THE RISE OF THE CNSA: A Cislunar Space Race

APP Technical Report

UVA | FRANK BATTEN SCHOOL of LEADERSHIP and PUBLIC POLICY

To: Center for Space Policy and Strategy
From: Paulina Keim
Date: April 8, 2022
Re: APP Technical Report

PROBLEM STATEMENT

On July 4, 2021 taikonauts from the Chinese National Space Administration (CNSA) carried out the country's first-ever spacewalk outside the Tiangong space station. The rapid growth of the CNSA has led to an increase in international cooperation between various other space agencies including the European Space Agency. However, the 2011 Wolf Amendment has effectively barred NASA from cooperating with the CNSA largely due to the militarized tilt of the Chinese space program.[1] The US Space Force was established in December of 2019 with the task of defending and protecting US interests in space. The limits of this mission have been primarily centered in Low Earth Orbit (LEO) to Geostationary Orbit (22,236 miles). However, global space operations are beginning to extend into cislunar space which will increase the reach of the Space Force's sphere of interest to 272,000 miles and beyond. **As the Chinese National Space Administration begins to develop cislunar capabilities as well as potentially weaponizing space this poses a threat to US interests and the interests of its allies.**

[1] Vasani, H. (2017, January 19). *How China is Weaponizing Outer Space*. The Diplomat. https://thediplomat.com/2017/01/how-china-is-weaponizing-outer-space/.

BACKGROUND

On May 15, 2021, the China National Space Administration (CNSA) landed its Zhurong rover on the surface of Mars.[2] This makes China only the second country behind the US to land and operate a rover on the red planet.[3] The meteoric rise of the CNSA is reminiscent of the Cold War space race between the US and the Soviet Union. The Zhurong rover is just one recent example of the CNSA's accomplishments in space hence why this section seeks to analyze the existing evidence pertaining to space activities of both the US and China. The development of the Chinese National Space Administration's (CNSA) civilian and military capabilities over the past decade is indicative of China's renewed status as a great power in the international system. The implications for US national security are numerous as space-related research and development drives military capabilities and augments intelligence, surveillance, and reconnaissance capabilities. China's zero-sum pursuance of space superiority is detrimental to US economic competitiveness, undermines strategic stability, and weakens US military advantages.

> *"Developing the space program and turning the country into a space power is the space dream that we have continuously pursued."- President Xi Jinping*[4]

This quote elucidates Xi's vision for China's space development. As an aspiring global space superpower, China has identified three major spheres for further scientific and technological development: deep space exploration, building an independent modular space station, and creating a permanent manned presence on the moon.

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[2] Harding, L. (2021, July 16). *The Space Race is back on – but who will win?* The Guardian. Retrieved December 14, 2021, from https://www.theguardian.com/science/2021/jul/16/the-space-race-is-back-on-but-who-will-win

[3] Webb, S., & Allen, R. (2021, July 1). *On its first try, China's Zhurong Rover hit a Mars Milestone that took NASA decades*. Space.com. Retrieved November 8, 2021, from https://www.space.com/china-mars-rover-zhurong-milestone-took-nasa-decades

[4] Shaohui, T. (Ed.). (2017, April 4). *Backgrounder: Xi Jinping's vision for China's space development*. Xinhua Net. http://www.xinhuanet.com//english/2017-04/24/c_136232642.htm.

China's Deep Space Exploration

China's outer space exploration program involves studying Earth, Mars, Jupiter, Venus, and Uranus and it aims to collect research on the origin of the solar system, asteroid chasing, and extraterrestrial life. China's deep space exploration begins with the Red Planet: on July 23, 2020, the CNSA launched Tianwen-1, the first independent Mars mission. Furthermore, on May 14, 2021, China's Mars rover Zhurong landed on the Martian surface and has covered over 3,491 feet.[5] Looking forward to the future China plans to launch a Mars sample-return mission by 2030.[6]

Chinese Space Station (CSS)

The CNSA seeks to launch a space station called Tiangong, "Heavenly Place," by 2022. The current International Space Station (ISS) is due to be retired after 2024 which means that the CSS could be the only space station in orbit past that date. China was initially excluded from the ISS program due to concerns that it would be used to improve its own military programs.[7]

Chinese Lunar Exploration Program (CLEP)

The Chinese Lunar Exploration Program, also known as the Chang'e Project, is an ongoing venture into robotic moon missions. The Chang'e Project also includes an extensive plan to launch a manned moon mission by 2030. Additionally, the CNSA recently announced a plan to build a lunar base with Roscosmos, Russia's space agency. Roscosmos and the CNSA have expressed an interest in further international cooperation.

Beidou Navigation System

In 2020 after more than 20 years of effort, China's domestically developed Beidou Navigation System reached geostationary orbit and is offering worldwide coverage.[8] This

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[5] Jones, A. (2021, September 5). *China's Zhurong Mars Rover returns Panorama ahead of Planetary blackout*. https://www.space.com/china-zhurong-mars-rover-communications-blackout-panorama-image.

[6] *China plans to launch a Mars Sample-return mission around 2030, and more*. China Global Television Network. (2021, June 13). https://news.cgtn.com/news/2021-06-13/China-plans-to-launch-a-Mars-sample-return-mission-around-2030-113ufuiRghG/index.html.

