening in the U.S. commercial space industry and a recognition that China needed to foster its own industry to compete internationally and position China to surpass the U.S. in space technology. While China's industry may not always receive funding directly from the central government, they receive engineering support and access to government facilities. Some launch vehicles are based on government owned launch vehicles or have major components purchased

[5] https://www.uscc.gov/sites/default/files/2019-11/2019%20Annual%20Report%20to%20Congress.pdf

from the state. In addition, provincial and municipal governments follow national guidelines to subsidize the development of new capabilities for commercial launch companies.

In just ten years, China has made tremendous progress in growing its non-government space capabilities, particularly in areas currently dominated by U.S. industry – launch and satellite manufacturing. In 2024, 145 orbital launches originated from the United States. China was second in the world at 68 launches attempts.[6] There are now multiple non-government space launch enterprises in China, with six new reusable rockets planned for maiden launches in 2025.[7] China has also made significant investments in launch infrastructure, including the construction of two new launch pads over just two years.

On the satellite side, China is accelerating build out of two LEO satellite broadband constellations. China has constructed at least seven new manufacturing facilities in recent years, with the capability to produce thousands of satellites annually. China's national and provincial governments continue to pass regulatory plans and orders intended to accelerate development of a LEO satellite and launch systems. By the end of 2024, China's filings at the International Telecommunications Union indicate plans for more than 156,800 satellites. Here, China's goal is objective and clear: to connect every unserved and underserved community across the world with state owned, state censored internet from space ahead of the U.S., just as they have on Earth with Huawei and ZTE.

It is important to note that China's expansion into LEO has not been done with consideration for principles like space sustainability and orbital debris mitigation. In the last 20 years, China has launched more rocket body mass in LEO that will not adhere to the 25-year disposal rule than rest of the world combined. Thousands of pieces of debris from China's 2007 anti-satellite test are still in orbit, where they will remain for 100 years. It goes without saying that the proliferation of space debris stemming from Chinese activities is a threat that endangers existing space operations and the future usability of space for all.

Recommendations

While those who are tired of continuing resolutions look with envy from time to time on a centrally planned economy, I believe the U.S. will continue to dominate in space precisely because we have a free and open society. We will win based on the strength of our ideas, our creativity, our ability to innovate. We will win, as long as we thoughtfully implement policies that unleash the innovation of the commercial space sector. CSF would humbly suggest consideration of the following recommendations.

[6] https://payloadspace.com/2024-orbital-launch-attempts-by-country/
[7] https://www.wsj.com/world/china/chinas-own-elon-musks-are-racing-to-catch-up-to-spacex-74b02a95?st=wQGt7k

- **Space As a National Priority -** The United States has recognized the value of investing in and unleashing "industries of the future" like AI, semiconductors, and quantum computing in order to maintain America's competitive edge. The space sector is a critical industry of the future, and in need of a comprehensive, focused U.S. policy.
- **Buy Commercial** – The U.S. Government should rely to the maximum extent possible on the domestic commercial space industry. The Department of Defense, intelligence community, and civilian agencies should look to integrate commercial solutions first before building their own capabilities to compete with commercial. They should invest in a healthy and competitive space industrial base and provide consistent funding for space programs. Furthermore, the U.S. Government must become a smarter buyer of commercial space solutions by using commercial contract vehicles and procurement options appropriately, which includes having well-defined, stable requirements.
- **Civil Space Exploration -** NASA and Congress should commit sufficient funding for civil space exploration and space science, including funding for a sustained U.S. presence on the Moon, ensuring access to the lunar surface and its resources. NASA should partner with the commercial industry to complete the Mars Sample Return mission and other space science missions and investigations. NASA should continue to partner with the commercial space sector across its programs, lowering costs and paying for results rather than effort.
- **ISS Transition -** NASA should aggressively move out on awarding and funding new commercial space stations in LEO in order to host research, economic activity, and American astronauts and international crew upon retirement of the International Space Station in 2030.
- **Spaceport Infrastructure Investment -** The Administration and Congress should make robust investments in spaceport infrastructure to increase U.S. access to space from a variety of launch providers and locations. The Administration should seek to streamline or waive regulatory requirements impeding the construction of new launch sites and launch infrastructure.
- **Launch Licensing Reform -** The Department of Transportation should reduce and streamline regulatory oversight of space launch and reentry in order to increase U.S. launch cadence and mass to orbit. CSF has previously testified on specific improvements that should be made to the commercial launch and reentry licensing process.[8]
- **CRSRA Licensing Reform –** The Department of Commerce, in consultation with the interagency, should reduce licensing time and continue to streamline licensing of commercial remote sensing systems.
- **Mission Authorization -** The Department of Commerce should begin to implement authorization and supervision of novel space activities not currently overseen by an

[8] https://democrats-science.house.gov/imo/media/doc/Mr.%20Cavossa%20-%20Testimony.pdf

existing regulatory regime, in order to give commercial operators certainty they have a pathway to flight operations.

- **International Leadership -** The Administration should continue to lead international discussions about norms in space, prioritizing sustainability.

Conclusion

The furthest humans have ventured into space since 1972 was last year, on a privately funded, privately crewed expedition called Polaris Dawn. The United States commercial space industry has the innovations and the talent to maintain American leadership in space and dominance in technology, we just need a willing partnership with the government to realize our full potential. I thank the commission for your attention to this important issue and look forward to your questions.

OPENING STATEMENT OF ANDREW COX, FOUNDER, FOURSPOKE LLC

MR. COX: I want to thank the Commission for the opportunity to speak today.

There is little doubt that China has a strategic intent to develop a robust space presence that competes with the West in all areas. There is also little doubt that China intends to hold our eroding space advantages at risk with sophisticated weapons that range from jammers that can deny virtually every part of the spectrum, on-orbit weapons that they routinely test, and direct ascent weapons that have been recklessly employed at multiple orbits and altitudes.

For over two decades I was part of the policy discussions, budget plans, and architecture pivots to prepare the U.S. for a contested space environment with a peer adversary like China. While our pace to address the threat is lackluster, is isn't because of a lack of leadership awareness. It is more attributable to endless policy debates that rehash old decisions, failed acquisitions, budget uncertainty, and traditional government infighting.

While fixing these challenges in the DoD and the IC is important, their repair will still fail to enable the United States to compete with China in space. The reason? China is executing a much broader strategy that involves all the mechanisms of national power in a well-synchronized effort to attain global dominance. While industry innovation on the U.S. side is better than China, Chinese government innovation is greater than ours. The U.S. efforts are not well synchronized, and sometimes even work at cross purposes. In short, China is playing chess and the West is playing checkers.

The good news is that we have seen this approach from China before with Huawei, where they undercut and infected the global marketplace with capabilities that advance Chinese strategic interests. We can recognize these symptoms and act differently.

China's objectives are clear: to create a state-controlled global network that gives them the ability to exert control over not just their own citizens but hold the free society at risk. This is unlike the U.S. leveraging commercial technology in contracts to modernize the military or intelligence collection. This is complete alignment of military and civil activities where the goals and purposes are the same. Evidence of this alignment is not elusive. For example, commercial space companies can be seen rolling spacecraft out of PLA-owned integration and test facilities.

The strategy is developed at the very highest level of government, and has several key thrust areas. First is to capture key technology. Industrial theft at nation-state scale is obvious. The Chinese internet is replete with doppelganger images of Western satellites. Their theft includes hostile takeovers of European companies to boost their high-rate manufacturing.

Second is to attain key footholds in the market. One of the key footholds in the satellite business is an ITU frequency allocation. China will even buy European companies like KLEO Connect to get them.

Third, subsidize industry to undercut the global market. China's approach to subsidies is creative, and it aligns all levels of government, from national to municipal. The subsidies are in the billions of dollars, and are resulting in a massive expansion that dwarfs commercial growth in the United States.

Fourth, build manufacturing at massive scales. Enabled by these massive subsidies and lubricated by an incredibly permissive regulatory environment, Chinese space manufacturing capacity has matured at light speed. Twenty-six high-rate satellite manufacturing facilities have been built in the past 3 years. Twenty-one launch-related companies have been established in the past 3 years, with over seven new launch complexes.

Fifth, manipulate seams in the regulatory environment. There appears to be no concern

by U.S. regulatory bodies that China's opaque ITU filings may present interference problems, and U.S. regulatory bodies have not raised concerns with how its regulations slow U.S. operators as compared to their Chinese or foreign counterparts. Once U.S. filings are made, competitors, generally ones that are licensed and often funded by foreign governments, are permitted to game the U.S. regulatory process to slow each other down, inserting objections that might give a particular company, even a Chinese company, an advantage.

China also overwhelms ITU standards bodies that are consensus based by rushing the field with massive numbers of personnel to dictate the agenda. When the agenda for future forums is set 4 years in advantage, those disadvantages are massive.

And lastly, expand into global markets. They will undercut the price to outpace Western expansion and offer additional incentives like funded schools and highways to sweeten the deal.

The United States' greatest power is the innovation and speed of its industrial base. We need a series of reforms that leverage our strengths, create a level playing field, and give DoD greater access to that innovation and speed.

First is regulatory reform. Both the FAA and the FCC need to institute serious regulatory reform to maximize industry competition while keeping prudent attention to safety of U.S. citizens and the environment. Regulatory reform should eliminate ambiguous requirements, repair overlap in agency authorities, and discontinue allowing the national Environmental Protection Act to be weaponized for parochial interests instead of truly protecting natural habitats and resources, specifically in the United States.

Regulatory timeline improvements. Previous attempts to streamline regulations have only created increased reporting requirements that require even larger regulatory staffs and longer approval timelines. Reforms should institute a shot clock -- it is March Madness -- that competes with China's, offering approval relief if the timelines aren't met. We should also align our approval processes with non-U.S. licensees.

Third, we need to engage in regulatory fare to build parity with China. Reforms should strengthen and align Western regulations related to theft of technology, manipulation of markets, and exploitation of international forums.

Fourth, we need to create more public-private partnerships that incentivize growth of space-related launch infrastructure, space technology, and manufacturing.

Fifth, create more flexible contracting and acquisition options for the DoD. Consider FAR modifications, like what is being proposed by the SASC and FoRGED. Look at expanding the use of service-type contracts to lease commercial space capabilities.

And finally, consider creating special budgeting provisions for DoD and IC efforts that minimally modify a commercially available service. Such structures may incentivize companies to develop commercially viable capabilities at their own risk, and also incentivize the DoD and the IC to avoid requirements creep in exchange for speed.

Thank you for your time.

PREPARED STATEMENT OF ANDREW COX, FOUNDER, FOURSPOKE LLC

Hearing Date: April 3, 2025
Andrew D. Cox
President, Fourspoke, LLC
Testimony before the U.S.-China Economic and Security Review Commission
Hearing: "The Rocket's Red Glare: China's Ambitions to Dominate Space"

It is a pleasure to get the opportunity to testify before this Commission today. I am thankful for the invitation from Commissioners Kuiken and Sims to provide my perspective on China's rapid space advancements and what it means to our national security.

There is little doubt that China has a strategic intent to develop a robust space presence that competes with the West in all areas: ISR, communications, precision navigation and timing, and tracking. There is also little doubt that China intends to hold our eroding space advantages at risk with sophisticated weapons that range from jammers that can deny virtually every part of the spectrum, on-orbit weapons that they routinely conduct on-orbit tests and tactics, and direct ascent weapons that have been recklessly employed at multiple orbits and altitudes.

For over 2 decades I have been part of the policy discussions, budget plans, and architecture pivots to prepare the U.S. for a contested space environment with a peer adversary like China. While our pace to address this threat is lackluster, it isn't because of a lack of awareness on the part of the US government leadership. Our repeated missteps are more attributable to endless policy debates that rehash old decisions, failed acquisitions, budget uncertainty, and traditional government bureaucracy and infighting. While fixing those challenges in the DoD and IC is important, their repair will still fail to enable the US to compete with China in space.

The reason? China is executing a much broader strategy that involves all the mechanisms of national power in a well-synchronized effort to attain global dominance. While U.S. innovation on the industry side is better than China, Chinese government innovation is greater than ours. The U.S. efforts are not well synchronized, and sometimes even work at cross purposes. In short, China is playing chess, and the West is playing checkers.

The good news is that we've seen this approach from China before with Huawei, where they undercut and infected the global Internet marketplace with capabilities that advance Chinese strategic interests. While the West was slow to react, and had to "disinfect" the networks afterwards, we can recognize the symptoms and act differently.

China's intent is clear. "Document No. 91" emphasizes the need for Military-Civil Fusion in the Defense S&T industry to create a Belt and Road Initiative "space information corridor"[1]. They have established strategic 5G cooperation agreements with state-owned enterprises (China UNICOM, Huawei, and Galaxy Space)[2]. Their objectives are also very clear. By creating a state-controlled global network, China can achieve several strategic goals:

[1] Tai Ming Cheung, Innovate to Dominate: The Rise of the Chinese Techno Security State. (New York: Cornell University Press, 2022), p. 136
[2] China News Network. DOI: June 6, 2020. https://new.qq.com/rain/a2020606A0EYHL00, DOA: August 25, 2021

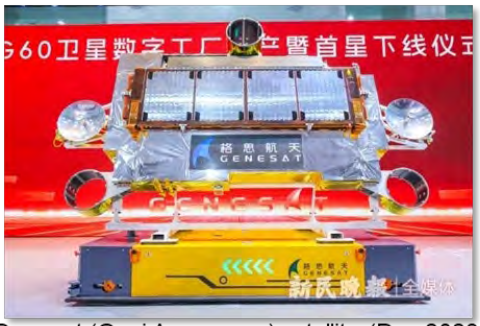
1. Extend and maintain global economic dominance in several other areas such as electronic vehicles, power systems, etc.
2. Dominate infrastructure such as automated port systems, railways, roadways, etc.
3. Conduct cyber warfare and information warfare, to include tracking and targeting dissidents overseas.
4. Conduct global ISR to monitor adversaries and avoid sanctions
5. Conduct long-range fires by integrating weapon systems into the global communications architecture and enabling them to hit moving targets over the horizon.
6. Conduct interference on other satellite systems to create an economic, military, or strategic advantage. Chinese SATCOM systems in LEO that have incredibly vague ITU filings routinely get go-orbital with OneWeb and Starlink satellites.

