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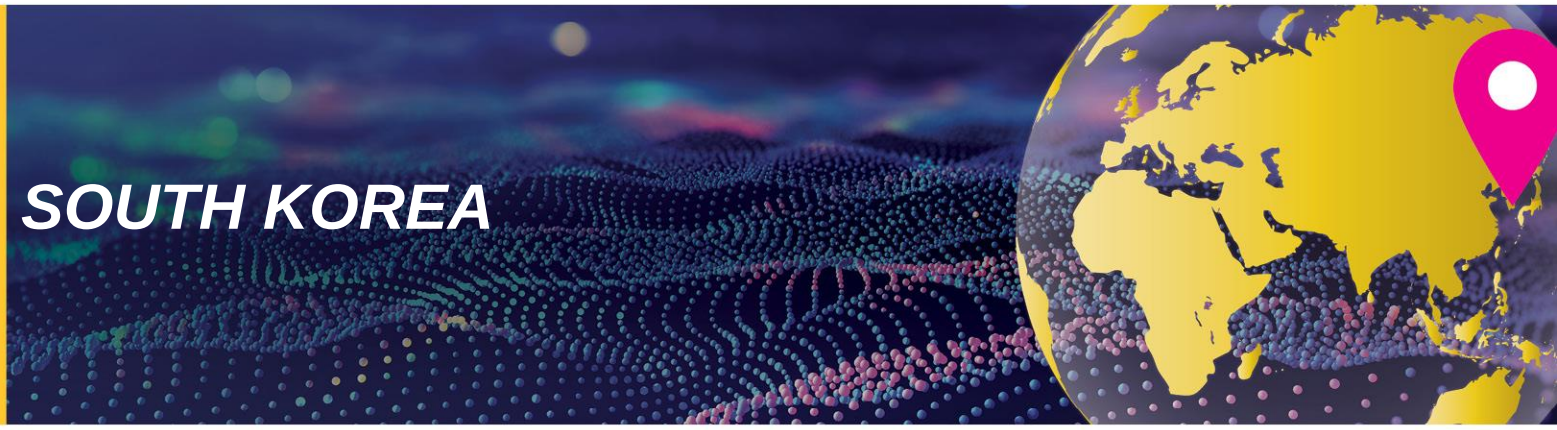

SOUTH KOREA

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Space operations have become increasingly global. Whereas only a few decades ago a couple of major government powers dominated space, now over 70 countries own or operate active satellites in orbit. One of these spacefaring nations is the Republic of Korea, a mature space nation with ambitions to become a space power. This brief is part of a series of country profiles that the Center for Space Policy and Strategy is publishing on space nations, which will highlight the countries' space development, diplomatic activity, and opportunities for collaboration with the United States.

Introduction

South Korea's space program has had a momentous year. In June 2022, the country launched a satellite into orbit using its own rocket for the first time.[1] Six weeks later, the country launched a lunar orbiter—its first lunar mission—which arrived at the moon in mid-December.[2] In February 2023, South Korea released its five-year basic space plan, which laid out bold objectives for government investment and structural changes to its space governance.[3]

The Republic of Korea (ROK) had a relatively late start in space, operating its first satellite in 1992, but has since emerged as a mature space nation. It is one of six countries, plus the European Space Agency, that can independently launch into high orbits, and it is pursuing its own positioning, navigation, and timing satellite constellation, which would be only the seventh such system in the world.[4] These ambitious plans extend to efforts to grow its commercial space sector into a major industry. Figure 1 contains some information about South Korea's space efforts.

Despite being treaty allies and important military partners, South Korea and the United States have thus far had limited collaboration on space issues. This dynamic is changing. Policy and geopolitical shifts have lessened the impediments that previously stood in the way of greater U.S.-ROK space collaboration, particularly for military space activity. As South Korea ascends toward becoming a space power, more opportunities will arise for the nation to engage and partner internationally, particularly with its longtime ally.

AEROSPACE

Figure 1: South Korea's space development.

Regulatory and Policy Context

South Korea's capabilities in space have historically been limited by regulatory and policy constraints. In the late 1970s, the United States and South Korea agreed to a memorandum of understanding that granted South Korea access to U.S. missile technology but imposed limits on any systems derived from this technology, such as space launch vehicles.[5] Specifically, the agreement reportedly allowed for launch vehicles (missiles or space launch systems) with a range of no more than 180 kilometers that could carry payloads weighing no more than 500 kilograms.[6] These parameters were sufficient for the development of missiles that could threaten Pyongyang but insufficient for the realization of an independent space launch capability. In 2001, after years of negotiations, the agreement was revised upon South Korea joining the Missile Technology Control Regime, an informal multilateral export control agreement aiming to limit the proliferation of missiles and missile technology.[7] Although this agreement offered South Korea more flexibility, restrictive U.S. export controls prevented the United States from assisting South Korea in its development of a space launch system.[8] Instead, South Korea turned to Russia, and the two countries jointly developed Naro-1, a space launch vehicle which reached low Earth orbit in 2013.[9]

Recent developments reflect a more conducive policy and regulatory environment for South Korean space efforts. In 2020 and 2021, after years of loosening restrictions, the United States and South Korea agreed to remove limits on South Korean missile and launch vehicle capabilities, which enabled greater freedom and flexibility for the nation's space launch program.[10] In June 2022, South Korea successfully deployed a working satellite into orbit from its three-stage Nuri rocket, which was built by the government's Korea Aerospace Research Institute (KARI), placing the country in the small club of nations that have shown an independent ability to launch into orbit.[11]