[7] Klisauskaite, V. (2021, May 8). *The space race: China's ambitious plans in cosmos*. AeroTime Hub. https://www.aerotime.aero/27865-China-ambitious-space-plans.

[8] Xie, J. (2021, September 2). *China's rival to gps NAVIGATION carries big risks*. VOA. Retrieved September 30, 2021, from https://www.voanews.com/a/east-asia-pacific_voa-news-china_chinas-rival-gps-navigation-carries-big-risks/6192460.html.

system is designed to rival US-owned Global Positioning System (GPS) and allows users to access its high-accuracy positioning, navigation, and timing services. According to the US-China Economic and Security Review Commission, Global Beidou is estimated to generate China a services market worth $298 billion and will make China and other countries less reliant on GPS.[9] China's state media claims that its navigation products have been exported to more than 120 countries. Aside from economic costs, Global Beidou also poses significant security costs to the US. Beidou is a two-way communication system that would allow China to track users of the system and open the door to potential cyber-attacks.

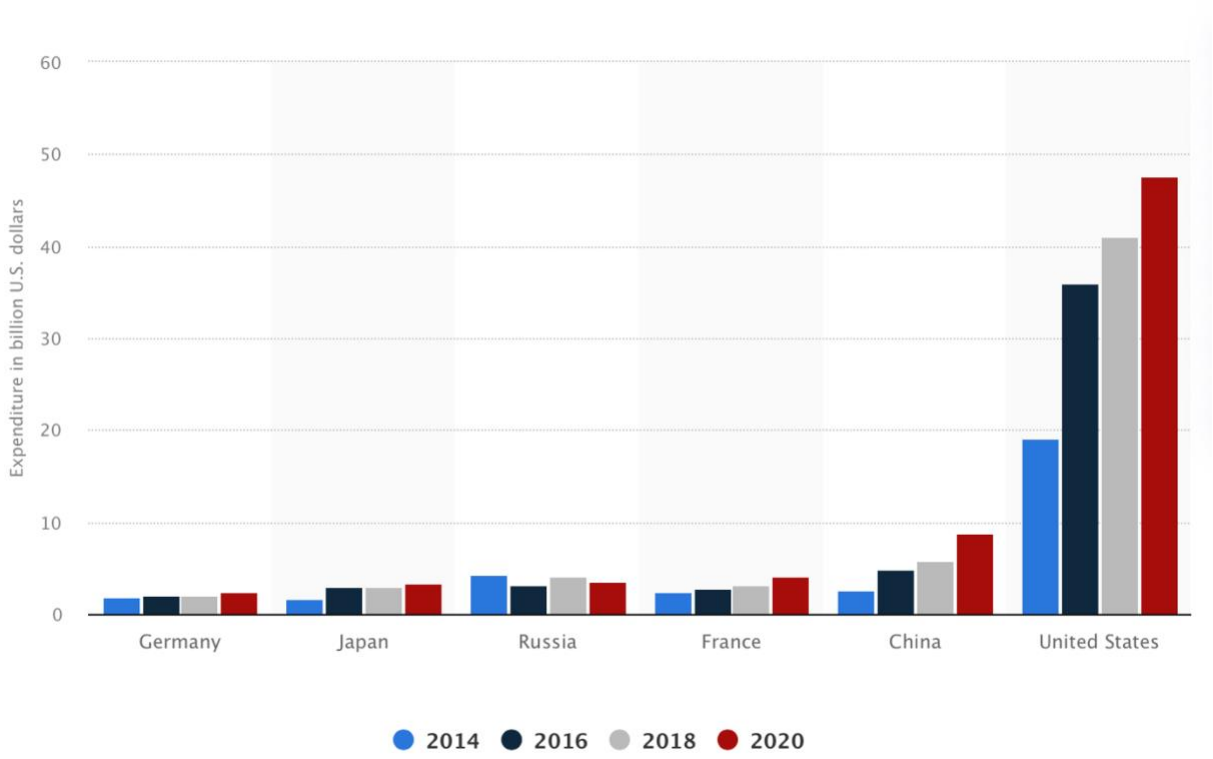
Thousand Talents Program

The Thousand Talents Program encourages Chinese citizens working in high-tech strategic sectors overseas to return to China. Awardees receive a guaranteed position at a university, R&D institute, or central state-owned enterprise, a one-time bonus of $140,000, insurance and housing subsidies, job offers for spouses, guaranteed admission to schools for their children, and more. This program will boost China's science and technology innovation capabilities thereby contributing directly to their space program and it will also encourage brain drain from other countries such as the US. These are just a few of the various costs that the US will incur both from an economic and security standpoint.

[9] Stokes, M., Alvarado, G., Weinstein, E., & Easton, I. (2020, March 30). *China's Space and Counterspace Capabilities and Activities*. U.S.-China Economic and Security Review Commission. Retrieved September 30, 2021, from https://www.uscc.gov/sites/default/files/2.18.15%20hearing%20release%20draft.pdf.

GOVERNEMENT EXPENDITURES ON SPACE PROGRAMS

The table below shows the government expenditures on space programs between 2014 and 2021.