This is unlike U.S. leveraging commercial technology on contracts to advance military modernization or intelligence collection. This is complete alignment of military and civil activities, where the goals and purposes are the same.

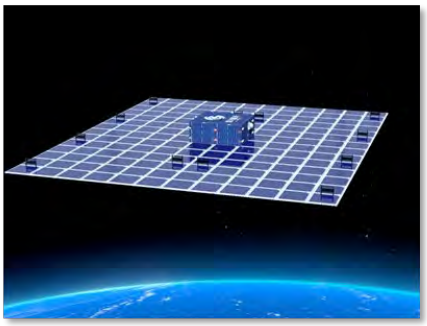
Evidence of this alignment is not opaque. Former Vice Premier Liu He is the forefather of SIGN, China's overall strategy for a globally interconnected terrestrial and space-based network[3]. Premier Li Quang, who orchestrates the State-owned Assets Supervision and Administration Commission (SASAC), initiated the G60 Starlink Industrial Base. "Commercial" space companies like Galaxy Space using assembly, integration, and test facilities at Shanghai Academy of Spaceflight Technology (SAST), which provides weapons technology for the PLA.

There is also evidence of commercial companies utilizing PLA-owned tracking and control sites for commercial companies in Kashgar. Finally, there is clear evidence of industrial espionage at scales that typically dwarf what can be done by any individual company. The Chinese Internet is replete with images of Starlink, Iridium, and AST Mobile doppelgangers that are almost mirror images of the "real thing" (below).

[3] Chenhua Sun, Yongwei Xiao, Weison Zhao, Po Zhou, "Development Conception of Space Ground Integrated Information Network LEO Mobile and Broadband Internet Constellation", Telecommunications Science 33, no. 12 (December 2017): 43-52



Genesat (Gesi Aerospace) satellite (Dec 2023)
Starlink Copycat



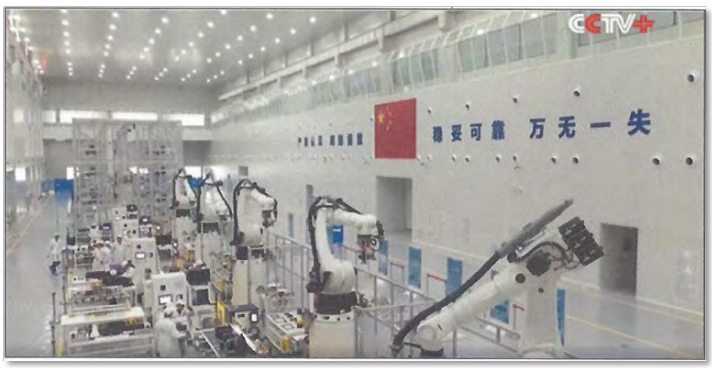
Galaxy Space Fall 2023
AST SpaceMobile Copycat

LandSpace
Falcon/Raptor Copycat

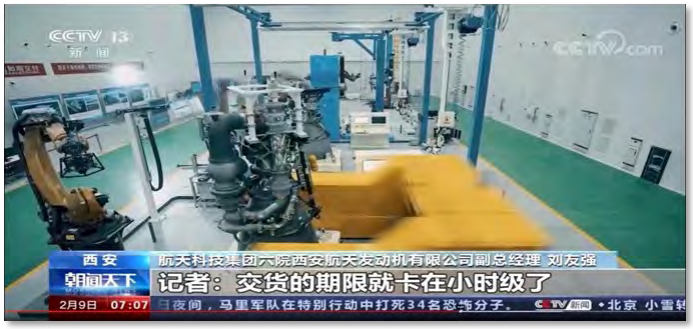
This alignment is not dependent on people placed in key positions or sublets of government facilities by pseudo commercial entities. It is guided by a strategy that is developed and maintained at the very highest level of government. President Xi Jinping chairs the Central Military Fusion Development Commission (CMCFDC), a Politburo level organization he created to align the priorities and efforts of the Central Military Commission and the State Council. It sets the policies, aligns research, and directs funding to support the objectives in the Innovation-Driven Development Strategy (IDDS) and the Belt and Road Initiative (BRI) Space Information corridor. The strategy has several key thrust areas, many of which are extremely similar to Huawei:

1. <u>Capture Key Technology:</u>

The industrial theft at nation-state scale is obvious, and is eerily similar to Huawei's quick rise to technology parity with companies like CISCO. Technology capture isn't limited to theft. In December of 2016, a Chinese appliance manufacturing company known as Midea, acquired 95% of Germany's premier robotics company (Kuka AG) in a takeover bid valued at $4.8B. In November of 2021, they purchased 100%, and the lack of CFIUS laws in Germany made the acquisition easy. Kuka can be found on the assembly lines of many of our Western satellite manufacturers, and it can now also be found in many Chinese satellite and rocket integration facilities.



Kuka at CASIC Wuhan (Shanghai)



Kuka at Rocket Assembly Facility

Kuka is a strategic buy for China. There are now 6 Kuka robotics manufacturing facilities in China, and the capability is fueling the rapid growth of mass satellite and rocket manufacturing in the country.


One of 6 Kuka Plants (Shanghai Songjiang District)

2. Obtain Key footholds in the market to initiate growth

One of the key footholds in the satellite business is frequency. In order to prevent satellite communications companies from interfering with another, the global spectrum is managed by the International Telecommunications Union (ITU), a part of the United Nations that provides frequency allocations to satellite owners. Without an ITU allocation, it isn't possible to operate in the space domain without likely interfering with another lawful transmission. GMS Space, which is the company that plans to fly G60 Starlink as a constellation of over 12,000 satellites, procured another Germany company known as KLEO Connect in order to obtain their valuable Ka ITU filing. This is exactly the kind of foothold that helps accelerate market entry. Another valuable foothold is terrain where satellite control antennas can be placed. There are already examples of Chinese satellite control sites in multiple countries that have now been locked behind security fencing and are operated exclusively by Chinese nationals. Their enthusiastic welcome, then complete ownership by China, is reminiscent of China's port infrastructure around the world.

3. Subsidize Industry to Undercut the Global Market:

China's approach to subsidies is creative. National level policies are established at the Central Committee to increase investment in space, but they are distributed and executed at the Provincial and Municipal level. The investments are backed by the highest level of Party governance: the National Development and Reform Commission (NDRC) and the Financial Economic Leading Group (FELG). However, the Provinces are able to specialize in and attract targeted talent and investments in specific areas (rocket assembly, engines, spacecraft design and manufacturing, etc.). Evidence of the scope of the subsidies is found in Provincial-level action plans:

- Yizhuang Area (Beijing) "Commercial Space High Ground" Policy, February 2024
- Shangong Provincial Policy, January 2024
- Guangong Province, "Nansha New Area" policy

The subsidies are in the billions of dollars, and range from R&D, to infrastructure investments, to insurance costs, to ITU filing rebates, to loan financing.

So, while the U.S. is debating whether and how to subsidize technologies like fiber to undercut U.S. satellite services, the Chinese subsidies are resulting in a massive expansion of facilities, technology, and manufacturing that dwarf the commercial growth in the United States (see Attachment 1, Statistics of China Space Growth). The most recent public-private partnership is the massive satellite manufacturing and launch complex being built on Hainan Island. The complex is astonishing: it will have a mega-satellite factory in the middle that can feed 16 liquid launch pads (one a sea-launched pad), quadruple the 4 liquid launch pads currently operational on the island.

4. <u>Build manufacturing at massive scales</u>

Enabled by these massive studies, and lubricated by an incredibly permissive regulatory environment (environmental, safety, zoning, etc.), Chinese space manufacturing capacity has matured a light speed. There have been 26 high-rate satellite manufacturing facilities built within the past 3 years. The G60 "Starlink" Satellite Smart Factory began earthworks in Feb 2022, and completed their first satellite production at the plant in December 2023.

The CAS Space rocket manufacturing facility began earthworks in December of 2020 and was completed by October of 2022 (see below):

The below satellite super factory with an annual production rate of over 1000 satellites in Wencheng is on track to start operation in June:

One of the most recent additions is the new CAST factory in Hangzhou. It is being built to deliver the SATNET mega constellation.

Their launch facilities are growing at a similarly blistering pace. There have been 21 launch-related companies established in the past 3 years, and over 7 different launch complexes developed (see Attachment 1).

5. Manipulate seams in the regulatory market to gain an advantage:

The internal regulatory environment within China is extremely permissive. The Chinese regulatory body equivalent to the FCC and FAA, known as the Ministry of Industry and Information Technology, is over-permissive compared to US safety standards. China's Wenchang Space Launch Center is located right next to a Hilton hotel, enabling guests to watch launches from their balconies. Even though China's standards for minimizing harm may not be uniform with the West, there appears to be no concern by U.S. regulatory bodies that China's opaque ITU filings may present harmful spectrum interference issues. The U.S. regulatory bodies have not raised concerns with how its regulations slow US operators as compared to their Chinese or other foreign counterparts. The below table describes some of the greatest standards misalignments that create regulatory asymmetry and slow down U.S. space industry growth:

Rule	U.S. License	Non-U.S. License
Operations during orbit raise	Requires separate authorization per launch (and increased fee)	None needed
Operations during de-orbit	Requires separate authorization per launch (and increased fee)	None needed

Debris mitigation plan	Must file	None needed
Federal coordination	Entire Space/Ground system must be coordinated across USG	Coordination only tied to earth stations operated in the U.S.
ITU Filings	Must file entire system with company ID	Can file partially and anonymously

Once filings are made, competitors—generally ones that are licensed and often funded by foreign governments—are permitted to "game" the U.S. regulatory process to slow each other down, inserting objections that might give a particular company a timing or other regulatory advantage. Not only does this behavior encourage several U.S. companies to make filings overseas, but it most clearly advantages China who is allowed to sidestep this counterproductive gamesmanship.

The other mechanism China uses to manipulate the market is to use their integrated military-civilian workforce to overwhelm standards bodies like the ITU that are *consensus-based*. China will typically "rush the field" with massive numbers of personnel that can overwhelm the agenda for the regulatory bodies that oversee international spectrum, such as the ITU and Word Radio Conference (WRC) forums. In contrast, the U.S. holds a convoluted process to determine its positions, including allowing operators owned by foreign governments to manipulate the outcomes. Worse, critical forums like the 2027 WRC, which sets the agenda for future ITU forums, will likely be hosted in Shanghai where the Chinese have a home-court advantage to "rush the field". Combine that with the fact that U.S. persons are limited and have IT and communications restrictions when they enter the country, and you have a perfect storm for the U.S. to take massive policy losses that could harm our interests for generations. These kinds of losses are big: when the agenda for future ITU forums is set 4 years in advance, opportunities to correct past mistakes are few and far between.

6. Expand into global markets:

The strategy played by Huawei is most likely going to be employed by China space companies as well. They will first expand into Southeast Asia markets where space coverage is easier, and the regulatory environment is in their favor. They will undercut the price and outpace the expansion of Western companies and offer additional incentives like funded schools and highways to sweeten the deal. Finally, they will slowly expand along the BIR to Africa, the Middle East, and South America.

7. Create catered environment in global regulatory bodies:

Once enough favorable conditions are met across the globe, the Chinese will leverage country partnerships to create even more favorable conditions within bodies like the ITU (like the World Health Organization and other international bodies).