Another potential policy shift that could open possibilities for South Korean space development and joint U.S.-ROK space ventures is a reported impending change to the Missile Technology Control Regime. As reported in March, the change would ease the licensing of U.S. satellite-related technology to countries that are members of the regime.[12] Although it would retain tight export limits on space launch vehicles, the change could pave the way for U.S. satellite technology or entire satellites being exported to South Korea. This topic came up in a recent joint statement from the two countries when President Yoon Suk-yeol met with President Biden in Washington in April 2023. Specifically, the joint statement from the meeting notes that both sides "called for strengthening U.S.-ROK commercial space cooperation and welcomed the United States' recent clarification of its export control policies on satellites and satellite components, which provides a foundation for expanded bilateral commercial and governmental space cooperation."[13]

Space Development

Already a mature space nation, the Republic of Korea is accelerating its efforts to become a space power. South Korea currently deploys electro-optical imagery, synthetic aperture radar, and communications satellites, which support civil and military activities, including observing threats in North Korea.[14] As mentioned, the country is also developing its own positioning, navigation, and timing satellites (called the Korean Positioning System or KPS). The country's 2022 budget for space was about US$580 million, which funded several different areas, as shown in Figure 2.[15] The amount represented a nearly 20 percent increase from the previous year's budget.

Yoon, who became president in May 2022, has made space a frequent talking point, including mentioning space in his first speech after the election.[16] As a candidate, he pledged to make the country one of the

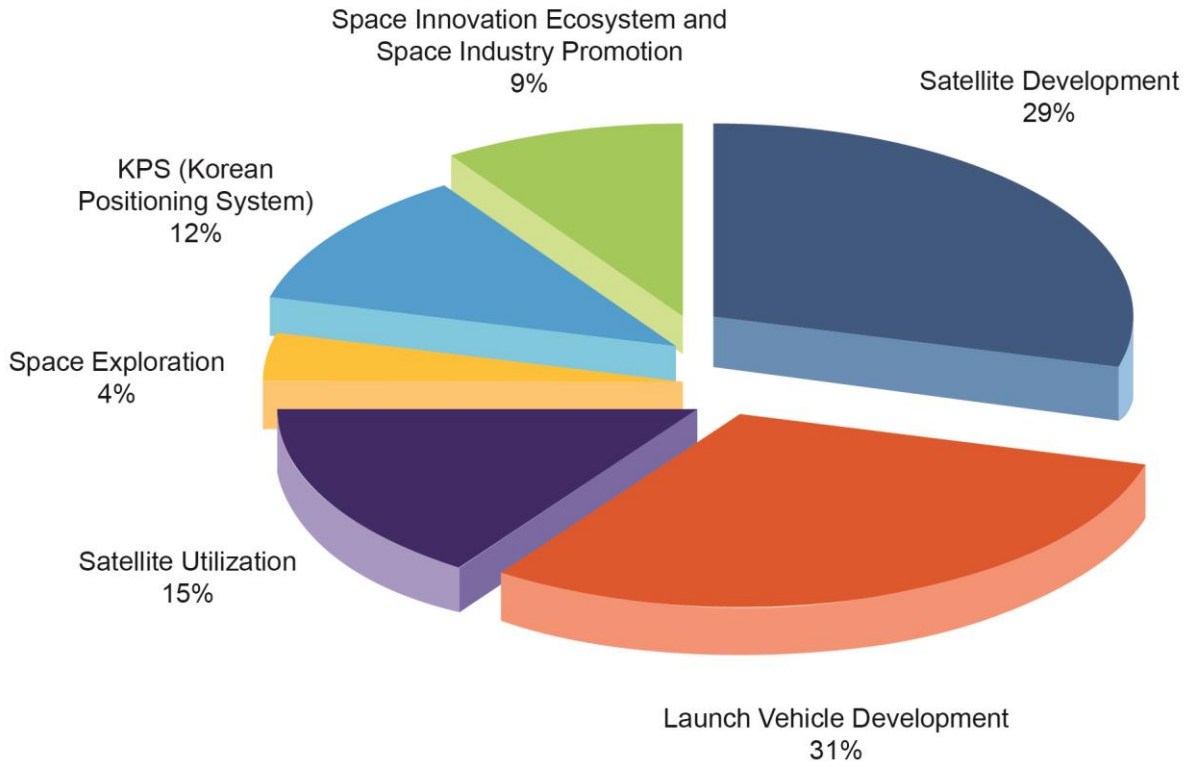
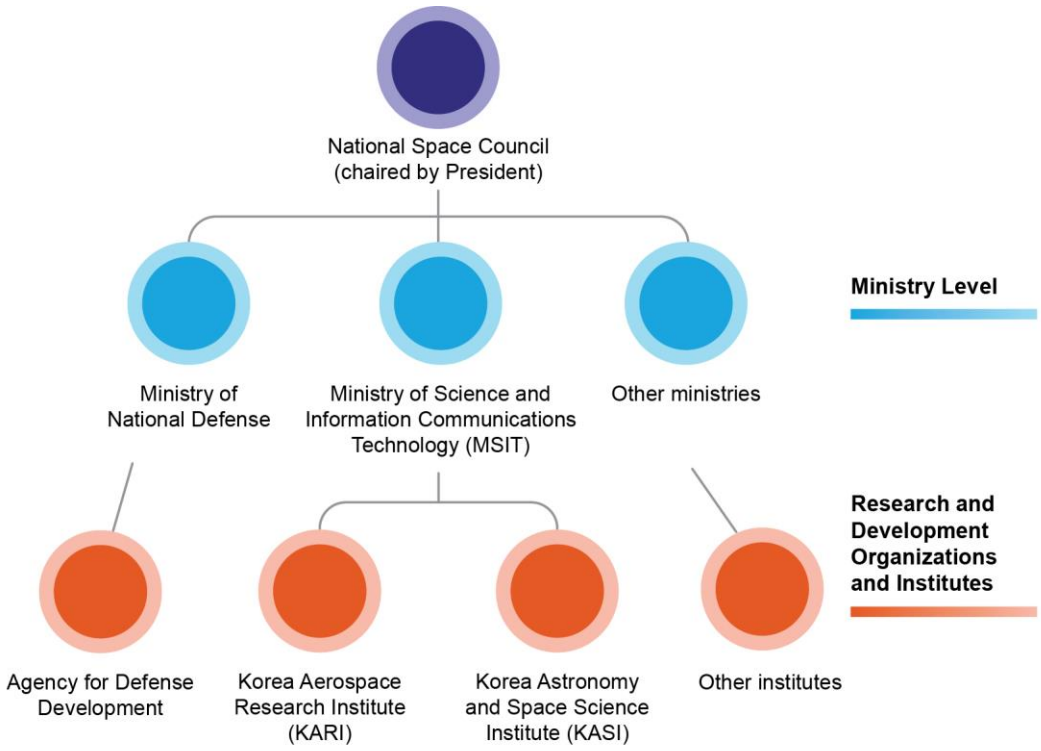