Source: Statista

The US spent $19.19 billion in 2014, $35.96 billion in 2016, $41 billion in 2018, and $47.69 billion in 2020.[10] Meanwhile, China spent $2.66 billion in 2014, $4.91 billion in 2016, $5.83 billion in 2018, and $8.85 billion in 2020.[11] However, this must be taken with the caveat that information about the CNSA and its expenditures is much more difficult to obtain data on. Furthermore, it will be interesting to see cost estimates for both the US and China for 2021 as well.

[10] Salas, E. B. (2021, July 21). *Global governmental spending on space programs of leading countries 2020*. Statista. Retrieved November 8, 2021, from https://www.statista.com/statistics/745717/global-governmental-spending-on-space-programs-leading-countries/

[11] Ibid.

EARTH-TO-SPACE WEAPONS

Kinetic

Kinetic earth-to-space weapons include a missile that fires a warhead from earth into space to strike a target satellite. The nature of such attacks allows for better confirmation of success for the attacker and makes it easier to attribute where the attack is coming from.[12] The effects of such weapons extend beyond just the damage from the designated target. Other effects include the production of space debris which can affect the operation of satellites in affected orbits. Additionally, nuclear detonations in space increase the radiation exposure of other satellites which can significantly shorten their lifespans. Such weapons have been tested by the US, China, Russia, and India.

Non-Kinetic

Non-kinetic earth-to-space weapons are weapons that disrupt the ability of satellites to function properly without making physical contact.[13] They can be stationed on ground, airborne, or maritime platforms. Examples include uplink jammers, cyberattacks, and laser dazzlers. Non-kinetic earth-to-space weapons can have drastic effects on their targets, but their effects generally do not result in collateral damage or orbital debris. Furthermore, multiple nations have tested these weapons including China, Russia, Iran, and more.

SPACE-TO-SPACE WEAPONS

Kinetic

Space-to-space kinetic weapons are satellites that are placed into orbit and maneuver to intercept their target by striking it or detonating a warhead in the vicinity.[14] Examples of such weapons include space-based missile defense interceptors and co-orbital ASAT

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[12] Cohen, R. (2020, May 29). *What's A space weapon? the answer can be complicated.* Air Force Magazine. Retrieved January 4, 2022, from https://www.airforcemag.com/whats-a-space-weapon-the-answer-can-be-complicated/

[13] Harrison, T. (2020, May). *International Perspectives on Space Weapons*. CSIS. Retrieved January 4, 2022, from https://csis-website-prod.s3.amazonaws.com/s3fs-public/publication/200527_Harrison_IntlPerspectivesSpaceWeapons_WEB%20FINAL.pdf

[14] Way, T. (2020, July 23). *Counterspace weapons 101*. Aerospace. Retrieved January 4, 2022, from https://aerospace.csis.org/aerospace101/counterspace-weapons-101/

weapons. Kinetic space-to-space weapons can produce space debris which would impact the operation of other satellites in similar orbits. Just like kinetic earth-to-space weapons, the detonation of kinetic space-to-space weapons increases radiation exposure of nearby satellites. During the Cold War, the Soviet Union tested co-orbital kinetic ASAT weapons multiples times.

Non-Kinetic

Non-kinetic space-to-space weapons can destroy, disrupt, or degrade a target satellite without making physical contact. They do so by placing a satellite into orbit and using non-kinetic means to disrupt the operation of another satellite.[15] Types of non-kinetic space-to-space weapons include co-orbital high-powered microwave weapons and co-orbital crosslink jammers. The effects of these weapons can be permanent or temporary depending on the type of weapon and the protections that the target satellite has. Furthermore, their detonations result in non-negligible amounts of orbital debris. There have been no-open source examples of non-kinetic space-to-space weapons being detonated.

SPACE-TO-EARTH WEAPONS

Kinetic

Kinetic space-to-earth weapons are weapons that are placed in orbit and when commanded they deorbit and reenter the atmosphere to strike a target on Earth. The effects of such weapons depend greatly on whether the warhead used is conventional or nuclear. Kinetic space-to-earth weapons operate like terrestrial-based ballistic missiles in their ability to hit targets on Earth with little to no warning.[16] Damage can be inflicted via the kinetic energy of the weapon itself or from a warhead deployed from a reentry vehicle. Utilizing kinetic space-to-earth weapons has been contemplated by US military professionals, but there have been no open-source instances of these systems being tested.

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[15] CSIS. (2020). *Types of Counterspace Weapons*. CSIS. Retrieved January 4, 2022, from http://www.satnews.com/images/*CSIS/CSISCounterspace_Weapons2.pdf

[16] Space.com. (2016, December 21). *The most dangerous space weapons ever*. Space.com. Retrieved January 4, 2022, from https://www.space.com/19-top-10-space-weapons.html

Non-Kinetic

Non-kinetic space-to-earth weapons are satellites equipped with non-kinetic weapons that aim at targets on Earth. Examples include space-based high-powered lasers which can be used to intercept aircraft or missiles and space-based downlink jammers which can be utilized to interfere with radars or satellite ground stations.[17] The effects of both jammers and lasers are localized to the target area and can theoretically strike without warning. Just like the aforementioned kinetic space-to-earth weapons, non-kinetic space-to-earth weapons have been considered for defense, but there have been no open-source examples of these systems being tested.