Recommendations

The United States' greatest power in global competition is the innovation and speed of its industrial base. While problems within the DoD must be fixed, they alone cannot help us maintain parity with China. The United States needs reforms that leverage our strengths, create a level playing field for our industrial base, and gives the DoD greater access to industrial innovation and speed:

1. Regulatory Reform: Both the FAA and FCC need to institute serious regulatory reform with the objective of maximizing industry ability to compete on a global scale while keeping prudent (but not onerous) attention to both safety of U.S. citizens and the environment. Previous attempts to create streamlined regulations (e.g., FAA's Part 450) have only elongated the process and created increased reporting requirements that require even larger regulatory staffs and efforts. Regulatory reform should include the following elements:
    a. Contract the FCC and the FAA from their expansive focus back to the original chartered intent of the organizations. For example, refocus FAA's Office of Commercial Space Transportation (AST) on issues specifically related to their regulatory scope: to protect the uninvolved public. Provisions such Conditional Expected Casualty (CEC) risk, historically utilized as a tool for launch, were codified into Part 450 for all re-entry events, regardless of whether safety is a concern.
    b. Fix the massive amounts of ambiguity that exist in regulatory documentation that make compliance subjective and evaluation processes ill-defined.
        i. Parts of 450 are inherently vague, making the prediction of licensing paths impossible. Compliance guidance for nearly all the most complex or new technical requirements in Part 450 remain unpublished, since Advisory Circulars, intended to help clarify Part 450 after instantiation, have rarely been published.
    c. Repair the overlap between approvals required from the multiple U.S. Government agencies. While the FAA and FCC are responsible for both launch and spectrum respectively, there remains a significant amount of overlap of Part 450 with other agency requirements (NASA, DoD). When input is requested from those agencies, the approval process becomes multi-threaded. The regulatory bodies need to work more quickly to de-conflict inter-agency direction.
    d. The use of the National Environmental Protection Act (NEPA) to constrain industry growth, almost for that purpose alone, runs counter to national security interests. The recent bi-partisan condemnation of the California Coastal Commission denial of additional SpaceX launches at Vandenburg (for dubious reasons) is germane.
        i. Limit application of NEPA to proposed actions affecting the U.S., in accordance with the language of the act. NEPA does not apply to the globe, nor to the space environment. It is also not relevant to re-entry events, particularly if the de-orbit has already been certified.
        ii. To expedite the construction of infrastructure and increase U.S. launch cadence, the head of various agencies (Air Force, NASA, the Corps of Engineers, Coast Guard) should apply exclusions to NEPA for all actions that involve the national security interests of the U.S. and for which such exclusions are permissible under the law.

2. Regulatory Approval Reform: both the FCC and the FAA desperately need regulatory reform. Previous attempts to create streamlined regulations (e.g., FAA's Part 450) have only elongated the process and created increased reporting requirements that require even larger regulatory staffs and efforts. Institute the following changes:
    a. Mandate a "shot clock" for each FCC and FAA submission, requiring regulatory bodies to comply with aggressive filing timelines that match or exceed China.
    b. Applications that are still pending at the conclusion of the shot clock should be deemed granted.
    c. The U.S. should change their regulation approval processes and standards to get uniformity with non-U.S. licensees.
3. Engage in Regulatory-fare to build parity with China:
    a. Strengthen and align Western regulations related to theft of technology, manipulation of markets, and exploitation of international forums
        i. Strengthen EU's Foreign Direct Investments process to include blocking or suspension power like CFIUS
    b. Prevent Chinese domination of the WRC and ITU agendas by overpowering consensus-based rule forums.
        i. Increase U.S. participation at industry and government levels
        ii. Protect "do no harm" exceptions at the ITU that enable U.S. companies to move quickly while the bureaucracy searches for a position. China uses consensus voting to block "go fast" provisions that put them at a disadvantage.
    c. Create a more agile tempo at the ITU and WRC that enables rapid adjudication of proposals to keep up with technology changes and missed manipulations.
    d. Increase the priority of tracking Chinese mega-constellations at the USSF Commercial Integration Cell at the CSpOC to monitor both co-orbital behavior as well as potential RF interference.
4. Create more public-private partnerships that incentivize the growth of space-related launch infrastructure, space technology, and manufacturing. Efforts taken on by Space Florida need to grow to other high-technology regions across the U.S.
5. Flexible contracting and acquisition for the DoD. While the recent adoption of Other Transaction Authorities has enabled the DoD and IC to move more quickly, adoption of OTAs is limited for multiple reasons. Consider other vehicle types or FAR/DFAR modifications (such as what is being proposed by SASC and FoRGED). Look at expanding the use of service-type contracts to lease commercial space capabilities until contracted purchase price is met.
6. Stable budgeting environment. While the challenges of delayed budgets and continuing resolutions are well documented, consider creating special funding and budgeting provisions for DoD and IC efforts that involve a minimum modification of an available commercial service. Such structures may incentivize companies to develop commercially viable capabilities at their own risk and incentivize the DoD and the IC to avoid requirements creep in exchange for speed. There are examples of specific funding types such as SCN (Ship Construction New) that were intended to fully fund the procurement of a specific item and enable execution flexibility. In the early days of the Missile Defense Agency, they had only "one color" of money that enabled them to solve R&D, Procurement, or Maintenance problems with great flexibility. Similar funding vehicles could be developed for critical industries such as space.

Attachment 1

Statistics of China Space Industry Growth

These statistics are provided to demonstrate the amount of growth in the Chinese space market, and to highlight 4 specific points:

1. The speed of their standup from conception to operational capability
2. The size/scale of standup in terms of square feet, numbers of facilities, and size of government investment.
3. The balanced investment strategy across spacecraft manufacturing, launch, and spectrum.
4. That the schedule is roughly on target: other investments, such as real estate, have been overprovisioned and a general failure. The scale of space investment is yielding results, and while some skepticism is warranted, complete skepticism is not.

Rocket Engines

In 2024, CASC vowed to prioritize engine development "to meet urgent demand in the commercial market". Since then, the pace and scale of rocket engine development has only accelerated. Today there are approximately 36 different liquid rocket engines in development by various companies (YF-100K, YF-102, FY102-R, YF-209, Thunder-R1, Tuanhuo-12, Cangquing-50, JD-2, TQ-12, Longyun, and Yuanli-85). Of these rocket engines, 24 of them are designed to be re-usable. Of these 36 different rocket engines, 20 of them have conducted a successful static fire test within the past 3 years, and 6 of them have been used operationally in the past 3 years . Of those that reached a successful static fire test, the average time from estimated initiation of development to static fire testing was only 45 months. There are 22 known production facilities, and 10 new engine and rocket test facility complexes distributed across China, with enough production capacity to satisfy the demand of their large rocket industry. Rocket engine development is a huge priority for the Chinese government: major players like AALPT, the sole engine provider for China's fleets of Long March rockets, vows to develop at least 8 engine models in 9 years between 2021 and 2028, as well as the CAS Institute of Mechanics who is eagerly to develop a Merlin-1D equivalent gas-generator cycle kerolox engine. But most important of all, Beijing is leveraging its commercial space sector with policies, incentives, and government-led initiatives such as the Rocket Street inside the city of Beijing.

Rocket Companies

China has approximately 11 viable rocket companies (iSpace, Landspace, Galactic Energy, Space Epoch, CAS Space, Deep Blue Aerospace, Space Pioneer, Orienspace, ExPace, ChinaRocket, CASC Commercial Rocket) and 3 liquid engine developers, one of which even provided reusable engines to CASC for 3 VTVL tests, an embarrassment to AALPT who monopolized rocket engines in China until the opening of commercial space in 2016. Except for the state-owned CASC, these rocket companies are private companies and are in average only 7 years old . Across these companies, there are 6 heavy lift variants (Pallas-2, Hyperbola-3B, Kinetica-2 Heavy, Kinetica-3 Heavy, Tianlong-3H, Yinli-3) and 29 small to medium lift rockets. Across those variants, 20 (of 35 rockets) or 57% are being built as re-usable rockets. 73% (11/15) of the non-reusable rockets are in full operations, while 20% (4 of 20 useable rockets, LM-12A, ZQ-3, Hyperbola-2/3, Nebula-1) of the reusable rockets have completed significant "hop tests" that demonstrate proficiency in re-usable design. While much of the rocket companies are

considered “commercial”, the Chinese government investment into rocket manufacturing in 2023 alone was $833M, according to CASIC.

Launch Complexes:

There has been a staggering growth in launch complexes in China that far dwarfs the launch complexes in the United States and Allied countries. The total number of launch complexes in China is 6, including a sea launch port and of those 5 launch complexes, 2 have developed in the past 5 years.. Some of these launch complexes are massive: the 5 new launch sites in Mongolia for commercial rockets spreaded across an area roughly 38 square miles at the Gobi Desert, each designed similar to Falcon-9’s, and the newest launch complex on Hainan Island will eventually grow into a satellite and rocket industrial and launch hub with at least 7 launch complexes covering 3.86 square miles. The total number of launch pads across these launch complexes is also staggering: there are 17 launch pads, 5 of which can support heavy lift, and 3 of which can support re-usable rocket launch recovery. Those that can support re-usable rocket launch and recovery have significant infrastructure on sight to support refueling operations. The new Hainan commercial launch site has a new dedicated propellant and cryogenic gas plant and has enough tanks for METHANE, LN2 and LOX to support 4 launch pads for more than 60 launch missions annually. The speed with which these launch complexes have stood up is similarly astounding. Typically, the span of time from ground-breaking to operations for the newest launch pads is only 6 months. Many of these complexes, to include the roadways and infrastructure that support them, are resourced by the Chinese government. The Hainan Island Complex, a mixed use commercial and government space complex with significant government support is astonishing. Recently, Beijing’s mouthpiece news media CCTV just showcased a scale model last week on national TV with 16 liquid launch pads, quadruple of the total 4 liquid launch pads currently operational on the island.

LEO Satellites:

There are roughly 37 LEO satellite manufacturing companies in China. About 11 of those companies are listed as LEO SATCOM companies, but 20 of them provide dual-use missions (PNT, ISR, etc.). 64 (24%) companies are less than 10 years old, but between them have put approximately 672 functional satellites on orbit in that period of time. It should be noted that many of them share similar orbit parameters (altitude, inclination, RAAN) with their western counterparts (SpaceX, Oneweb, etc.). They are postured to quickly ramp into high-rate production. Within the past 3 years, there have been 3 “mega factories” built and another is nearing completion. These mega-factories are massive: The CAST factory in Hangzhou is advertised to be able to manufacture 1,000 lasercom terminals and 120 feeder link antenna a year and has supplied satcom payloads to China’s SatNet mega-constellation satellites being launched since 2023. The Geely’s GeeSpace factory claims to be able to produce 500 satellites a year, Galaxy Space’s factory near Shanghai is purported to have a 300 to 500 a year capacity, and a satellite super factory in Wenchang is advertised to manufacture more than 1,000 satellites a year and is expected to be operational in June. Each of these mega-factories are being built at a blistering pace: the Wenchang facility went from ground-breaking to expected operations within a year. The second phase of the CAST Hangzhou factory with a floor area of 134,800 m2 to crank up more subsystems for SatNet satellites went from ground-breaking in May 2024 to expected operations later this year. A sizeable amount of these investments has been made by the Chinese government. For example, the Hainan commercial space launch site will provide a vertically integrated hub-and-spoke satellite manufacturing infrastructure built by the government with the “Satellite Super Factory” and its adjacent subsystem and

component manufacturing plant to produce more than 1,000 satellites per year and a reusable launch vehicle complex to encompass the future reusable rocket programs

ITU Filings

All of that manufacturing is on pace to feed the voracious ITU filing pace of the Chinese government. In total, the Chinese government has submitted filings for 74,424 satellites between 500 and 900km. Many of these filings are within frequency allocations that overlap with other US satellite companies (11.7GHz and 13.25 Ghz), and companies like Huawei are moving into Ka and DTD frequencies (S-band).

PANEL II QUESTION AND ANSWER

COMMISSIONER SIMS: Thank you all for your statements. We will move into the Q&A portion. We will go in reverse alphabetical order, but since I have the mic and no one can stop me, I am going to take the prerogative of the chair and go first.

The first question I have is for Mr. Curcio and maybe Mr. Cavossa, as well, but anybody who has a view on this I would love to hear it. Is U.S. investment in any way fueling China's private sector or commercial space growth?

MR. CURCIO: As best I can tell, no, it is not. The closest thing we would see to that is a couple of subsidiaries or no longer subsidiaries of U.S. venture capital funds, so for example, Sequoia China, I think Matrix Partners, as well, their China branch, has invested in some of the very early stages of Chinese commercial space, back in 2015, 2016, 2017. I don't know if there is any reason for this, but we have not seen those entities invest in any of the more recent, well, in the last 5 or 6 years, as far as I can tell. But that would be the closest we have seen to that.

MR. CAVOSSA: Sir, the only thing I can sort of point to is perhaps mimicry, if anything, where I have not seen cases where U.S. is investing in China. But what we are noticing is that when something gets invested in here in the United States, in space, in commercial space, it doesn't take too long to see similar investments made in similar Chinese technologies soon after that. So when they see progress here, it dictates some of the things they do.

COMMISSIONER SIMS: Okay. For both of you, as well, and others if you have thoughts, how is IP theft impacting China's commercial space growth, as well, on either side of the fence there, commercial or government side?

MR. CAVOSSA: It is not something that I can speak intelligently about. Again, going back to my previous answer, sir, we just see a lot of things, when the Chinese government announce it or when commercial entities in China announce new programs, new technologies, they look an awful lot like U.S. programs and those technologies. So there is an assumption I make, but I am not privy to details.

COMMISSIONER SIMS: Okay.

MR. CURCIO: I have one. Something comes to mind. You know, often you see, in Chinese media, things like, a couple of weeks ago there was an article where they tore apart a Starlink third-generation terminal, and it was like they tore it all the way down to like the nuts and bolts, some Chinese electrical engineer. And layer after layer, and photos, really high-definition photos, of here is the terminal not torn apart, here is the first layer, here is the second layer, and then analysis of how are they doing this and what might China need to be doing in order to build similar terminals. So you do see that with some regularity.

MR. COX: I will just add to that. When I talked about doppelgangers, they are exact copies. The reaction wheels are all in the right spots. The phased array transmitters are all exactly the same. We see Starlink doppelgangers. We see Iridium. It is all across the board.

And it is not just necessarily theft of a spacecraft design. Back in 2019, China bought KUKA Robotics, which was the premier German robotics firm that does automated assembly line manufacturing. Now you see that KUKA Robotics firm all over China. They have six KUKA Robotics firms in China alone. And if you look at almost every satellite manufacturing building, or rocket manufacturing building, you will see KUKA Robotics there.