Figure 2: South Korea's space budget, by category and percentage.

seven biggest space nations in the world by 2035.[17] The importance of space to the administration is also reflected in the country's Fourth Space Development Promotion Basic Plan, released in March 2023 (the prior iterations were released in 2007, 2012, and 2018).[18] The fourth plan lays out significant changes in planned government space development and an emphasis on building the country's own space industry.

Plans for Government Development. The fourth basic plan contains ambitious objectives for the country's national space program. It proposes doubling the budget for space from its 2022 levels by 2027.[19] It sets the goal of developing 130 government satellites by 2030, a more than six-fold increase of the number currently in orbit.[20] For space exploration, it proposes developing an independent projectile that can land on the moon in 2032



National Space Council: Writes the national space development roadmap

Ministry of National Defense: Oversees military space activity

MSIT: Sets national science and technology policy and funds R&D and commercial ventures

Agency for Defense Development: Conducts R&D in defense space technology

KARI: Conducts R&D for satellites and space launch vehicles

KASI: Conducts R&D for governmental astronomy and telescopic projects

Figure 3: South Korean governance structure for space activity.

and land on Mars in 2045.[21] It also addresses ventures in military space technology—such as space situational awareness—and new capabilities and next generation systems for weather observation, maritime communications, flood monitoring, disaster emergency communication, and support for aviation operations.

An important feature of the plan is the proposed change to the governance structure for space. The National Space Council, which sets out the national direction for space development, includes members at the minister level and was previously chaired by the prime minister, the deputy head of the government. The basic plan elevates the chair to the president, consistent with the Yoon administration's treatment of space as a national priority.[22] The elevation of the council to the presidential level will lead to more senior involvement in space policy decisions, even after the Yoon administration. The council will not only set the national agenda for space but also seek to achieve more collaboration among the country's space development organizations and agencies, such as the Agency for Defense Development and KARI. Another change made in the plan is the proposal of a new national space agency—the Korean Aerospace Agency (KASA)—which Yoon proposed as a candidate and which the administration hopes to establish by the end of 2023.[23] Figure 3 lays out the governance structure for ROK's current space efforts.

Emphasis on Industry. An objective of the Yoon administration is to build Korea's space industry—to turn the country into a "space economy" power, a theme expanded upon in the basic plan.[24] The plan reports that South Korea's approximately 400 space companies contribute to about one percent of global space sales, and it sets the goal of increasing that to 10 percent by 2045.[25] The country seeks to achieve this goal partly through guaranteeing a market for Korean commercial space companies. The plan recognizes that much of the commercial space activity in South Korea, as it is globally, is reliant on government spending. Indeed, the ROK government bought 66 percent of the commercial space sales in South Korea in 2020. The role of the government in creating an early market for Korean space companies will continue, according to the plan, as the country progresses toward its 2045 goal.

Another approach to accelerate South Korea's domestic space industry is to transfer technology and space systems from the government to the private sector. This would apply to satellite systems and launch vehicles, including transferring Nuri, the Korean space launch vehicle, to stimulate a commercial-led space launch market. The Nuri transfer is expected to cost between $500 and $600 million from 2022 through 2027.[26]

The country has already had some transfers and public-private partnerships in development.[27] In 2021, Korea Advanced Institute of Science & Technology (KAIST), a national research university, agreed to share its spacecraft manufacturing technologies with three major South Korean aerospace companies: Hanwha Aerospace, Korea Aerospace Industries, and LIG Nex1.[28] Also in 2021, KAIST and Hanwha Group—which encompasses both Hanwha Aerospace and Hanwha Systems—agreed to build a space research center, which would, among other things, seek to pursue intersatellite link technology.[29] As another example, KAIST recently agreed to partner with Korea Aerospace Industries to further develop ground processing technologies for satellite imagery.[30]

The encouragement of public-private partnerships for space and the notion of transferring public space technology to the private sector seems to carry broad government support, including from the country's legislative body, the National Assembly. In June 2022, the National Assembly passed an amendment to the country's Space Development Promotion Act that largely focused on commercial activity. The amendment calls for the "establishment of space infrastructure for space development and provision of open access to the private sector" and "designation of new space technologies and acceleration of technology transfer."[31] The budget also suggests support for private space industry: the 2022 funding for "space innovation ecosystem and space industry promotion" is a nearly 40 percent increase from 2021 and more than double the amount from 2020.