US-CHINA HEAD-TO-HEAD COMPETITION

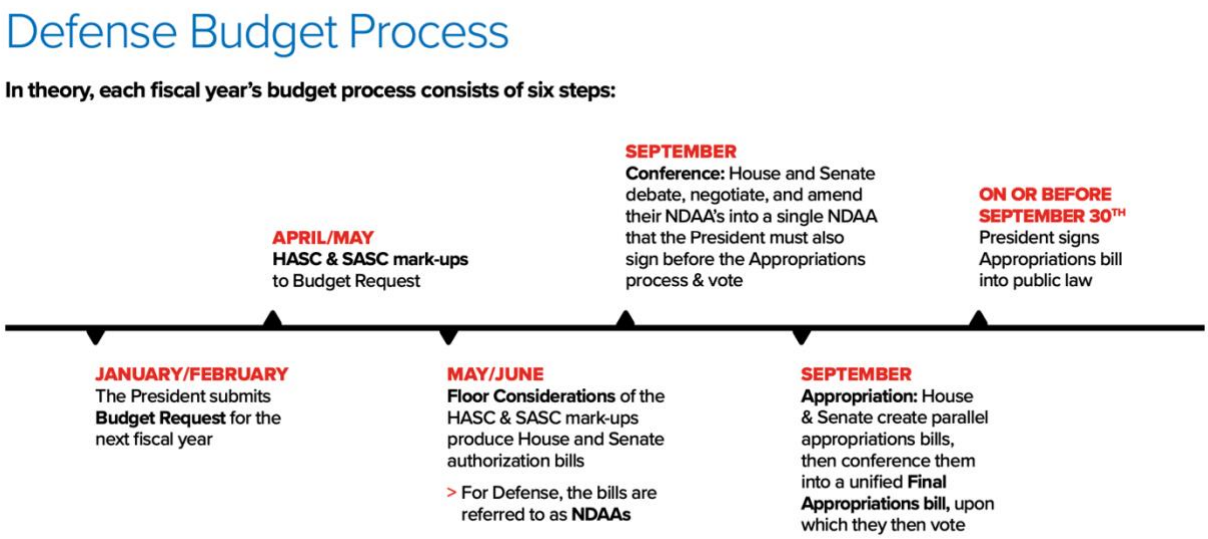
Defining the types of outer space weapons above will help illuminate this discussion of US and China head to head competition on outer space weapons. Both the US and China have demonstrated direct-ascent ASAT capabilities, a type of earth-to-space weapon.[18] Furthermore, missile defense systems can also double as earth-to-space weapons against satellites in low earth orbit. In 2008 the US demonstrated these capabilities by using an SM-3 missile interceptor to strike the country's own malfunctioning satellite. China has demonstrated its non-kinetic earth-to-space capabilities by dazzling a satellite with a laser from Earth which has raised concerns for US national security. For years the US has been toying with the idea of developing an array of space-to-space kinetic interceptors and space-to-space high-powered lasers capable of intercepting missiles in flight. However, nothing has been deployed or demonstrated as of yet. Both the US and China greatly benefit from the information garnered from both military and intelligence satellites thus the strategic landscape of new military competition in space is a key area to watch as it presents both opportunities and dangers.

US DEFENSE BUDGETING AND DECISION-MAKING

[17] Mehta, A. (2020, May 27). *What is a space weapon, and who has them?* C4ISRNet. Retrieved January 4, 2022, from https://www.c4isrnet.com/battlefield-tech/space/2020/05/27/defining-what-a-space-weapon-is-and-who-has-them/

[18] MacDonald, B. (2008, September). *China, space weapons, and U.S. security*. Council on Foreign Relations. Retrieved January 4, 2022, from https://cdn.cfr.org/sites/default/files/pdf/2008/07/China_Space_CSR38.pdf

In order to fully understand the United States' space program with respect to national security one must understand the decision-making process, specifically the budgeting process. The process begins with the President formulating the fiscal year's budget request with the Department of Defense and the Office of Management and Budget (OMB).[19] The request is submitted to the House Armed Services Committee (HASC) and the Senate Armed Services Committee (SASC) which then becomes a part of the National Defense Authorization Act (NDAA). Once the authorization legislation is out of committee it goes to the floor of the House and Senate for debate and amendment with each chamber producing their own defense authorization bills. Then the legislation goes to a Conference Committee where the House and Senate negotiate their respective differences and produce a single unified NDDA which the President then reviews for signature. After the authorizing process comes the appropriating process. The House Committee on Appropriations and Senate Committee on Appropriations fund discretionary authorized activities and create their own appropriations bills. Once again, the two chambers work together to negotiate a single appropriations bill that requires presidential approval.[20] The figure below helps illustrate this process.



Source: Corporate Office Properties Trust

[19] Montgomery, M. (2021, April 7). *The NDAA process, explained*. Center for Arms Control and Non-Proliferation. Retrieved January 7, 2022, from https://armscontrolcenter.org/the-ndaa-process-explained/

[20] Corporate Office Properties Trust. (2020, January). *The annual defense budget process*. Corporate Office Properties Trust. Retrieved January 7, 2022, from https://s23.q4cdn.com/233908562/files/doc_downloads/irw/COPT_Research/Annual-Defence-Budget-Process.pdf

The Fiscal Year 2022 budget gave the Space Force a budget of $17.4 billion, a 13.1% increase from Fiscal Year 2021.[21] However, in the report accompanying the FY22 Defense Appropriations Bill, the House Appropriations Committee expressed concern over the Space Force's procurement methods of equipment and technology. The report states, "The Space Force lacks a clear plan which defines its future space architecture and lacks a strategy for how this architecture will be acquired."[22] Despite this criticism, the Space Force still received almost everything it asked for. This demonstrates that the Space Force's budget is largely decided upon within the organization, but Congress has the ability to make recommendations and changes.