It is hard to believe that they didn't learn very quickly by buying that company how to build a high-rate manufacturing line for satellites. Thanks.

DR. ALKIRE: If I could just add, foot-stomp and mimicry. We definitely see the

mimicry, down to the details of design. Whether that is through theft of intellectual property or not, I can't say.

But another observation, and maybe it is a question for some of the other panelists, like Blaine who has more expertise in the Chinese commercial sector. But in the U.S. we have commercial entities that provide whole space services to the Department of Defense. And it is not my area of expertise, but what I see from China is you have the large state-owned enterprises and their subsidiaries that provide the bulk of the space capabilities. Yes, some newer entrants in the commercial market that are active in launch and a few niche areas. But I wonder now if we are starting to see a change, if China's government wants to have it both ways. It wants to have the advantages of the state-owned enterprises, but if it also aspires to have the same kind of commercial sector that can innovate and that can provide space services, and not just contribute to the PLA on the margins.

COMMISSIONER SIMS: Mr. Cox, one of the things in your testimony that stuck out to me is you said something to the effect that the United States' greatest power is our industrial strength in this space, which is something I feel like we don't hear very often right now, when we are compared to China, that we have an industrial advantage over them.

So I would be curious, any more thoughts you may have on that, in general, but specifically, what areas of our industrial base do you see that we are weak and where we lack self-sufficiency in some of the important supply chains in the space industry?

MR. COX: Yeah. There is a lot to that question so I will try to unpack it in an organized way. But the first thing is I would say when it comes to our advantages, certainly the level of innovation is our greatest strength. And the last subject we talked about was how often they copy, right. We still innovate way faster than China. But that advantage can quickly erode once your adversary learns how to copy, and copy at mass scale. So quantity will have a quality all its own. So if I can get as close to a capability on com or IRS, remote sensing, but I can produce it way faster than you can, I will take that seat.

So I think we have to jealously protect that advantage of our innovation and figure out more creative ways to both prevent its theft as well as to remove some of those impediments we have to competing in the international market.

I also think that we still have troubles, as a former government employee, of taking advantage of that innovation on the government side. You heard CSO talk about that, as well. We have antiquated acquisition structures that are fossilized, that have taken on a lot of structure, and we need to strip some of that down so that we can take advantage of that innovation.

COMMISSIONER SIMS: Thank you. I will turn it over to my co-chair, Commissioner Kuiken.

COMMISSIONER KUIKEN: Thank you very much, Commissioner Sims. First of all great, testimony from all five of you. I really appreciate you being here today.

Ms. Samson, Mr. Cavossa, Mr. Cox, one of the things I sort of heard from all three of you was a discussion about ITU and sort of international institutions. One of the questions I asked General Saltzman, although not as directly now that I sort of look back at it in hindsight, is, are these institutions up for the role that they were intended to play. And I think the answer is no.

So then there is always this sort of political tension between whether or not we should stay with these institutions or abandon them outright. I think the answer here is we should stay with them and probably make them more robust. But I am sure there is some tension there that you guys are much more familiar with, and I would appreciate all three of you just sort of quickly giving views.

MS. SAMSON: So if I understand your question properly is whether the international institutions are able to have these conversations. Is that what you are asking?

COMMISSIONER KUIKEN: I mean, we created the ITU to manage where satellites get parked, if my sort of knowledge of their mission is correct, right.

MS. SAMSON: Right.

COMMISSIONER KUIKEN: If China just decides to ignore them, like are there ITU police that are going to fly up to space and readjust them? Obviously, I know the answer to that. But it seems to me that this is an institution that was created some period of time ago, that has largely played the role that it was originally intended to do. But sort of the game has changed, and maybe they haven't changed with it, and maybe there are ways that we should think about it. I think Mr. Cox or Mr. Cavossa mentioned something about a 4-year cycle that I am sort of not familiar with. But that is the question. Does that make sense, Ms. Samson?

MS. SAMSON: Yes. I mean, actually the ITU, I would say, is more evolved than some of the other international institutions because it allows for member states but also companies can be members, as well. So it is one of the few organizations, the multilateral fora, that deal with space that allows the commercial sector to be involved. And that is crucial because the commercial sector is a huge stakeholder in space and they have a lot of effect on it. So I think actually it is important to have that conversation.

Basically, they have a work group that picks the topic, and they work it 4 years ahead of time. But the U.S. is actually very involved in that too, so I don't know necessarily that the U.S. is getting steamrolled there, actually. I would not describe that, as well.

And the ITU is actually taking on newer topics. They are starting to focus on space sustainability, which is crucial because if we are talking about issues that are complicating the space environment, you know, it is not just orbital spots but it is spectrum usage. So the idea of trying to manage effective use of spectrum is really helpful.

And in regard to the United Nations, that is one of the few places the United States and China can actually talk about a lot of these issues, and China is a big participant in both the civil space and the security space conversations. Given how important space security and stability is to the future of U.S. space, the future of our national security space establishment, how our economy functions, I think it is important to have these conversations in these fora. So I would not actually advise pulling back. Thank you.

COMMISSIONER KUIKEN: I am not advising pulling back either. I was just sort of curious. You guys are the subject matter experts here. I am curious on sort of your views on the tension points and thinking about sort of revitalizing a place like ITU.

MR. CAVOSSA: Yeah, I will just add, sir, the ITU and UN, COPUOS bodies are the best thing that we have, and our general feeling is that the United States government just needs to do a better job of advocating for U.S. interests in these bodies more aggressively.

MR. COX: I would echo that statement. I think it is very tempting to talk about, well, should we just ignore it, but it really does. These bodies do add value. I think we have to look at, really, it is two aspects. One is, well, what about our U.S. regulatory environment, the things that we can change. That is where we really need significant reform. Because as it relates to SATCOM, we don't enter the ITU until we get through our own, I would call, laborious process, and that is where we lose the competitive edge. When China can go straight to the ITU, without waiting, and we sit there in a backlog of years to get there, that is where the disadvantage starts.

I think the ITU can be productive, but the United States has to look at it like a strategic environment, where you can't sit on your heels and just sort of watch things happen, or allow

someone who comes with more people to vote, takes advantage of you because you haven't thought about that strategically.

So I think we just need to think about these bodies in a more strategic, again, whole-of-government activity, where we are trying to make sure that we advantage U.S. industry and U.S. capability.

COMMISSIONER KUIKEN: I heard you and Mr. Cavossa make the regulatory reform comment. I sat on the Armed Services Committee and listened to everyone always talk about acquisition reform. And as you peel back the onion on acquisition reform a lot of times it is sort of self-deterring within the executive branch, not necessarily something that the Congress has imposed on the executive branch.

In the space of regulatory reform, are the backlogs because there are not enough people? Is it because people don't want to make decisions? There is always something that is holding up a process, and often it is being under-resourced, or under-resourced in terms of dollars or in terms of technology or in terms of people or other things. Or are these just institutions that are sort of under-resourced, or is it something else there?

MR. CAVOSSA: I will comment on behalf of industry to say that when we look at U.S. regulatory bodies there is always a benefit to saying we can throw a little bit more money at them, more resources, more people. But then, of course, those organizations, once they are larger, might decide to create even more process and more structure and more red tape. That is, unfortunately, human nature.

We tend to see, sir, when we look at U.S. regulatory bodies, broadly defined, whether that is the FCC, the FAA, Office of Space Commerce, is they have within their power today the ability to modernize their licensing system and cut red tape and move things along more quickly. They have created, at times, too much process, too much structure. They have, at times, read a rule in the most strict sense of the word rather than a way that they can lean a little bit more towards industry side. And those are the sort of interpretations we would like to focus on.

COMMISSIONER KUIKEN: Thanks.

MR. COX: If I could just add to that --

COMMISSIONER KUIKEN: The next question is for you, Mr. Cox.

MR. COX: All right. I will just be quiet then.

COMMISSIONER KUIKEN: Your mention of, I think it is KUKA Robotics, right, reminded me of the testimony we heard in our Made in China 2025 hearing from, I think it was Liza Tobin, who used to be with SCSP. She talked about this sort of gigantic investment in advanced manufacturing that China has made. You sort of highlighted it in space.

Is it as dramatic as it sounds? Has U.S. industry not made similar investments in terms of automation? Like I have actually visited most of the SpaceX facilities have a fairly good sense of things, but I would just be interested in you sort of giving some additional views there.

MR. COX: Again, I don't think the issue is necessarily an imbalance of industry making the right investments. I think industry does, again, a pretty good job of making the investments in the right places, at the right times. It is why China copies us. The issue is that China copies us. If you were out on that SpaceX floor and Redmond, did you see what the robots were, that were assembling? Those are KUKA Robotics robots.

So the fact that China bought that company, they learned decades of how to do high-rate satellite manufacturing by simply doing -- it was a hostile takeover. They bought 95 percent of the company in one fell swoop at 50 percent over the stock price. And so with that one small investment they recovered 10, 15 years of learning.

COMMISSIONER KUIKEN: Mr. Cavossa, how much are American companies helping the Chinese space program?

MR. CAVOSSA: I am not aware today where we are helping, directly, the Chinese space program, other than through perhaps intellectual property theft and mimicry. I am not aware of any place where we are helping the Chinese government today.

COMMISSIONER KUIKEN: Thank you. I actually didn't realize I had a big red light, so I will turn it back to Co-Chair Sims.

COMMISSIONER SIMS: I just assume you have utter contempt for the clock. Commissioner Stivers.

COMMISSIONER STIVERS: Thank you. Thank you all for being here today and for your testimonies. Going back to international space governance frameworks, you know, generally we are in the situation where the U.S. is withdrawing, rejecting, ignoring international agreements across the board, and cooperation with other countries generally. But you also have the China situation, where they are taking advantage of the situation diplomatically, but also has a track record of ignoring international agreements whenever it believes it is not in their interest.

So in this context, how can we most persuasively -- and this is a question mostly for you, Ms. Samson, but please, anyone else can jump in -- how can we more persuasively make the case for the Trump administration to continue to engage in these international agreements? Is there a way or a recommendation where the private sector can more take the lead on some of these agreements, more so than they have done in the past?

MS. SAMSON: I think there is power to the U.S. government maintaining its connection with previous administrations' agreements. Something like the Artemis Accords, for example, which, as I said, is how the U.S. interprets the Outer Space Treaty principles and apply them to future peaceful exploration of space. That is a huge thing, that we have 53 countries that have signed onto it. It is a declaration that this is how the U.S. views these sorts of things and how we want to go moving forward. And a lot of countries like that vision. That is why there are so many more that have signed on to the Artemis Accords than have joined the International Lunar Research Station.

If the U.S. decides to back out of it, I mean, that is not legally binding. It is just a comment or standing. But that sends a signal that the U.S. cannot be trusted, and as I said before, that leaves an opening for China to reach in.

You know, China has got their space station now. I know they volunteered to have other countries come and be astronauts on them. They are going to have that possibility after the International Space Station is gone, less the U.S. is going to do something like that with a commercial space station, which I haven't heard anything like that. So I think that is a real concern.

And then, as well, China is using the opportunity to build outreach to other countries, using space as a soft power advantage, and demonstrating that they can provide something. And if the U.S. is pulling back on funding internationally, that is leaving a huge gap for the Chinese to come in and do that.

So again, I think this is just really short-sighted for the United States to be doing those sorts of things. Talking to international partners, they are very worried about whether they can even depend upon the United States anymore, and that gives China the chance to show that they can be depended upon.

MR. CURCIO: Just to add from my side, potentially trying to bridge the information asymmetry gap, since November of last year, for example, we have seen the Chinese version of

Starlink, this Spacesail, the Thousand Sails constellation. They have made an MOU with Telebras in Brazil. They made an MOU with Measat in Malaysia. We have seen China agree to bring a Pakistani astronaut to the Chinese Space Station. We have seen China, about a week after USAID was defunded, we saw a ChinaAid ground station unveiled in Namibia, at the Chinese embassy in Windhoek.

So making some of that clearer to the current Administration, saying, look guys, this is an accelerating trend that China is moving into not just usual suspect countries but also some other countries that are a little bit more neutral, if not slightly pro-U.S. -- Brazil, Malaysia, for example. It is concerning, to say the least.

COMMISSIONER STIVERS: Thanks. Any others?

So Ms. Samson, going back to you again, first of all, thank you for your testimony and your persuasive opposition to scientific research cuts. It is just really unbelievably counterproductive vis-à-vis the U.S. and China's competition and our entire future.

But I would like to go into your first recommendation about the Wolf Amendment, which sets an approval process for U.S.-China cooperation on space. I would be supportive of the Wolf Amendment but I am open to be persuaded on revisions. It seems that simple dialogue between and U.S. and China could continue as long as it goes through an approval process through the FBI, so that we are not sharing sensitive technology and the like. How should it be revised, and how can you make the case that cooperation between the U.S. and China would produce anything significant?

MS. SAMSON: Thank you. So, I mean, you go back to why the Wolf Amendment was created in 2011. There were a couple of things. There was concern about IP theft. There was concern about cyberattacks. There were concerns about China's human rights violations. So they said, look, we are not going to prevent the United States from doing -- actually, at that point, the U.S. was thinking about getting China on the International Space Station. So they said, look, we are not going to prevent the United States from doing bilateral thing with China, but basically it says that the White House Office of Science and Technology policy, the National Space Council, NASA cannot do bilateral activities with their Chinese counterparts unless, as you said, they have notified the FBI, they have notified Congress, they ensured they are not working on the human rights violators, and they report a certain time ahead of time.