View from the United States

As a rising space power and longtime security ally, South Korea should appear to the United States as a compelling partner for space, including for military activity. South

Korea's ascent in space comes at a time in which the U.S. government has been more active in pursuing defense collaboration for the domain. In a memo released in January 2023, General B. Chance Saltzman, Chief of Space Operations of the U.S. Space Force, said the service should pursue stronger partnerships with allies, naming "partner to win" as one of his top three priorities.[32] Earlier, in February 2022, the United States—along with Australia, Canada, France, Germany, New Zealand, and the United Kingdom—released a shared vision document on combined space operations. The document discussed, among other things, developing interoperable architectures to support joint military operations and fostering responsible military behaviors in space.[33]

South Korea seems to be a willing partner for more extensive collaboration. Analysts have assessed that President Yoon's top foreign policy priority is to establish a closer security relationship with the United States.[34] In his first press conference after the March 2022 election, Yoon declared, "First, we will build a Korea-U.S. Comprehensive Strategic Alliance," and, in November 2022, asserted that the Korea-U.S. alliance "will be extended into the Korea-U.S. space alliance."[35] Although South Korea has historically had to balance its economic relationship with China and its security relationship with the United States, it is unclear whether further integration with the United States on military space capabilities would raise serious objections in Beijing.

The U.S.-ROK space collaboration has progressed significantly in recent years. In April 2022, South Korea's Ministry of Defense and the U.S. Department of Defense agreed to carry out research for an official joint document on space policy.[36] In December 2022, the U.S. Space Force stood up a field component command in South Korea, its first ever command post in a foreign country.[37] The joint statement from President Yoon and President Biden's April 2023 meeting in Washington emphasizes that "the alliance also applies to space" and notes that both presidents welcomed "deepening space security cooperation."[38] These developments are important in their own right but will also create opportunity for more collaboration on joint military capabilities and in diplomatic efforts.

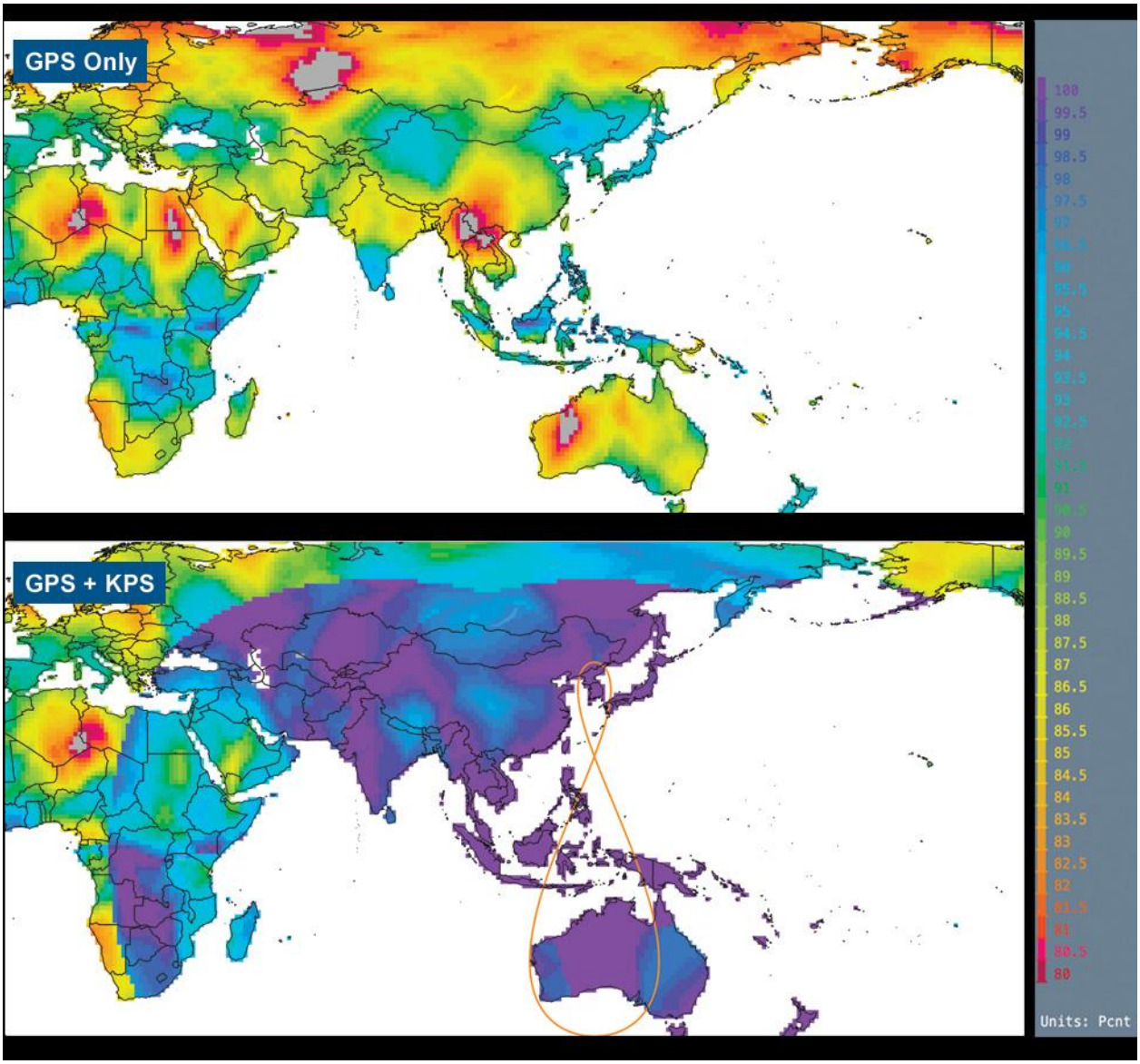
Prospects for Integrated and Interoperable Capabilities in Space. Positioning, navigation, and timing (PNT) could be an intriguing area for potential joint U.S.-ROK collaboration. South Korea allocated 12 percent of its 2022 space budget for its planned PNT satellite network, KPS.[39] With launches planned from 2027 to 2035, KPS would comprise an eight-satellite independent regional system.[40] Such a capability over South Korea could be particularly valuable to the United States as a backup or complement to the Global Positioning System (GPS).