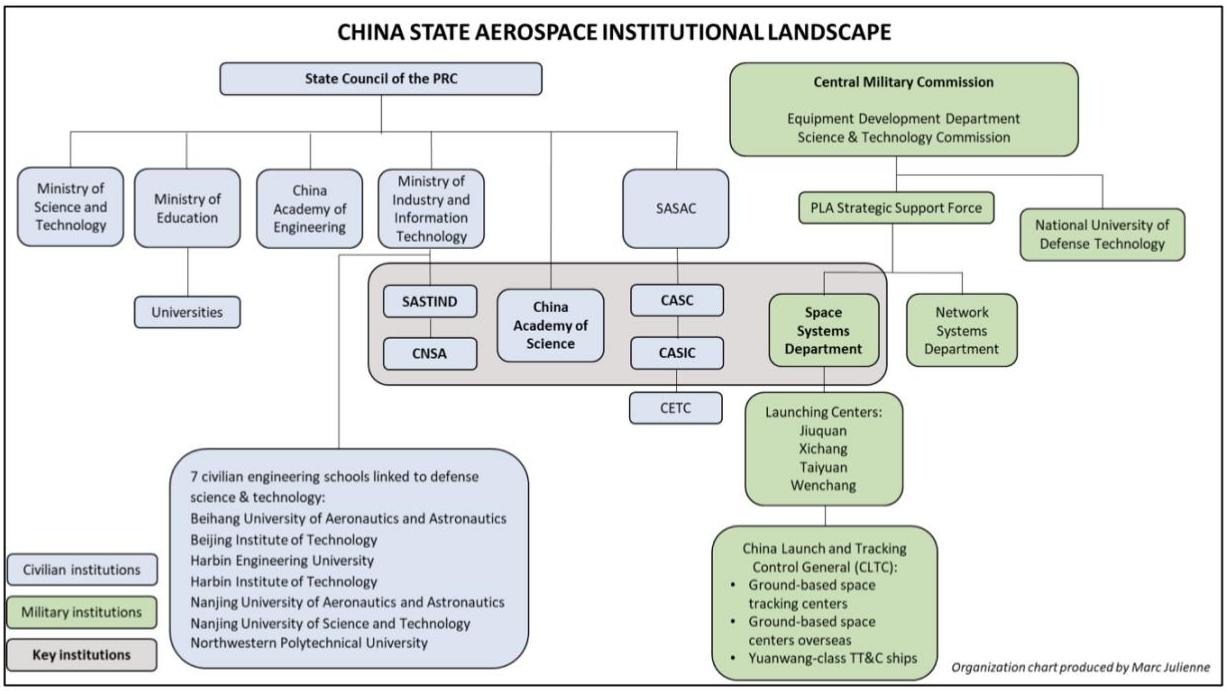
CHINA'S STATE APPARATUS AND DECISION-MAKING

China's space program dates back to the mid-1950s when the country began a ballistic missile program in response to perceived US and Soviet threats. The three pillars of China's space program are national development, military empowerment, and great-power competition. China presents its space ambitions as peaceful, but its military activities in outer space are largely unknown. China's space institutional landscape is unique because it is not what it appears. A prime example is that the CNSA is largely a front for international cooperation. The CNSA has little policy leverage on China's space program and is largely focused on space diplomacy, promoting China's achievements, and seeking new strategic partners. The majority of decision-making is made in the Science, Technology, and Industry for National Defense (SASTIND) and the People's Liberation Army (PLA), specifically the Strategic Support Force. Other important decision-making actors include the state-owned aerospace conglomerates the China Aerospace Science and Technology Corporations (CASC) and the China Aerospace Science and Industry Corporation (CASIC), as well the Chinese Academy of Science

[21] House Appropriations Committee. (2021, July). *FY2022 Defense Subcommittee Appropriations Bill*. House Appropriations Committee. Retrieved January 7, 2022, from https://docs.house.gov/meetings/AP/AP00/20210713/112896/BILLS-11700--AP--AP00.pdf

[22] Zeller, S. (2021, July 13). *Lawmakers Pan Biden's first Space Force Budget*. Roll Call. Retrieved January 7, 2022, from https://www.rollcall.com/2021/07/13/lawmakers-pan-bidens-first-space-force-budget/

(CAS).[23] At the top, the CPC Standing Committee and the Central Military Commission (CMC) ultimately decide the strategic operations of China's space program, both of which are headed by Secretary-General Xi Jinping. The figure below goes more in-depth into China's aerospace institutional landscape.