So it is not that it prevents it but it provides, as I said, a speed bump. It slows it down.

And then you look at that and you say, what has actually happened. A lot of U.S. institutions are actually afraid to do anything with China because they are worried that that will affect their ability to have U.S. government funding or grants. So we lose out on the opportunity of this cross-technological building.

During the Cold War, the U.S. and the Soviet Union had scientific outreach so they could maintain a foundation, a relationship, that allowed for at least some understanding and communication that can help deescalate things if they go possibly elsewhere.

And then looking at what China's space program has done, we all know China's space program has grown tremendously. This has done nothing to slow it down. Basically, all it does is it sends a sign that the United States is finding difficulty in working with the other preeminent space power.

I think a lot of people don't realize, Russia is a failing space power. Their civil space program is in tatters. They don't have a commercial space program. The military space is the only thing that they really have.

So really, the U.S. is cutting itself off by not being able to coordinate, at least. We have to

be able to coordinate with the Chinese. We are both launching very large constellations. We don't have any way to communicate, really, about when these satellites are changing positions. We are both looking at going to similar places on the moon, and that is going to be a concern in terms of lunar dust, in terms of making sure if there is any kind of interoperability for human safety. We need to be able to coordinate on these sorts of things.

And so I think there are missed out opportunities, both in terms of how we can strengthen the U.S. space infrastructure, but also it sends a diplomatic message that the Chinese use against us to justify why they don't have to cooperate with the United States at all.

And again, we keep doing our adversaries' work for them. We hand them the language that they can use as a noose around our throats.

One of the other things I will do -- I know I am over -- one of my recommendations was that we needed to stop referring to space as a warfighting domain. Is it an operational domain? I think that makes total sense. By using space as a warfighting domain, again, we are doing our adversaries' work for them. We are saying, "Here. Here is the language to portray the United States as the bad one, as the one that is weaponizing space." And then they use that in these international discussions that the United States needs to be able to make sure that we understand what responsible behavior is, to argue to other countries, to developing countries, that the United States is not acting in good faith and they should not listen to us. Thank you.

COMMISSIONER STIVERS: Thank you.

COMMISSIONER SIMS: Thank you. The Chair recognizes Commissioner Brands.

COMMISSIONER BRANDS: Thank you. Just on this same subject, Ms. Samson, and anybody else who would be interested in answering this, it strikes me that the discussion we are having about engaging the PRC on space issues, it seems to parallel in some ways to discussions we have about engaging the PRC on a whole range of issues, so military-to-military ties, where there would seem to be obvious benefits from a U.S. perspective of having these discussions.

I am curious. Do we get a sense that there is a demand signal on the Chinese side for this, and is there any reason to be concerned that the PRC might take a different approach to this sort of engagement, whether as an intelligence phishing exercise or anything beyond sort of a good-faith sharing of information and attempted deconfliction?

MS. SAMSON: I mean, China is part of these discussions at the United Nations and COPUOS. They have got a working group on space resources that they have been a part of, and they just started an action team, and China is very much a part of that. So they understand there is a need to be able to deconflict a lot of these sorts of things. Their participation in these working groups indicates that they understand governance has a role to play and that they would like to be part of that, and they want to help shape that conversation.

So that is why I think it is really important for the U.S. also to participate, which we are right now, to continue to participate in these international discussions. Because this is where the decisions are being made, and these are where the conversations are being had. If we want to make sure our interests are looked out for, we need to be part of these discussions about space resource use and things of that nature.

I don't necessarily if the Chinese have reached out about bilateral coordination. I think, again, they may not see it in the Wolf Amendment that there is any point of doing so. But there have been bilateral discussions amongst our DoD, Ministry of Defense, and our State Department, Ministry of Foreign Affairs. So there is some interest there.

And I think, again, if you look at what they are planning for the International Lunar Research Station, they are looking at a lot of the similar things that we are trying to establish on

the moon, and it makes sense. Their principles are very similar to the Artemis Accords principles. Again, they are working with the same laws of physics. They are working with the same legal structure started by the Outer Space Treaty. So they have similar interests, and I think it would be foolish of them not to want to coordinate with the United States, because we are going to be the two lunar space powers. Thank you.

DR. ALKIRE: I just wanted to maybe push back slightly on the concept of stop referring to space as a warfighting domain. The importance of international cooperation and engaging the Chinese aside, that is all important. But let's remember that China also has defined space as a warfighting domain since 2015, and China's military leadership tends to exaggerate the capabilities that we have and how we might employ them. And I think we would have little chance in messaging to them otherwise. They will continue to see us as viewing space as a warfighting domain, even if we message to the contrary.

MR. COX: I would second that view, we can continue to splice our language but it won't matter. I would also, you asked a question specifically about military-to-military. I think our historical experience on that is it is inherently stabilizing if we can do it right. I think the challenge that you have, particularly on the space side with China, is making sure we make those connections at the right levels. And just as an example, when they blew up their own weather satellite, that General Salzman referenced, in 2007, it wasn't abundantly clear that that was as well staffed as it would have been here in the United States.

So knowing where to plug in and who to talk to, who has the right balance of both strategic and national-level policy as well as the tactical implementation of that is incredibly complex. And so getting it right is really important.

COMMISSIONER BRANDS: Just one more question. Ms. Samson, you mentioned Russian plans to put nuclear weapons in space during your testimony, and based on what I read I understand there was some hope in the U.S. government at that time that that would create friction with the Chinese who might weigh in and tell the Russians this was a bad idea. Just based on your understanding, is that a meaningful point of friction between Russia and China in the way that they view space?

MS. SAMSON: I haven't seen any statements by Chinese government officials on this specifically. The only thing I can point to is, like I said, their votes in the U.N. at both the Security Council and in the General Assembly. It is my understanding, again, to be clear, Russia has never acknowledged that they are doing this. In fact, they have denied it. It has been U.S. intelligence that has come up and said that they understand that Russia is developing the nuclear warhead with the intention of using it in an anti-satellite capacity from the EMP that would be released from a detonation.

But it is also my understanding that when this was being first talked about, the U.S. did reach out to India and to China and say, "Can you talk to Russia?" because they would stand to have a lot to lose.

I will point out that right now there are about 11,500 active satellites, of which the U.S. has about 8,000, roughly, maybe a little more than that. China has about 1,000. Russia has about 320. Russia has a lot. I mean, they would lose stuff and they have got people up in the Space Station, but they have a lot less to lose, whereas China and India both have invested more. But again, nothing specifically that they have said about that.

COMMISSIONER BRANDS: Thank you very much.

COMMISSIONER SIMS: Commissioner Schriver.

VICE CHAIR SCHRIVER: Thank you, Mr. Chair, and thank you to our witnesses. I

appreciate your testimony. I learned a lot. I have a specific question or two and then a general question for the panel.

Dr. Alkire, I might start with you and invite you to, if you would like, to go into a little more detail on one of your recommendations. You said take a broader view, study dependencies, and try to exploit the vulnerabilities that China might have where they are dependent and mitigate risk where we are dependent. But you kept that at a pretty general level. Where might that lead us, and what are the types of things that you would expect would result in such an analysis, and where you would want to invest?

DR. ALKIRE: Certainly. I mean, I think the notion of striving for dominance or superiority is glib. It needs to be a very nuanced discussion, particularly when we talk about specific warfighting scenarios in the Indo-Pacific, the high-end scenarios that are priorities for our government. You know, what are the dependencies and when during a conflict?

And if you are going to strive for space superiority, what does that mean? Does that mean you are going to hold all of your adversaries' satellites at risk, irreversibly, instantaneously? Is it the ability to hold at risk flexibly, through reversible means, or if necessary, through irreversible means? What are the timelines associated with that relative to what is happening in the broader joint war fight?

So I think it is really important for us to understand, from a military perspective how space is contributing to our broader joint or coalition war fight and China, and understand what those dependencies are and when. And then use that much more detailed look to be able to prioritize, what are those investments in resilience that we need in the United States in order to have robust architectures to provide us the space capabilities we depend upon, like, for example, position navigation and timing systems.

What are some of China's key capabilities? I think General Saltzman had talked about their intelligence in surveillance and reconnaissance as part of their kill chains, kill webs, kill meshes, what have you, in the Pacific. Our analysis kind of shows the same thing. I talked about China being the only country that has a synthetic aperture radar satellite in geostationary orbit. There are other ISR satellites and other parts of the kill chain that integrate with that.

So understanding what are the key dependencies there for China and be able to hold those at risk, if necessary. And it is not that we will necessarily deny, degrade, or attack those capabilities. Our hope is always for deterrence.

VICE CHAIR SCHRIVER: Thank you. I appreciate that. And I do think demonstrating you hold something at risk is all about deterrence, not a desire to necessarily engage in that way.

Speaking of engagement, so I wanted to pick up this point about potentially engaging bilaterally with the PRC. Having been in charge of the U.S. mil-to-mil relationship with China on a couple of different occasions, I think my enthusiasm is a bit in check on this. But I understand the points about they are engaging in international fora, they are the other major space power, and an emerging one. I understand all that. So rather than try to litigate that with you, there were comments made about plugging in at the right place, the right people, and basically constructing the right conversation with the Chinese bilaterally.

So if we could get the right Chinese official to come visit the United States and lead a bilateral dialogue, who would it be, or if that is too specific, what organization do we want to plug in, and what would the agenda be at an initial meeting or a quick follow-on meeting, after the introductions?

MS. SAMSON: I can't speak to who exactly would be there, but I think we would be looking for science, you know, scientific research, looking at exchanging information about

space weather, and exchanging information about orbital data, exchanging information about robotic space exploration, that sort of things. So probably CNSA and whoever else conducts that sort of thing there.

But I think just accessing the tremendous amount of investment that they have made I think would strengthen the U.S. space system, and it would also be helpful from like a space traffic coordination circumstance to be able to share that kind of information. This is not secret information.

One of the things that has always frustrated me for the U.S. national security space establishment is it tries to classify the existence of objects in space, and basically anyone with a telescope or even a good iPhone can identify objects in orbit. It is not a secret anymore. But it is helpful to have that kind of coordination so that you we are not running into each other.

So I think that is where I would focus on, starting at the basic level of doing scientific data exchange and information for space flight safety and allowing ways in which for the commercial operators to also share best practices that they have developed. That would be very helpful too.

VICE CHAIR SCHRIVER: Anybody else on that point? Has anybody got an interlocutor in mind?

MR. CURCIO: Just a couple of ideas. I think the large, non-geostationary communication constellation operators, so the Spacesail comes to mind, China Satellite Networks Ltd. would come to mind as well. these two companies are planning to launch thousands of satellites over the next few years. It is going to be important from a space traffic management perspective.

The companies I mentioned during my testimony, So Chang Guang, CGSTL, they have a couple hundred satellites in orbit. They continue to launch a lot of satellites. So again, they represent maybe 15, 20 percent of all Chinese satellites on orbit today.

CASC, the large, state-owned space conglomerate, they still represent most of China's launches today. They are sending 60, 70 rockets into orbit per year, that that number will only go up as they start to do reusable rockets.

So those four entities come to mind as, let's say, the most logical four in terms of just putting the most stuff up there into space. Yeah, and at least two of them are nominally commercial companies, which may or may not make it a little bit easier, from a Chinese side perspective, and also maybe from a U.S. perspective, to have those kinds of dialogues.

VICE CHAIR SCHRIVER: Thank you. May I ask one final question?

COMMISSIONER SIMS: Please do.

VICE CHAIR SCHRIVER: With 22 seconds. I was going to do rapid fire but maybe we will just, whoever wants to --

COMMISSIONER SIMS: Take your time. I mean, once Kuiken just goes wild and blows through the time, it is anything goes.

VICE CHAIR SCHRIVER: Well, I was going to ask, let's say a miracle happened and Congress said, "You can spend unlimited amount of money." Probably not going to happen in this environment, but "I will give you an unlimited amount of money, but you can only spend it on one thing." What would you spend it on?

COMMISSIONER SIMS: At least you made it a good question.

MR. CAVOSSA: I mean, given some of the comments from General Saltzman earlier, and our testimony one of the big things we worry about on the industry side is lack of launch infrastructure and resiliency. We are very much single-threaded through two launch facilities today in the United States, for the most part, and additional funding is needed to build up more

spaceport infrastructure.

DR. ALKIRE: I am going to cheat and give you two. One is continuing the track of acquiring resilient architectures, so you don't need new money if we just continue on that. So that is how I am cheating.

But I would say space domain awareness and command and control are becoming increasingly important for space operations, and those, at least near term, probably ought to be priority areas.

MR. CURCIO: Yeah, from my side I think it is a little bit cheating, as well. It is a pretty broad category. But a broader variety of commercial contracts. One thing that worries me right now in the U.S. is that we are very much a space industry that is SpaceX and Starlink, and then everyone else is pretty far behind those two. And if we look at the Chinese commercial space industry, I always say, yeah, SpaceX is far ahead of the top Chinese commercial launch company. But if we look at the number 3, number 4, number 5, number 6 commercial launch companies, it is not so clear. And then if we look at the number 40 commercial launch company, like there is no number 40 commercial launch company in the U.S. Maybe there doesn't need to be one.

But there is a much broader and deeper commercial space sector in China than we realize, and I fear that is going to be a problem when we only have like SpaceX and Starlink as our two far and ahead leading companies.