An interoperable KPS-GPS capability could take multiple forms. One approach would be for South Korea to develop the same non-military signals used by GPS, designing their signals to meet GPS signal specifications. Japan did this for its navigation satellites—the Quasi-Zenith Satellite System or QZSS—which has allowed a high level of interoperability and synchronization between GPS and QZSS. South Korea and the United States could also integrate their military PNT capabilities with South Korea hosting U.S. GPS military payloads (called military code or M-Code) on KPS satellites. Such integration would offer heightened precision over North Korea and swaths of China and Russia. The KPS satellites could host standard M-Code payloads or a high-power version that makes the signals much less vulnerable to jamming. Hosting U.S. military payloads on KPS satellites would pose trade-offs: it could take years of testing and synchronization, it could raise technological security concerns, and the high-power M-Code option would likely add to the weight requirements for the satellites. However, achieving a more accurate and resilient capability in a strategically important region makes these trade-offs worth considering. The United States is gaining some experience integrating military payloads on foreign satellites: in 2023,

the United States is scheduled to launch U.S. national security payloads via a Norwegian spacecraft, the first time that a foreign spacecraft will host operational U.S. national security payloads.[41]

Figure 4 diagrams the accuracy of GPS versus a joint GPS-KPS system. Specifically, it shows percentages of time with minimal estimated positional error. As the colors turn from red to green to purple, the system is more likely to achieve a specific accuracy threshold.

South Korea and the United States have discussed PNT collaboration, among other areas. In 2021, the two countries signed a joint statement on cooperation for global navigation satellite systems, in which they agreed to "pursue interoperability, to the extent possible."[42] In August 2022, the Minister of Science and Information Communications Technology met with Chirag Parikh, the Executive Secretary of the U.S. National Space Council.[43] They reportedly discussed collaboration for KPS, among other topics.



Note: These visuals use a 20-degree elevation. The colors specifically refer to the percentage of time that the position dilution of precision (often referred to as PDOP), which is proportional to position error, is less than 4.0, a common threshold for PNT. In the red, the system will achieve a PDOP of 4.0 or less 80 percent of the time; in the purple, the system will achieve a PDOP of 4.0 or less 100 percent of the time.

Figure 4: Potential accuracy of a joint GPS-KPS system.

Outside of PNT, in April 2022, the two countries announced an agreement that included cooperation on space situational awareness for military purposes to "share intelligence about outer space, nurture space experts through training and exercises, and enhance interoperability for combined space operations."[44] Analysts have pointed to space situational awareness as a compelling area for deeper collaboration between the two countries.[45] The joint statement from President Yoon's April 2023 visit to Washington also mentions that both sides will "work towards advancing bilateral space situational awareness cooperation," and the two countries signed a memorandum of understanding to share space situational awareness information in 2014.[46]

Multilateral defense space collaboration could be another approach for South Korea, including trilateral defense space collaboration with the United States and Japan.[47] Japan and South Korea are two of United States' closest allies and military partners, two of the three countries in which the United States deploys more troops than anywhere else in the world. The two countries are also developing capabilities in similar areas—Japan has a regional independent PNT satellite network, deploys electro-optical and radar reconnaissance satellites, and is pursuing sophisticated space situational awareness systems.[48] Although South Korea and Japan's relationship has often been limited by historical tensions, there are signs for optimism. In August 2022, Japan, South Korea, and the United States participated in a missile defense exercise, which followed a trilateral ministerial meeting in Singapore.[49] In September 2022, Japanese Prime Minister Fumio Kishida met President Yoon for a short meeting at the UN General Assembly.[50] Yoon, as president-elect, proposed taking a "future-oriented" approach toward ROK-Japan and calling for urgently restoring their relationship.[51]