Source: The French Institute of International Relations

POLICY ALTERNATIVES

Invest in LUMINT

LUMINT

The first policy alternative is to invest in the emerging lunar intelligence field. Lunaspatial intelligence (LUMINT) is the collection of intelligence to monitor activity in cislunar space and on the lunar surface.[24] LUMINT is similar to Earth-focused geospatial

[23] Julienne, M. (2021, January). *China's Ambitions in Space*. The French Institute of International Relations. Retrieved January 6, 2022, from https://www.ifri.org/sites/default/files/atoms/files/julienne_china_ambitions_space_2021.pdf

[24] Cohen, R. (2020, April 22). *Emerging lunar intelligence field to SHAPE space ops*. Air Force Magazine. Retrieved December 11, 2021, from https://www.airforcemag.com/emerging-lunar-intelligence-field-to-shape-space-ops/.

intelligence (GEOINT) which will be discussed further below. Sabre Astronautics and Rhea Space Activity received a $50,000 contract from the Air Force to develop a system to collect and manage lunar intelligence.[25] This will increase capabilities for situational awareness in cislunar space. Rhea and Sabre Astronautics are working to create a three-dimensional dashboard to show the coordinates of important objects in cislunar orbit in order to increase space domain awareness.[26] Additionally, Saber hopes to introduce LUMINT into the Space Force's virtual reality space cockpit and predictive ground station interface software. LUMINT's applications will also suggest an optimum satellite constellation architecture to monitor cislunar spacecraft.

Lessons Learned from GEOINT

There are many lessons that can be learned from the development of geospatial intelligence (GEOINT) which can inform the future development of LUMINT. GEOINT is intelligence derived from the analysis of images and data from a particular location.[27] In 1996 the National Imagery and Mapping Agency (NIMA) was created to bring the United States' imagery and geospatial assets under one umbrella. NIMA continued to evolve as GEOINT formally arose as a discipline.[28] In 2003 NIMA changed its name to the National Geospatial-Intelligence Agency (NGA) as it began to achieve greater insight into national security challenges using GEOINT.[29] Advancements in technology have allowed the NGA to utilize geospatial data in a myriad of ways to create interactive, customized, and dynamic visual products. Furthermore, GEOINT fits into the broader intelligence community by leveraging data obtained through the other intelligence collection disciplines, such as signals intelligence (SIGINT), human intelligence (HUMINT), and Measurement and Signature Intelligence (MASINT), to provide more accurate, relevant,

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[25] Mizokami, K. (2021, November 2). *The Air Force wants a way to monitor traffic...around the moon*. Popular Mechanics. Retrieved December 18, 2021, from https://www.popularmechanics.com/military/research/a32162612/air-force-lunar-intelligence/

[26] Mayfield, M. (2020, May 29). *China's Cislunar Space Ambitions Draw Scrutiny*. National Defense Magazine. Retrieved January 6, 2022, from https://www.nationaldefensemagazine.org/articles/2020/5/29/china-cislunar-space-ambitions

[27] OmniSci. (n.d.). *What is Geospatial Intelligence (GEOINT)?* OmniSci. Retrieved January 5, 2022, from https://www.omnisci.com/technical-glossary/geoint

[28] National Geospatial-Intelligence Agency. (n.d.). *NGA History*. National Geospatial-Intelligence Agency. Retrieved January 6, 2022, from https://www.nga.mil/about/history.html

[29] Ibid.

and comprehensive products.[30] LUMINT is currently in the budding stages of its development as a discipline, but it will surely face the questions of how to keep up with rapid technological change and how it will find its place in within the intelligence community as a whole.

Develop Cislunar International Treaties

Developing cislunar international treaties is a policy option that relies on diplomatic means and multilateralism. However, in order to develop future international treaties, one must understand two key areas of policy history: the five United Nations treaties in outer space and previous US treaties in space. Both areas will be discussed in depth below.

The Outer Space Treaty

The Outer Space Treaty is a multilateral treaty that was drafted and negotiated by the United Nations. It forms the basis of international space law and has over 111 countries signed on including the US and China. It was signed on January 27, 1967, during the wake of the Cold War and the original space race.[31] This treaty forbids weapons of mass destruction in space and reserves the moon and other bodies for peaceful purposes.

Rescue Agreement

The Rescue Agreement is an international agreement ratified by the UN in 1968 that outlines the obligations for any country that becomes aware that the people of a spacecraft are in danger. More specifically, this agreement states that any party who is a signatory to the agreement must help rescue the personnel of a spacecraft who have landed within that state's territory due to an emergency landing. Furthermore, the party

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[30] Murrett, R. (2006). *Geospatial Intelligence (GEOINT) Basic Doctrine*. Office of Geospatial Intelligence Management. Retrieved January 5, 2022, from https://irp.fas.org/agency/nga/doctrine.pdf

[31] United Nations Office for Outer Space Affairs. (n.d.). *The Outer Space Treaty*. United Nations Office for Outer Space Affairs. Retrieved January 6, 2022, from https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introouterspacetreaty.html

must extend assistance via a search and rescue operation if necessary.[32] A major criticism of the agreement is that it is vague and is open to differing interpretations.

Liability Convention

The liability convention is another UN negotiated treaty that came into force in 1972. It establishes that the launching state is liable for any damage caused by its space objects on Earth or in space. The liability convention also provides the procedures for the settlement of claims for such damages.[33] The only claim filed under this convention was in 1978 when one of the Soviet Union's nuclear-power satellites crashed in Canadian territory.