MS. SAMSON: I agree with Brien about SSA and Blaine about needing to deepen the U.S. commercial sector. One of the things that really struck me when the Falcon 9 stopped working last summer is just basically U.S. launch stopped for a while. You know, it was commercial, this is military, and there were ripple effects down the line.

But if I were given the opportunity to say, okay, Congress is going to give us unlimited resources, financial resources, focus on active debris removal. There is no U.S. entity in charge of that. The U.S. hasn't really done a lot of that. Even the Europeans and the Japanese have invested money in doing missions that look at this sort of thing. The Space Force has done just some nominal, very small contracts, and frankly, the optics of the U.S. military space organization doing that is not great, given the dual-use nature of active debris removal. But it needs to happen. It is essential to being able to continue to utilize space, and the U.S. government should be an anchor tenant in any kind of active debris removal stuff. Thank you.

MR. COX: I am going to try to cheat more than anybody at this table. I don't know if that is a competition or not. So first off I would say we are not going fast enough in building resilient architecture. So if we want more money, we have got to put more money towards it. The only real architectures that we have made resilient by design are missile warning, missile tracking, our satcom architectures, and we are just now starting on GPS. There are a whole host of things that we haven't touched, that still have that giving China the first mover advantage that the Chief talked about earlier. You can't do that without fixing launch. You can't proliferate without fixing launch.

The second thing I would do is focus on how do I hold my adversaries' capabilities at risk. The Chief talked about that, as well. We have very, very scant investments in offensive and defensive space control that can hold our adversaries capabilities at risk. That is the second big investment, and you can't do that without SSA.

VICE CHAIR SCHRIVER: Thanks. I think I beat Kuiken in the longest questions today.

COMMISSIONER SIMS: Next, our wonderful Commission Chair, Commissioner Price.

CHAIR PRICE: Thank you, and thank you all for your testimony today. This is so

interesting. I wanted to start with Mr. Curcio, although you just began to answer the question, in response to Commissioner Schriver. I wanted to go back to your recommendations, which you put in your written testimony but didn't get a chance to do in your spoken testimony.

The first question I was going to ask was for you to expand on the need for broader space industrial base, but you just did that. If you have anything else you want to add to that, that would be great.

But I also want you to go back to your fourth recommendation about a more unified and better organized space strategy, what you would particularly see, and if you could talk about that for a moment.

MR. CURCIO: Sure. Thank you very much for reading the written testimony. Good to know that you do. I don't have much to add on the need for a broader space industrial base. I think that is really the idea, is that, yeah, we need more than just SpaceX and Starlink. We can't just be reliant on these two companies, controlled by one person.

In terms of more unified and better organized space strategy, my ignorance may be showing a little bit. I am not so familiar with the U.S. strategy formulation process, in general. I am much more familiar with China, as it would turn out. I see, on the Chinese side, a lot more national-level strategies that trickle down to provincial governments and city governments and district governments, in many cases. And you can see the way that national priorities are almost used as like a signaling device, where as soon as the national government says something, a lot of different entities down the chain mobilize into action relatively quickly. And relating to what I mentioned earlier in my testimony, like this provincial government and the Chinese Academy of Sciences subsidizing, providing tech transfer to this remote sensing company. I mean, that is at least, in part, related to national government priorities around things like "digital China," they call it, which is trying to build a 3D map of China using, among other things, remote sensing satellite data.

So the government is saying we want to have this capability or this concept, Belt and Road being another example, where they say, "We want to have more international collaboration," and that sort of acts as a signaling device for sub-national governments and commercial companies and the state-owned enterprises to do these things.

Maybe a better way of summarizing that point is just having a clearer process by which priorities made at a national government level are actually reflected in reality, or in states or cities or companies down the chain.

CHAIR PRICE: Thank you. Mr. Cavossa, the whole public-private partnership when it comes to space is just different than in what we have done in the past. Can you talk a bit about how your industry sees that partnership, what would be the perfect balance, where we need to work harder? But what you would see as the balance there.

MR. CAVOSSA: Sure. I mean, we can talk about it in the form of a couple of different customers. So the U.S. Department of Defense has become very reliant on commercial industry for satellite communications and remote sensing, and entirely pretty much reliant for launch. So those are good case studies where the DoD, U.S. government, Space Force, has said we are going to rely as heavily as practical on commercial and use firm, fixed-price contracts and competitively bid and milestone based procurements.

NASA, on the other side, on civil space, has moved out on that in a handful of areas, as well, with things like commercial crew and commercial cargo contracts in the past. And they are looking at new procurements right now, where they are looking at, okay, instead of building something, this spoke, government only on a cost-plus contract basis, let's look at firm fixed

price. Let's look at milestones and competitive contracts.

So we are trying to, just as an industry, get the entire Federal Government, U.S. government, to say you don't have to build everything yourself, and that firm fixed price is a much better approach generally than cost-plus contract when it comes to commercial industry. We can move faster, and we can provide, generally, 90 percent of the solution for, I would say, 50 percent of the cost, when we are doing this sort of public-private partnership approach.

Did that answer your question, or did I miss it?

CHAIR PRICE: Yeah. Well, somewhat. Just as we try and find that right balance, that is the question. And there are pros and cons on both sides. And what are we missing when it becomes all government. What are we missing when it becomes all private. The Chinese have a very different model, so they can just sort of open the playing field in a very different way. So just trying to figure that out.

MR. CAVOSSA: Yeah, and I would argue that, based on what we are seeing, the Chinese are doing both at the same time right now. They have their state-owned enterprises where they are very much supporting those entities, and they have encouraged a lot of commercial entities to try to build public-private partnerships in the country, and outside the country. So they are moving forward on that.

And I would say, overall, the U.S. is doing well in public-private partnerships. But, of course, we are biased. As commercial space, we would like every procurement pretty much to be a commercial procurement.

CHAIR PRICE: Does anyone else have any thoughts?

MR. COX: Yeah. I would just amplify it to say maybe we should be looking at how China does it, because they are very, very creative. And finding more opportunities like the Space Flora Commission, where there is a strong partnership between the state and industry, try to bring specific industries to the state, not that much different than how China does it provincially, that some of our panel members have talked about.

So can we create opportunities where there are pockets of investment being made that align with a national strategic objective, but bring, no, not that much different than China, where they have the G-60 Starlink corridor, or they have focused on high-rate satellite manufacturing. How can we sort of mimic those operations to create centers of excellence across the country where we can draw talent, we can create industries, help work on infrastructure like launchpads and those kinds of things. I think we can do a lot more.

CHAIR PRICE: Anyone else?

DR. ALKIRE: I just wanted to add, there was some discussion about the importance of not going with a single source, like SpaceX or Starlink, for industrial-based reasons. But there is another thing, which is there are advantages to resilience in doing that. If you have, let's say, a communication terminal for a military platform that can not only talk to Starlink but can talk to other commercial systems or military communication systems, that creates additional complexities for adversaries trying to degrade or deny that capability. So there are resilience benefits as well as industrial-based considerations.

CHAIR PRICE: All very helpful. Thank you.

COMMISSIONER SIMS: All right. To the man who continues to celebrate Liberation Day, even the next day, Commissioner Miller.

COMMISSIONER MILLER: Thank you, and thank you to all of you. You have had excellent testimonies today.

One of the things I have been very surprised by is that we spent a half a day talking about

space, and I don't think we have brought up the idea of critical minerals. If you got to the moon, there are a lot of critical minerals there. If we land on Mars, there are a lot of critical minerals there.

I am very interested in this issue on two different points. The first is, we land on the moon, we land on Mars, are there treaties right now that even pretend to govern what we are allowed to hoover up, what we can call our own? I know there have been. How do we handle this right now?

And I am even more interested, the second part of this question, which is half this discussion has been about how do we incentivize commercial firms to be involved in these public-private cooperations, cooperative endeavors. What are the pros and cons of allowing commercial firms to be involved in owning some of these critical minerals? Is this part of the debate right now? Is it something that is being pushed by industry? Is it a terrible idea?

I would love it if you could make us smart on one or both of these issues. We can start with Mr. Cox, if you would like, Mr. Cavossa, anyone who is interested in answering either of these questions.

MS. SAMSON: I mean, I can just talk about the big picture. The Outer Space Treaty doesn't really say anything about critical minerals or space resources, but Article II says you cannot appropriate space or space resources. So there has been a debate internationally about what does that mean when it comes to space resource views. If you are not allowed to appropriate in space, does that mean, can you use resources? The U.S.'s policy is that yes, you can, and a lot of our European colleagues have said no, you cannot. So there has been that dispute.

The discussion in the United Nations and in COPOUS, the legal subcommittee, they have been taking up a space resource working group, where they talk about this sort of things, and trying to get a common understand. That is why something like the Artemis Accords has been so helpful, because basically it does have a carve-out and talks about space resource use and that sort of thing.

As well, and I talk about this in my written testimony, the Chinese submitted a paper to the legal subcommittee last year talking about how they saw space resource use, and they are open to it. They are open to there being civil actions on the moon, and they said the commercial sector, they are not against it. They just would like to have some discussions, again, a common understanding about what entities are allowed.

And then on your question about commercial sector, is there any discussion about them being involved in this, not necessarily, but I think that is part of the broader conversation about mission authorization. Under Article VI of the Outer Space Treaty, nations are required to authorize and continually supervise the actions of their national actors. So as we evolve our use of space, and as the commercial sector is doing new things, one of the big things is trying to get mission authorization. I will point out a case where that was not happening, and that was actually pretty controversial.

Last year there was a U.S. commercial company, Astrobotic, was going to be going to the moon, and they were carrying a bunch of payloads with them. One of them included human cremains, cremated remains, and they were going to dump it on the moon. There are some people that found that offensive. The moon is a sacred place to some cultures, and they said, "We do not want human cremains there." And they said, "Hey, why isn't anyone taking care of that? Why did the U.S. government allow that?"

And there is no one authorized to do those kinds of payloads. Right now they are working

on mission authorization. NASA doesn't have anything to say on that. It is the commercial sector.

And so the question is, if you are going to be having commercial companies being involved in using the space resource use, getting mission authorization, clarified of who is in charge of monitoring that sort of thing, and authorizing that, that is going to be key to allowing that to work. Thank you.

COMMISSIONER MILLER: Anyone else?

MR. CAVOSSA: I will just add, sir, that critical resources, critical minerals, moon, Mars, asteroids, these are all things that are very much, I think, in play, I think in our lifetime we will see. My member companies are very interested in this sort of thing, and it is sort of unsettled in international law, I think, on where folks stand on this, as Victoria said. In Europe it is viewed one way, and in the United States it is viewed in another.

But during our lifetime, we will be seeing robots or landers on the moon, on Mars, and other places, either using it for in situ resource utilization or with the hope, I'm sure, of bringing it back, and it is something we all should be very focused on. If we don't do it, China will inevitably head down that path.

COMMISSIONER MILLER: So can I say it is a consensus judgment of many of you, if not all of you, that commercial firms being incentivized by getting some sort of share of these mineral deposits is something that is advisable, or is it deserving of more consideration? I am trying to get an idea of this, and not just where things are going but where things should be going.

MR. CAVOSSA: I think where it should be going, yes.

COMMISSIONER MILLER: Let me move on to the next one then, the next question. General Saltzman, we had asked him earlier about quantum communications, because it was one area in which the United States seems to be lagging behind the Chinese. With all this talk of public-private cooperation, is there something we could do to supercharge this cooperation in the United States in order to get back on track to compete with the Chinese on quantum satellites?

DR. ALKIRE: I will take a little bit of that. I am not an expert, necessarily, in quantum technology, but as you are aware, sir, there are many different kinds of quantum technologies -- quantum computing, quantum sensing, quantum communication. I am not aware of anything that is preventing the U.S. from being competitive in that. If it is a priority, my understanding is that, at least from a Department of Defense perspective, some of the other quantum technology areas have tended to be higher priority -- quantum sensing, followed by probably quantum computing.

So could we compete well if there was interest in it? I have no reason to think we couldn't.

COMMISSIONER MILLER: Any ideas on particular ways of doing it? All right. We will continue to noodle on that.

DR. ALKIRE: We need a clear application. I understand what benefits that quantum communication brings, you know, the inability to eavesdrop without it being detected and the link being broken, et cetera. I am also aware that there are significant challenges with it. In order to do it over very long ranges you need quantum repeater capabilities. Otherwise you have to rely upon classic computing, and that sort of breaks the benefits, if you will. It creates nodes that an adversary could go after with cyber means, as an example.

So there are still challenges that China and anyone else doing work in this area face, not that they won't eventually overcome it. But I think there has to be a clear application for it to drive the development.

COMMISSIONER MILLER: Thank you.

COMMISSIONER SIMS: Commissioner Friedberg.

COMMISSIONER FRIEDBERG: Thank you very much, and thanks to our witnesses. Really excellent and informative testimony.

Mr. Curcio, I wanted to start with you. It sounds like you are describing sort of space industrial policy, which in many ways seems to resemble China's industrial policies in other domains. You let 1,000 flowers bloom, let a whole bunch of companies emerge, let them sort of fight it out and compete amongst themselves, and then the winners emerge from that process.

But I wonder, in this case, what is it exactly that is going to determine who the winners are? What makes the market? Because if it is electric vehicles, presumably it is millions of Chinese customers or international customers. In this case, who is on the other side of this equation?