Diplomatic Partnership. The Republic of Korea has historically supported multilateral space diplomacy—ratifying the UN Outer Space Treaty, the Rescue Agreement, the Liability Convention, and the Registration Convention and participating as a member of the Conference on Disarmament and the Committee on the Peaceful Uses of Outer Space. [52] Up until recently, South Korea has avoided taking a position on the most contentious space security debates. In 2008, Russia and China introduced a draft treaty called the "Prevention of the Placement of Weapons in Outer Space, the Threat of Use of Force Against Outer Space Objects," commonly known as PPWT, which Russia reintroduced in 2014.[53] The purported aim of the draft treaty is to prohibit weapons from being deployed in space. The United States opposed the proposal due to concerns about verification, challenges in defining key terms in the treaty, and gaps in coverage of key technologies such as ground-based anti-satellite weapons.[54] Until recently, South Korea had abstained on resolutions referencing PPWT, such as "Further practical measures for the prevention of an arms race in outer space," or other Russian and Chinese proposals such as "No first placement of weapons in outer space."[55] In 2022, however, ROK shifted its position and voted "No" on "No First Placement," indicating a greater willingness to oppose the Russian- and Chinese-backed proposals.[56]

Furthermore, South Korea has recently made diplomatic statements that complement U.S. efforts to develop norms of responsible behavior in space rather than the approach favored by Russia and China of prohibiting the development or deployment of specific capabilities. South Korea's response to a 2021 UN resolution on developing norms of behavior, a UK-led effort supported by the United States, criticized the "capability" approach.[57] South Korea argued in its statement that the focus on "regulating weapons or capabilities themselves" may be partly responsible for the absence of an "international legal regime specifically dealing with the deliberate threats of States to space assets or activities of other States."[58] More importantly, the statement argued for the importance of defining responsible and irresponsible behaviors. Along these lines, in 2022, South Korea became the sixth country to join the United States in its pledge not to conduct direct-ascent anti-satellite missile tests.[59]

As space becomes more contested, South Korea will be a valuable ally and partner in the critical efforts to build agreement about which behaviors in space are acceptable or unacceptable. South Korea also joined the NASA-led Artemis Accords in May 2021, and the country's Vice Foreign Minister Choi Jong-moon stated shortly after the signing that multilateral space diplomacy was the most effective means to solve transnational space issues.[60] The

alternative, said Choi, was a competitive "race to the bottom" wherein countries fought amongst themselves rather than cooperating on extant and emerging space issues. South Korea's growth as an active player in space diplomacy will likely continue as the country engages more in the domain.

Conclusion

This year, 2023, marks the seventieth anniversary of the signing of the U.S.-ROK mutual defense treaty. Situated in a region of strategic importance and close to several potential adversaries, South Korea is a crucial ally for the United States, hosting tens of thousands of U.S. military forces. Although the two countries' wide-ranging levels of military cooperation have not historically expanded to space, circumstances have become auspicious for extensive U.S.-ROK defense space collaboration. The Republic of Korea's gains in advancing its commercial space industry and integrating and expanding its government space development will make the country an attractive partner for joint systems and diplomatic efforts. With the relaxation of policy and regulatory hurdles that had limited its space growth, South Korea has emerged as a mature space nation with the intent to become a space power.

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References

[1] Choe Sang-Hun, "South Korea Launches Satellite With Its Own Rocket for the First time," *The New York Times*, June 21, 2022, https://www.nytimes.com/2022/06/21/world/asia/south-korea-rocket-launch-nuri.html.

[2] Smriti Mallapaty, "To the Moon! South Korea's first lunar mission is on its way," *Nature*, August 5, 2022, https://www.nature.com/articles/d41586-022-02113-z.

[3] South Korean Ministry of Science and ICT, "Fourth Space Development Promotion Basic Plan: Realization of a space economy powerhouse by 2045," December 2022, (machine translated), https://www.msit.go.kr/bbs/view.do?sCode=user&bbsSeqNo=65&nttSeqNo=3017397.

[4] Euroconsult, "New record in Government Space Defense spendings driven by investments in Space Security and Early Warning," (December 15, 2022). https://www.euroconsult-ec.com/press-release/new-record-in-government-space-defense-spendings-driven-by-investments-in-space-security-and-early-warning/; . "Competing in Space," National Air & Space Intelligence Center, December 2018. https://media.defense.gov/2019/Jan/16/2002080386/-1/-1/1/190115-F-NV711-0002.PDF.

[5] *The US-South Korea Alliance: Meeting New Security Challenges*, edited by Scott Snyder, "Outer Space," James Clay Moltz, (Boulder, Colorado: Lynne Rienner Publishers 2012); *Asia's Space Race: National Motivations, Regional Rivalries, and International Risks* (New York: Columbia University Press, 2018).

[6] Daniel Pinkston, "The New South Korean Missile Guidelines and Future Prospects for Regional Stability," *International Crisis Group*, October 25, 2012, https://www.crisisgroup.org/asia/north-east-asia/korean-peninsula/new-south-korean-missile-guidelines-and-future-prospects-regional-stability.

[7] *The US-South Korea Alliance: Meeting New Security Challenges*, edited by Scott Snyder, "Outer Space," James Clay Moltz, (Boulder, Colorado: Lynne Rienner Publishers 2012); Daniel Pinkston, "The New South Korean Missile Guidelines and Future Prospects for Regional Stability," *International Crisis Group*, October 25, 2012, https://www.crisisgroup.org/asia/north-east-asia/korean-peninsula/new-south-korean-missile-guidelines-and-future-prospects-regional-stability; Stephanie Wan, "U.S. - South Korean Space Cooperation," *Secure World Foundation*, September 2010, https://swfound.org/media/205872/us-korean_space_cooperation_final_sept_2010.pdf; U.S. Department of State, Missile Technology Control Regime (MTCR) Frequently Asked Questions, https://www.state.gov/remarks-and-releases-bureau-of-international-security-and-nonproliferation/missile-technology-control-regime-mtcr-frequently-asked-questions/.