Registration Convention

The Registration Convention in 1976 created a system to identify and register space objects.[34] The impetus for the Registration Convention was the growing concern about the number of inactive satellites in space. These satellites litter geostationary orbit and any collision would result in the loss or serious injury of satellites. Currently, there are almost 12,000 objects registered in the United Nations Office of Outer Space Affairs' Online Index of Objects Launched into Outer Space.

Moon Agreement

The Moon Agreement was a 1984 agreement that reaffirmed and expanded upon the Outer Space Treaty specifically relating to the moon and other celestial bodies. It states that the moon and other aforementioned bodies must be used exclusively for peaceful purposes, their environments must not be disrupted, and the United Nations should be

[32] Robert.wickramatunga. (n.d.). *Rescue Agreement*. United Nations Office for Outer Space Affairs. Retrieved January 6, 2022, from https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introrescueagreement.html

[33] United Nations Office of Outer Space Affairs. (n.d.). *Convention on International Liability for Damage Caused by Space Objects*. United Nations Office of Outer Space Affairs. Retrieved January 6, 2022, from https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introliability-convention.html

[34] United Nations Office for Outer Space Affairs. (n.d.). *Registration Convention*. United Nations Office for Outer Space Affairs. Retrieved January 6, 2022, from https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introregistration-convention.html

informed about any structures built on the surface.[35] However, it has not been ratified by either the US or China and thus it has little more than symbolic relevancy in international space law.

The Artemis Accords

The Artemis Accords were signed on October 13th, 2020 and they are an international agreement between the US, Australia, Brazil, Canada, Isle of Man, Italy, Japan, South Korea, Luxembourg, Mexico, New Zealand, Poland, Ukraine, UAE, and the US. It is an American-led effort to return humans to the moon by 2024, with the ultimate goal of expanding space exploration. It is based on the aforementioned Outer Space Treaty of 1967 thus many of the same principles expressed in the original document are expressed in the Artemis Accords including fostering peaceful relationships in space, describing plans transparently, striving to develop interoperable technology, providing emergency assistance to astronauts in distress, and registering space objects. The biggest difference in the Artemis Accords is that the US strives to, according to NASA, "play a key role in achieving a substantial and robust presence on the Moon while preparing to conduct a historic mission to Mars."[36]

Moving Forward: NATO Alliances

Back in 2019 NATO officially designated space its firth official theater of conflict after air, sea, land, and cyber.[37] The Space Force has been looking towards its NATO allies to deter threats in orbit from China. Chief of Space Operations General John W. Raymond had meetings in June of 2021 in Luxembourg, Belgium, Spain, and the Netherlands in an attempt to build support for various measures intended to provide stability in orbit. Additionally, Germany, France, and the United Kingdom have launched their own military space units over the past few years and the US has also opened a dialogue.

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[35] United Nations Office for Outer Space Affairs. (n.d.). *Moon Agreement*. United Nations Office for Outer Space Affairs. Retrieved January 6, 2022, from https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/intromoon-agreement.html

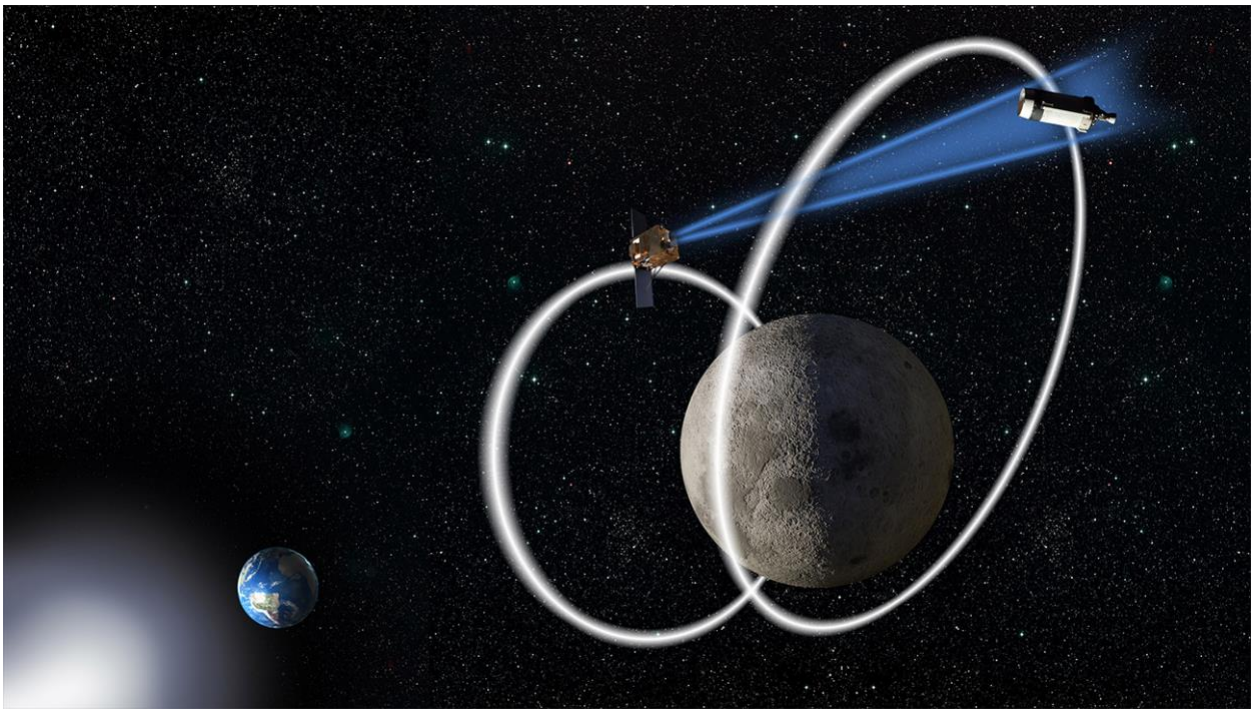
[36] NASA. (n.d.). *Artemis Accords*. NASA. Retrieved January 6, 2022, from https://www.nasa.gov/specials/artemis-accords/index.html