MR. CURCIO: Thank you for your question. I think the emergence of the broader commercial space industrial base is leading to chances to create winners and losers, as it were. So for example, which launch companies out of the 40 or 50 might become the winners. The ones that are, I guess, winning contracts with a growing number of commercial satellite manufacturers that are typically funded by certain provincial governments, as we talked about earlier, and then who are doing successful launches.

We have seen Galactic Energy is certainly the most well-established commercial launch company. They have sent 18, 19 rockets into orbit, carrying something like 75, 80 satellites. And they have found a decent handful of customers that are varying flavors of commercial. And the same applies if you are a satellite operator, for example. You have satellite operators that have been able to bring solutions to typically provincial governments, city governments, let's say.

So remote sensing, to take an example. You have had remote sensing companies making contracts with provincial forestry bureaus or provincial agriculture bureaus, to actually use their remote sensing data for various real-world applications.

And it has happened in steps, because I think there is a certain level of hesitance by provincial governments to give contracts to companies that are not proven. There is a certain chicken-and-egg element. But again, you have a lot of high-level support, a lot of financial support, a lot of technology transfer and that type of support that is all feeding into these companies that are, step-by-step, starting to develop real-world capabilities.

So I think if we compare now to, say, 7 or 8 years ago, there is a much more well-developed market, for lack of a better term, for some of these companies to actually show off and sell and prove their services, and that process has started to lead to winners and losers. So it has been a little bit of an organic process, but obviously with a whole lot of government and other financial support.

COMMISSIONER FRIEDBERG: So all of the customers in your story are Chinese. Is that right?

MR. CURCIO: The vast majority, yes, but there have been a limited number of international customers that have launched satellites on some of these rockets. Oman, for example, recently launched a satellite. Well, China recently launched a satellite for Oman, I should say. And there was a Chinese commercial company involved in the manufacturing of that satellite. But yes, in general, the overwhelming majority of the demand right now is coming from China.

COMMISSIONER FRIEDBERG: Okay. Thank you. Mr. Cox, in your really interesting discussion of this explosive development of China's space industrial base you, I think in your

testimony, you draw a parallel to the Huawei story. And I wanted to ask, how do you think about the implications down the line of China's development of a massive global internet space-based network? Is this going to be a space-based equivalent of 5G, where China is going to provide connectivity for maybe primarily for countries in the developing world, and is therefore going to have the potential ability to surveil, to monitor communications, maybe to interrupt those under some circumstances?

MR. COX: That is exactly what I am implying. I don't know that I could have said it any better. I think I would also add that the parallels with Huawei are amazing, but they actually extend a little bit. Because in this particular case, as you probably recall, we had to work with our Western partners to say, hey, you may not want some of that infrastructure in your national networks because it has got a back door. So we had to kind of pluck it out.

The difference with space is it is really hard to pluck it out. I mean, they are transmitting inside our boundaries. As we extend this space internet to things like direct-to-device, like where I am communicating via S band to one of these things. Now the network is inside the fence lines. And so if we don't consider that serious, we really should.

Now, that is not to say that it shouldn't exist, but if we are not paying attention to it and we are not realizing that this is really about a strategic competition to enable access, and enable access freely, then we are missing the boat.

COMMISSIONER FRIEDBERG: Do you have any estimate of what the additional coverage would be? So there is some portion of, let's say, the developing world where people do have access to internet, presently via terrestrial means. How many more people are going to be added, potentially, by these space-based networks? Is it a billion? Two billion? Three billion? What is the impact of this?

MR. COX: Yeah, it is certainly in the billions. The ability to provide 200-plus megabits per second down to anywhere on the Earth, that is a huge, and a necessary, improvement in the lives of the global population. So having that ability to do it, with thousands of satellites, that is really where the competition begins.

COMMISSIONER FRIEDBERG: Last quick question. How many U.S. or Western competitors are there who are working towards providing some kind of similar service?

MR. COX: I will let you answer that.

MR. CAVOSSA: Sure. I mean, I can think off the top of my head of five or six companies today launching satellites into low Earth orbit that would rival that system. And then in addition to that, sir, there are dozens of satellite communications providers in geostationary orbit that are already in the hundreds of satellites that cover the whole Earth multiple times over. So there are many U.S. and European and Western providers today to compete.

COMMISSIONER FRIEDBERG: Thank you.

COMMISSIONER SIMS: Thank you all.

In closing, thank you again to all our witnesses for their excellent testimonies today. You can find those testimonies as well as a recording of the hearing on our website. I would like to note that the Commission's next hearing will focus on China's domestic energy challenges and China's growing impact on global energy markets.

And with that we are adjourned.

[Whereupon, the above entitled matter went off the record at 1:05 p.m.]

QUESTION FOR THE RECORD

RESPONSE OF BRIEN ALKIRE, SENIOR OPERATIONS RESEARCHER, RAND

The Expansion of China's Military Space and Counterspace Capabilities and Implications for Space as a Contested Domain

Addendum

Brien Alkire

CT-A3951-2

Document submitted April 23, 2025, as an addendum to testimony before the U.S.-China Economic and Security Review Commission on April 3, 2025

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The Expansion of China's Military Space and Counterspace Capabilities and Implications for Space as a Contested Domain

Testimony of Brien Alkire[1]
RAND[2]

Addendum to testimony before the U.S.-China Economic and Security Review Commission

Submitted April 23, 2025

Following the hearing on April 3, 2025, the U.S.-China Economic and Security Review Commission sought additional information and requested an answer to the question in this document. The answer was submitted for the record.

Question

In your testimony, you highlighted the importance of understanding specific U.S. and Chinese dependencies on space for joint warfighting. For China, please highlight current PLA dependencies on space for joint warfighting and how does the PLA perceive their own vulnerabilities for these dependencies? And what are the trend lines based on the capabilities they are currently fielding? Please provide examples.[3]

[1] The opinions and conclusions expressed in this addendum are the author's alone and should not be interpreted as representing those of RAND or any of the sponsors of its research.

[2] RAND is a research organization that develops solutions to public policy challenges to help make communities throughout the world safer and more secure, healthier and more prosperous. RAND is nonprofit, nonpartisan, and committed to the public interest. RAND's mission is enabled through its core values of quality and objectivity and its commitment to integrity and ethical behavior. RAND subjects its research publications to a robust and exacting quality-assurance process; avoids financial and other conflicts of interest through staff training, project screening, and a policy of mandatory disclosure; and pursues transparency through the open publication of research findings and recommendations, disclosure of the source of funding of published research, and policies to ensure intellectual independence. This testimony is not a research publication, but witnesses affiliated with RAND routinely draw on relevant research conducted in the organization.

[3] All questions are presented verbatim as they were submitted to RAND.

Answer

China expects future conflicts to be fought mostly outside its borders and in the maritime domain,[4] and China will depend on space-based assets for a wide range of military applications.[5] The People's Liberation Army (PLA) expects space to play an important role by enabling long-range precision strikes, and PLA writings highlight the benefit of near-real-time shared awareness of the battlefield in enabling quick, unified efforts to seize tactical opportunities; space-based systems will play an increasingly important role in support of these goals.[6]

Three space mission areas that are especially important for enabling long-range precision strikes are (1) intelligence, surveillance, and reconnaissance (ISR) for enabling long-range targeting and damage assessments; (2) satellite communications for sharing targeting information and command and control of forces; and (3) positioning, navigation, and timing (PNT) services from space for enhancing the precision of long-range fires. Today, the PLA benefits from hundreds of satellites capable of providing ISR with optical, multispectral, radar imagery intelligence (IMINT) satellites and radio frequency sensors, increasing the PLA's ability to detect U.S. aircraft carriers, expeditionary forces, and air wings.[7] Interestingly, China has a few IMINT satellites in geostationary orbit in the Indo-Pacific at an altitude of 35,767 kilometers, including the Yaogan-41 optical satellite and the Ludi Tance-4 synthetic aperture radar satellite, both launched in 2023.[8] This would be a very unusual orbit for IMINT satellites in civilian or commercial applications because the high altitude (and therefore long range) would severely limit the resolvable distance between features in the imagery products.[9] In most applications, it is much more common to place IMINT satellites in low earth orbit (LEO) at altitudes typically around 600 kilometers to reduce the resolvable distance of features in the imagery products. However, the resolvable distance for the Yaogan-41 and Ludi Tance-4 may be adequate for imaging very large objects, such as aircraft carriers, and the geostationary position of the satellites provides persistence as compared with LEO. Hence, the PLA likely depends on these satellites for persistent monitoring and potentially targeting U.S. aircraft carriers in the Indo-

[4] Defense Intelligence Agency, *2022 Challenges to Security in Space: Space Reliance in an Era of Competition and Expansion*, 2022, p. 9, https://www.dia.mil/Military-Power-Publications/.

[5] Corey Crowell and Sam Bresnick, *Defending the Ultimate High Ground: China's Progress Toward Space Resilience and Responsive Launch*, Center for Security and Emerging Technology, July 2023, p. 1, https://cset.georgetown.edu/publication/defending-the-ultimate-high-ground/.

[6] Defense Intelligence Agency, 2022, p. 9.

[7] Headquarters Space Force Intelligence, "Space Threat Fact Sheet," U.S. Space Force, February 21, 2025, p. 1.

[8] Clayton Swope, "No Place to Hide: A Look into China's Geosynchronous Surveillance Capabilities," Center for Strategic and International Studies, January 19, 2024.

[9] For background information about ISR, including equations for relating resolvable distance to range for imagery, see Jon C. Leachtenauer and Ronald G. Driggers, *Surveillance and Reconnaissance Systems: Modeling and Performance Prediction*, Artech House, 2001.

Pacific region. China's IMINT satellites are being augmented with electronic reconnaissance satellites that monitor radar and radio transmissions.[10]

As described earlier in my testimony, China increased its number of communication satellites by a factor of 12 in the past eight years, and China has multiple efforts to field resilient, proliferated LEO communication satellites similar to Starlink. The PLA likely depends on communication satellites to convey critical targeting data to Chinese military operations centers that are beyond line of sight.[11] China's BeiDou PNT satellite system achieved full operational capability in 2020. The PLA likely depends on this PNT system to enable long-range precision fires and to provide a communication capability for command and control of forces.

China's leaders assume great malice and great capability when assessing threats posed by the United States in space,[12] and the PLA's perception of the threat that the U.S. military poses to China's satellites can be inflated by the exaggeration of U.S. capabilities. For example, PLA researchers insist that Starlink satellites carry a wide range of counterspace payloads for reversibly or irreversibly targeting satellites.[13] How China reacts to the threat to space that it perceives from the United States may shed some light on how China perceives the vulnerability of its dependencies. Consider the Chinese reaction to Starlink. As mentioned in my testimony, Project SatNet is a national priority that would provide China with a capability similar to Starlink. The development of Project SatNet is likely motivated by the fear of falling significantly behind U.S. capabilities in space but also is likely intended to provide China with a countermeasure to the perceived threat posed by Starlink.[14]

The PLA will likely continue to field resilient architectures for the space systems it is highly dependent on, such as ISR, communication satellites, and PNT satellites. An example is the Project SatNet proliferated communication satellite effort. China will likely continue to develop a flexible portfolio of counterspace capabilities or capabilities that could provide dual-use as counterspace capabilities. Recent demonstrations of on-orbit inspection and repair satellites are an example of the ongoing development.[15]

[10] Defense Intelligence Agency, 2022, p. 11.

[11] Defense Intelligence Agency, 2022, p. 11.

[12] Howard Wang, Gregory Graff, and Alexis Dale-Huang, *China's Growing Risk Tolerance in Space: People's Liberation Army Perspectives and Escalation Dynamics*, RAND Corporation, RR-A2313-2, 2024, p. v, https://www.rand.org/pubs/research_reports/RRA2313-2.html.

[13] Howard Wang, Jackson Smith, and Cristina L. Garafola, *Chinese Military Views of Low Earth Orbit: Proliferation, Starlink, and Desired Countermeasures*, RAND Corporation, RR-A3139-1, 2025, p. vi, https://www.rand.org/pubs/research_reports/RRA3139-1.html.

[14] Wang, Smith, and Garafola, 2025, p. 29.

[15] For instance, see "China Achieves Space Refueling Technology: A New Era of 'Space Equality' Dawns," The Nation, February 24, 2025, https://thenationonlineng.net/china-achieves-space-refueling-technology-a-new-era-of-space-equality-dawns/.

QUESTION FOR THE RECORD

RESPONSE OF BLAINE CURCIO, FOUNDER, ORBITAL GATEWAY CONSULTING

QFR submitted by Commissioner Kuiken and Commissioner Sims: Similar to the relationship between Space-X and Starlink, could you expand on the "virtuous cycle dynamic" of how China's advancing reusable launch rocket capabilities will expand and enhance their capabilities to launch satellites? Is the relationship between these two technologies a mutually reinforcing one?