[8] *The US-South Korea Alliance: Meeting New Security Challenges*, edited by Scott Snyder, "Outer Space," James Clay Moltz, (Boulder, Colorado: Lynne Rienner Publishers 2012). Daniel Pinkston, "The New South Korean Missile Guidelines and Future Prospects for Regional Stability," *International Crisis Group*, October 25, 2012, https://www.crisisgroup.org/asia/north-east-asia/korean-peninsula/new-south-korean-missile-guidelines-and-future-prospects-regional-stability; Stephanie Wan, "U.S. - South Korean Space Cooperation," *Secure World Foundation*, September 2010, https://swfound.org/media/205872/us-korean_space_cooperation_final_sept_2010.pdf.

[9] *The US-South Korea Alliance: Meeting New Security Challenges*, edited by Scott Snyder, "Outer Space," James Clay Moltz, (Boulder, Colorado: Lynne Rienner Publishers 2012); Daniel Pinkston, "The New South Korean Missile Guidelines and Future Prospects for Regional Stability," *International Crisis Group*, October 25, 2012, https://www.crisisgroup.org/asia/north-east-asia/korean-peninsula/new-south-korean-missile-guidelines-and-future-prospects-regional-stability; Choe Sang-Hun, "South Korea Launches Satellite With Its Own Rocket for the First time," *The New York Times*, June 21, 2022, https://www.nytimes.com/2022/06/21/world/asia/south-korea-rocket-launch-nuri.html.

[10] Ankit Panda, "Solid Ambitions: The U.S.-South Korea Missile Guidelines and Space Launchers," *Carnegie Endowment for International Peace*, August 25, 2020, https://carnegieendowment.org/2020/08/25/solid-ambitions-u.s.-south-korea-missile-guidelines-and-space-launchers-pub-82557; Hyung-Jin Kim, "South Korea to have solid-fuel rockets in major deal with US," *Defense News*, July 28, 2020, https://www.defensenews.com/global/asia-pacific/2020/07/28/south-korea-to-have-solid-fuel-rockets-in-major-deal-with-us/; Timothy Wright, "US and South Korea scrap ballistic-missile range limits," *IISS*, June 2, 2021, https://www.iiss.org/blogs/analysis/2021/06/us-south-korea-ballistic-missile-range-limit; Sung-won Shim, "U.S., South Korea agree on longer range ballistic missiles," *Reuters*, October 7, 2012, https://www.reuters.com/article/us-korea-usa-missile/u-s-south-korea-agree-on-longer-range-ballistic-missiles-idUSBRE89602J20121007. Kim Tong-Hyung, "S Korea test launches 1st domestically made space rocket," *Associated Press*, October 21, 2021, https://apnews.com/article/space-launches-technology-science-

south-korea-eba9af4f1dec9751133fd7052b9da146; "South Korea launches its first homemade space rocket," *The Guardian*, October 21, 2021, https://www.theguardian.com/world/2021/oct/21/south-korea-launches-its-first-homemade-space-rocket;

[11] Choe Sang-Hun, "South Korea Launches Satellite With Its Own Rocket for the First time," *The New York Times*, June 21, 2022, https://www.nytimes.com/2022/06/21/world/asia/south-korea-rocket-launch-nuri.html.

[12] Theresa Hitchens, "Commerce eases satellite exports to MTCR partners; South Korea a key focus," *Breaking Defense*, March 16, 2023, https://breakingdefense.com/2023/03/commerce-eases-satellite-exports-to-mtcr-partners-south-korea-a-key-focus/.

[13] "Leaders' Joint Statement in Commemoration of the 70th Anniversary of the Alliance between the United States of America and the Republic of Korea," The White House (April 26, 2023) https://www.whitehouse.gov/briefing-room/statements-releases/2023/04/26/leaders-joint-statement-in-commemoration-of-the-70th-anniversary-of-the-alliance-between-the-united-states-of-america-and-the-republic-of-korea/#:~:text=Guided%20by%20our%20shared%20commitment,to%20build%20prosperity%20and%20security.

[14] *The US-South Korea Alliance: Meeting New Security Challenges,* edited by Scott Snyder, "Outer Space," James Clay Moltz, (Boulder, Colorado: Lynne Rienner Publishers 2012). *Asia's Space Race: National Motivations, Regional Rivalries, and International Risks* (New York: Columbia University Press, 2018).

[15] Conversion based on exchange rate of December 30, 2022. "Foreign Exchange Rates," The Federal Reserve (Accessed on March 30, 2023) https://www.federalreserve.gov/RELEASES/H10/hist/dat00_ko.htm. Budget data from KARI officials, November 2022.

[16] Esther Chung, "Yoon sets Korea-U.S. ties as a top priority," Korea JoogAng Daily, (March 13, 2023) https://koreajoongangdaily.joins.com/2022/03/13/national/diplomacy/korea-election-new-president/20220313191919489.html.

[17] Park Si-soo, "South Korea's new president seeks independent space agency, deeper US space cooperation," Space News (May 9, 2022) https://spacenews.com/south-koreas-new-president-seeks-independent-space-agency-deeper-us-space-cooperation/.

[18] "Korea: The Space Economy at a Glance 2014," *OECD Library*, accessed March 24, 2023, https://www.oecd-ilibrary.org/docserver/9789264217294-36-en.pdf?expires=1679601370&id=id&accname=guest&checksum=E71BF5A238EE08E5BCC99F3162C3A4E5; " S. Korea vows to promote private-led space development by 2030," *Pulse*, February 5, 2018, https://pulsenews.co.kr/view.php?year=2018&no=83120.