[37] Posaner, J., & Herszenhorn, D. M. (2019, November 19). *Stoltenberg: Nato won't put weapons in Space*. POLITICO. Retrieved January 6, 2022, from https://www.politico.eu/article/stoltenberg-nato-wont-put-weapons-in-space/

General Raymond stated, "Partners are important to us, and there are opportunities for like-minded nations."[38] Yet much is to be determined about what these agreements and partnerships will actually look like and entail.

Option 3: Seek Industry Collaboration on the Cislunar Highway Patrol System (CHPS)

The Cislunar Highway Patrol System is a spaceflight experiment designed to improve the Space Force's ability to identify and detect objects in cislunar space.[39] Such objects include mission related debris, rocket bodies, and various other previously untracked cislunar objects. CHPS will also be able to provide position updates on spacecraft operating in cislunar space that are difficult to observe from other vantage points. The CHPS spacecraft will launch into cislunar space in 2025. It will use smaller wide-field sensors and more sensitive narrow field sensors to discover and key eyes on objects operating in this region as depicted in the image below.



Source: Air Force Research Laboratory

[38] Posaner, J. (2021, July 22). *US Space Force seeking alliances in Europe to guard orbit*. POLITICO. Retrieved January 6, 2022, from https://www.politico.eu/article/us-space-forces-seeks-allies-in-europe-guard-orbit/

[39] Air Force Research Laboratory. (2022, March 1). *SPACE DOMAIN AWARENESS MISSION BEYOND GEOSYNCHRONOUS EARTH ORBIT (GEO)*. Air Force Research Laboratory. Retrieved April 7, 2022, from https://afresearchlab.com/technology/cislunar-highway-patrol-system-chps/

The Air Force Research Laboratory (AFRL) is currently developing novel on-board image processing and orbit determination software as well new navigation techniques to adapt specifically to cislunar.[40] Additionally, AFRL should work with the private sector contribute to the development of CHPS as well. As recently as April 1, 2022 companies that are a part of the Space Enterprise Consortium (SpEC) were encouraged to submit proposals to join the project. According to the CHPS program manager, Michael Lopez, "AFRL is interested in hearing from companies that may have ideas that differ from ours, and could contribute to the satellite's capabilities."[41] CHPS will help monitor spacecraft in cislunar to ensure safety of operations and provide attribution if any harmful actions are taken by an adversary. China similarly understands the strategic importance of cislunar space for high-level domain awareness thus it is vital that the US maintain a competitive edge by working with the private sector.

EVALUATIVE CRITERIA

The table below provides an overview of the ranking for each policy option based on the following criteria: cost-effectiveness, diplomatic cost, ease of implementation, and sustainability.

	Invest in LUMINT	**Develop Cislunar International Treaties**	**Seek Industry Collaboration on CHPS**
Cost-Effectiveness	Medium	High	High
Diplomatic Effectiveness	Medium	High	Medium
Ease of Implementation	Medium	Low	High

[40] AFRL. (n.d.). *Cislunar Highway Patrol System (CHPS)*. AFRL. Retrieved April 7, 2022, from https://www.afrl.af.mil/News/Photos/igphoto/2002556344/mediaid/4752579/

[41] Perkins, J. (2022, March 21). *AFRL's Cislunar Highway Patrol System seeks industry collaboration*. AFRL. Retrieved April 7, 2022, from https://www.afrl.af.mil/News/Article/2972971/afrls-cislunar-highway-patrol-system-seeks-industry-collaboration/

Sustainability	High	Medium	High

RECOMMENDATION

The United States movement beyond GEO into cislunar space opens new opportunities and risks. Cislunar space is a strategic realm because it offers energy, materials, and integrated intelligence. That is why strategic solutions must be offered. Ultimately, it is recommended that the US implement policy alternative three, seek industry collaboration with CHPS, because in aggregate it is the most cost-effective and diplomatically effective solution as well as being easy to implement and highly sustainable in the long run. Option three is the most cost effective because there is are very few costs to partnering with the private sector aside from administrative costs. Additionally, while option three is not as diplomatically effective as option 2, it still ranks moderately highly on that criteria. Option three is significantly easier to implement than the other two options. Developing cislunar international treaties ranks low in this category because outer space treaties are incredibly difficult to enforce, if history has shown us anything. Option three ranks above option 1 because the developments of CHPS are significantly farther along the developments of LUMINT. Finally, Option three is highly sustainable for the future because increasing domain awareness will have direct positive impacts on US national security for years to come.