Blaine Curcio response to QFR:

"Today, China's ability to launch large numbers of satellites is largely constrained by a lack of launch capacity. The state-owned rocket manufacturers, namely CASC subsidiaries CALT and SAST, are currently manufacturing ~60-70 rockets per year, all of which are expendable. Most of these rockets are already spoken for by existing state-backed missions, e.g. Chinese Space Station Shenzhou (crewed) and Tianzhou (cargo) missions, Yaogan and Gaofen remote sensing satellite missions, China Satcom GEO satellite missions, and a variety of science & technology test satellite missions. The number of rockets available to launch large batches of low-earth orbit communications satellites is currently limited. We saw evidence of this in February 2025, when SpaceSail (operator of the G60/Thousand Sails constellation) had to cancel a tender for 9 launches of 162 satellites[i], because they only received two bids (CALT and SAST). They then re-tendered it, and it was cancelled for the same reason.[ii] That being the case, currently there is demand in China to launch hundreds of low-earth orbit communications satellites per year, and not enough launch supply. Reusable rockets would provide an initial jolt in launch supply, allowing for a ramp-up of low-earth orbit satellites launching, which could allow these major low-earth orbit constellations to reach commercial maturity more quickly. As these constellations are by far the biggest source of launch demand (look at the number of Starlink satellites launched as a % of all satellites launched from the US as a prime example of this), it could end up being a virtuous cycle whereby constellations come into service and start making money selling bandwidth --> more demand from constellations for launch services --> more money going to the launch companies --> more rockets being developed, and so on".

[i] 卫星参数网 (Satellite Parameters Network), " 千帆星座一年 162 颗卫星发射首次招标流标, 报名数量不足三家" (The first bidding for Qianfan Constellation's 162 satellite launches in one year failed, with less than three applicants), *Weiqin*, February 14, 2025.
https://web.archive.org/web/20250425152156/https://mp.weixin.qq.com/s/X9iKyB_cuVgOR4sJI12IPg
[ii] 太空那些事儿(Space Things), "千帆招标发射"两连败",或将改变方式," (Qianfan's bidding for launch failed twice in a row, and the method may change), *Weiqin*, February 17, 2025.
https://web.archive.org/web/20250425152718/https://mp.weixin.qq.com/s/hSn8z8B7gu5UE8wnGLCwyA

QUESTION FOR THE RECORD

RESPONSE OF VICTORIA SAMSON, CHIEF DIRECTOR OF SPACE SECURITY AND STABILITY, SECURE WORLD FOUNDATION

SECURE
WORLD
FOUNDATION

April 25, 2025

Victoria A. Samson

Chief Director, Space Security and Stability, Secure World Foundation

Follow-up question for the record based on testimony before the U.S.-China Economic and Security Review Commission on April 3, 2025: "The Rocket's Red Glare: China's Ambitions to Dominate Space"

Question for the record:

- What strategic objectives are China pursuing through the construction and operation of space infrastructure, such as overseas ground stations, in "Global South" countries? And what are the implications for host nations' technological sovereignty and space autonomy?

China has invested heavily in ground infrastructure related to its space program around the world, particularly in the Global South. This can be partially traced to its growth in satellites on orbit, particularly given that it is in the early stages of launching several very large constellations, and it needs to be able to communicate with them as they circle the planet. But due to the inherent dual-nature of this infrastructure and the relatively blurry line between China's civil and military space programs, it is possible that this ground infrastructure could be used for Chinese national security space missions or priorities. The information created by this infrastructure could be used by China to help conduct military operations, image sensitive military activities or installations of other countries, track missile launches, and monitor satellites on orbit. China's command, control, computing, communications, cyber, intelligence, surveillance, reconnaissance and targeting (C5ISRT) network is thought to be strengthened by its expanded ground infrastructure presence.

The United States also has ground stations overseas to help with satellite communications and tracking, but these generally tend to be either sited in countries that are already U.S. allies or in overseas U.S. territories. Additionally, when the United States builds these ground stations, it is very clear who the owner and user is, and they are not part of larger aid packages.

China is reported to have access to images and data collected by the telescopes and ground stations that it has built. As well, it is said to be maintaining well-established presences in many of the countries where it is building that space ground infrastructure.

In addition to the potential for contributing to China's military space capabilities, this investment in the Global South pays off in terms of soft power outreach for China. Often, it is building this ground infrastructure and host countries' own satellite systems in places that have natural resources that China wants access to (like critical minerals) and/or China is leveraging the relationship to generate diplomatic

support elsewhere. Given that the United States is vastly shrinking its soft power outreach by pulling back on overseas spending and greatly reducing the State Department's and NASA's budgets, this is only making China an even more attractive and reliable partner to the countries of the Global South.

China maintains a fleet of Yuanwang ships that are primarily used to support Chinese space launches.[1] The ships will deploy to areas around the world where they can augment China's ground-based satellite tracking, telemetry, and control (TT&C) located in its territory. China built a ground station in Addis Ababa, Ethiopia, which began operations in May 2021, and is planning to build another in Namibia.[2] It also has ground stations in Guárico and Leupa, Venezuela; Río Gallegos, Argentina; Amachuma and La Guardia, Bolivia; and Alcantara and Cuiaba, Brazil.[3] As well, China has a remote sensing ground station in Kashi, Pakistan; it used to have access to ground stations operated by the Swedish Space Corporation (SSC) in Kiruna, Sweden, Santiago, Chile, and Dongara, Australia, but citing geopolitical changes, the SSC announced in September 2020 that it would not be renewing China's contracts allowing this.[4] Finally, in February 2023, China announced that it would be building a ground station at its Zhongshang station in Antarctica.[5] All of these TT&C capabilities are coordinated through the Xi'an Satellite Measurement and Control Center. Typically, TT&C facilities use antennas to detect signals from active satellites and broadcast commands to them or receive transmissions from them, which would not be able to track orbital debris or satellites broadcasting on different frequencies. These facilities may include telescopes or other SSA sensors that could do such tracking. However, to date, there is no evidence that the international TT&C sites operated by China are fundamentally different from similar sites operated by other countries.

The consequences for the host countries' technical sovereignty and space autonomy have been mixed. In some cases, it brings resources that the host country can then use for profit. An example would be the "Ground Station as a Service" initiative started by the Ethiopian Space Science and Geospatial Institute (SSGI), which charges for services done at the Chinese-built ground station at the Entoto Observatory and Space Science Research Center in Addis Ababa.[6] SSGI's director of satellite operations,

[1] Chen Guoling and Zou Weirong, "China Advances Maritime Space Monitoring and Control Capability," Ministry of Defense of the People's Republic of China, June 23, 2017, http://eng.mod.gov.cn/news/2017-06/23/content_4783536.htm.
[2] "Ethiopia launches innovative satellite data service in partnership with China, official says," *Xinhua*, March 5, 2024, https:// english.news.cn/20240305/00aaebd994bc408ea3089f7b82b7bcbb/c.html; Joey Roulette, "China builds space alliances in Africa as Trump cuts foreign aid," *Reuters*, February 11, 2025, https://www.reuters.com/investigations/chinabuilds-space-alliances-africa-trump-cuts-foreign-aid-2025-02-11/.
[3] Cate Cadell, "A growing global footprint for China's space program worries Pentagon," *Washington Post*, November 21, 2023, https://www. washingtonpost.com/world/interactive/2023/ china-space-program-south-america-defense/.
[4] "China Remote Sensing Satellite Ground Station," China Academy of Science Aerospace Information Research Institute, Accessed February 11, 2025, http://english.aircas.cn/ research2020/bsi/202302/t20230213_327036. html; Jonathan Barrett and Johan Ahlander, "Exclusive: Swedish space company halts new business helping China operate satellites," *Reuters*, September 21, 2020, https://www. reuters.com/article/world/exclusive-swedish-space-company-halts-new-business-helping-china-operate-satell-idUSKCN26C1ZS/.
[5] Andrew Jones, "China to build satellite ground stations in Antarctica," *SpaceNews*, February 2, 2023, https://spacenews.com/china-to-build-satellite-ground-stations-in-antarctica.
[6] "Ethiopia launches innovative satellite data service in partnership with China, official says," *Xinhua,* March 5, 2024, https://english.news.cn/20240305/00aaebd994bc408ea3089f7b82b7bcbb/c.html

Melaku Muka, says that Ethiopian professionals run the satellite center independently due to training they received from Chinese space experts.[7]

In other cases, the capacity-building of the host country's citizens and their independence from China is less clear-cut. In 2017, China and Egypt announced that China would be building a satellite facility in Cairo.[8] Egyptian engineers were sent to China for training between November 2017-January 2018.[9] Of the three satellites that came out of this partnership, two were built in China, while the third was built in Egypt with Chinese-made parts, and the satellites were all launched from China. The third satellite, MisrSat-2, was launched in December 2023; while it belongs to Egypt, it is reported that China maintains access to the data and imagery that it collects.[10] It should be noted that the head of the Eyptian Space Agency, Sherif Sedky, says that Egypt has control over its satellites and that the data generated from them belongs to Egypt.[11]

And in other cases, there seems to be little host country independence in the use of its Chinese-built ground infrastructure in its territory. For example, China's satellite tracking and control center was opened in Neuquén, Argentina in April 2017 to help China with its deep space tracking.[12] However, it is operated by China Satellite Launch and Tracking Control General (CLTC), which is linked to China's military space program, is staffed by Chinese military personnel, and has in its contract that Argentina may "not interfere or interrupt" any activities happening at the facility.[13] China has a 50-year tax-free lease for this center.[14] Argentina's space agency, National Commission for Space Activities (CONAE), can only use the facility for roughly two hours a day, or 10 percent of its operational time; surrounding the facility is a 62-mile frequency exclusion zone where access must be authorized by the Chinese

[7] Ibid.
[8] Joey Roulette, "China builds space alliances in Africa as Trump cuts foreign aid," *Reuters*, February 11, 2025, https://www.reuters.com/investigations/chinabuilds-space-alliances-africa-trump-cuts-foreign-aid-2025-02-11/.
[9] Ibid.
[10] Ibid.
[11] Ibid.
[12] Julie Michelle Klinger, "A brief history of outer space cooperation between Latin America and China," *Journal of Latin American Geography*, volume 17, number 2, July 2018, https://www.bu.edu/pardeeschool/files/2018/09/Klinger-JLAG-Outer-Space-Cooperation.pdf.

[13] R. Evan Ellis, "China-Latin America Space Cooperation: An Overview," *The Diplomat*, February 16, 2024, https://thediplomat.com/2024/02/china-latin-america-space-cooperation-an-overview/; Matthew P. Funaiole, Dana Kim, Brian Hart, Joseph S. Bermudez Jr., "Eyes on the Skies: China's Growing Space Footprint in South America," CSIS, *Hidden Reach Issue No.* 1, October 4, 2022, https://features.csis.org/hiddenreach/china-ground-stations-space/.

[14] Carlo J.V. Caro, "The Patagonian Enigma: China's Deep Space Station in Argentina," *The Diplomat*, January 8, 2024, https://thediplomat.com/2024/01/the-patagonian-enigma-chinas-deep-space-station-in-argentina.

government.[15] Tracking stations that China built in Venezuela and Bolivia are thought to allow China remote access to their facilities; additionally, the contracts for the Bolivian installations reportedly give Chinese technicians regular physical access.[16]

A CSIS 2024 analysis warned that if there was a conflict, ground stations operated by foreign partners "could be exploited to conduct offensive activities, irrespective of the intentions of their hosts or the stated use of the facility," and that it "could also impair the ability of the host nation to maneuver or maintain neutrality in a conflict scenario with consequences in other strategic areas, especially with regard to sovereignty."[17]

Space cooperation will no doubt continue to expand, given the momentum created by existing relationships. China has 23 bilateral space partnerships with African entities.[18] An example of one is the China-Arab BeiDou Centre, which is located outside of Tunis, Tunisia, and is funded by China and the Arab Information and Communication Technology Organisation; this center is the first one built overseas for China's BeiDou global navigation satellite system.[19] China has reportedly had over 14 meetings with the African Union Commission to promote the adoption of BeiDou.[20] In general, according to Joseph Sany of the United States Institute of Peace, "China pushes space collaboration in Africa in a very intentional way by allocating funds and identifying areas of existing priorities."[21] And in April 2024, at the 10th anniversary of the China-Community of Latin American and Caribbean States (CELAC) Forum (which has served as a platform for China's Belt and Road Initiative), was the meeting of that group's first Space Cooperation Forum.[22]

[15] Ibid.
[16] Cate Cadell, "A growing global footprint for China's space program worries Pentagon," *Washington Post*, November 21, 2023, https://www. washingtonpost.com/world/interactive/2023/ china-space-program-south-america-defense/.
[17] Guido L. Torres and Laura Delgado López, "Space, Speed, and Sovereignty: Hypersonic Tensions in the Southern Hemisphere," CSIS, May 21, 2024, https://www.csis.org/analysis/space-speed-and-sovereignty-hypersonic-tensions-southern-hemisphere.
[18] Joey Roulette, "China builds space alliances in Africa as Trump cuts foreign aid," *Reuters*, February 11, 2025, https://www.reuters.com/investigations/chinabuilds-space-alliances-africa-trump-cuts-foreign-aid-2025-02-11/.
[19] Jevans Nyabiage, "How China ties space projects in Africa with climate and security priorities," *South China Morning Post*, November 21, 2023, https://www.scmp.com/news/china/diplomacy/article/3242162/how-china-ties-space-projects-africa-climate-and-security-priorities.

[20] Ibid.
[21] Ibid.
[22] "China inaugurates the First Space Cooperation Forum with Latin America and the Caribbean," *El Diario*, April 24, 2024, https://www.eldiario.net/portal/2024/04/24/china-inaugura-primer-foro-de-cooperacion-espacial-con-america-latina-y-el-caribe/; "How a key mechanism drives China-Latin America cooperation," *Xinhua,* January 14, 2025, http://english.scio.gov.cn/m/in-depth/2025-01/14/content_117662497.html.