[19] Shin Ji-hye, "Moon landing in 2032, Mars by 2045: Yoon sets space goals," *The Korea Herald*, November 28, 2022,

https://www.koreaherald.com/view.php?ud=20221128000695.

[20] "Union of Concerned Scientists Satellite Database," *Union of Concerned Scientists*, updated May 1, 2022, https://www.ucsusa.org/resources/satellite-database.

[21] Shin Ji-hye, "Moon landing in 2032, Mars by 2045: Yoon sets space goals," *The Korea Herald*, November 28, 2022, https://www.koreaherald.com/view.php?ud=20221128000695.

[22] Hae-Sung Lee and In-Yeop Kim, "S. Korean President Yoon to lead national space policy," *The Korea Economic Daily*, November 28, 2022, https://www.kedglobal.com/aerospace-defense/newsView/ked202211280023.

[23] Shin Ji-hye, "Moon landing in 2032, Mars by 2045: Yoon sets space goals," *The Korea Herald*, November 28, 2022, https://www.koreaherald.com/view.php?ud=20221128000695.

[24] "Yoon to announce road map for 'future space economy,'" Yonhap News Agency (November 27, 2022) https://en.yna.co.kr/view/AEN20221127002200315.

[25] Center for Future Defense Technology & Entrepreneurship, "South Korea's Space Industry, Seokyeong University (March 21, 2022).

[26] Shin Ha-Nee, "Hanwha Aerospace chosen for Nuri's technology transfer," Korea JoongAng Daily, (October 7, 2022), https://koreajoongangdaily.joins.com/2022/10/07/business/tech/Korea-Hanwha-Aerospace/20221007174047468.html. Conversion based on exchange rate of December 30, 2022. "Foreign Exchange Rates," The Federal Reserve (Accessed on March 30, 2023) https://www.federalreserve.gov/RELEASES/H10/hist/dat00_ko.htm.

[27] For more information on South Korea's public-private partnerships, see: Hyeung Jun Ahn, Hyun Jun Park, Min ji Kang, and Ji Eun Yoo, "Plans for Public-Private Partnership Expansion to Improve Space Industry Competitiveness in the New Space Era," Science and Technology Policy Institute, Vol. 273, (May 12, 2021).

[28] Park Si-soo, "Hanwha, KAI and LIG Nex1 to lead South Korea's private-sector-driven satellite development," *SpaceNews*, (June 14, 2021) https://spacenews.com/hanwha-kai-and-lig-nex1-to-lead-south-koreas-private-led-satellite-development/.

[29] Kyung-min Kang, "Hanwha, KAIST to co-launch space research center," The Korea Economic Daily (May 17, 2021). https://www.kedglobal.com/space-business/newsView/ked202105170020

[30] Kim Joo-heon, "KAI teams up with KAIST to develop super-resolution technology for satellites," Aju Business Daily (July 25, 2022). South Korean space companies have also been engaging with the broader space industry. For example, Hanwha Systems in 2021 purchased an 8.8 percent stake ($300 million) in satellite company OneWeb. Hanwha Systems in 2021 also invested $30 million in a Kymeta, a U.S. satcom company. Jason Rainbow, "South Korea's Hanwha enlarges space focus with $300 OneWeb investment," SpaceNews (August 12, 2021) https://spacenews.com/south-koreas-hanwha-enlarges-space-focus-with-300-million-oneweb-investment/; Kymeta Corporation, "Hanwha Systems $30M Investment into Kymeta Corp. Approved by CFIUS," (May 26, 2021) https://www.kymetacorp.com/news/hanwha-systems-30m-investment-kymeta-corp-approved-. cfius/.

[31] South Korea Ministry of Science and Technology, "The Amendment to the Space Development Promotion Act to pass the National Assembly," June 7, 2022, https://www.msit.go.kr/eng/bbs/view.do?sCode=eng&mId=4&mPid=2&pageIndex=&bbsSeqNo=42&nttSeqNo=687&searchOpt=ALL&searchTxt=.

[32] U.S. Space Force, "CSO releases Lines of Effort," (January 18, 2023) https://www.spaceforce.mil/News/Article/3270867/cso-releases-lines-of-effort/.

[33] U.S. Department of Defense, "DoD and Partners Release Combined Space Operations Vision 2031," (February 22, 2022) https://www.defense.gov/News/Releases/Release/Article/2941594/dod-and-partners-release-combined-space-operations-vision-2031/.

[34] Jenny Town, "The Election of Yoon Suk-Yeol and Implications for the United States: An Alliance-First Approach to North Korea," The National Bureau of Asian Research (March 24, 2022) https://www.nbr.org/publication/the-election-of-yoon-suk-yeol-and-implications-for-the-united-states-an-alliance-first-approach-to-north-korea/.

[35] "Yoon sets Korea-U.S. ties as top priority," *Korea JoongAng Daily*, March 13, 2022, https://koreajoongangdaily.joins.com/2022/03/13/national/diplomacy/korea-election-new-president/20220313191919489.html; Park Si-soo, "South Korea leader eyes 'landing on moon in 2032, Mars in 2045,'" *SpaceNews*, November 29, 2022, https://spacenews.com/134853-2/.

[36] Ji Da-gyum, "S. Korea, US agree on first joint research to develop defense space strategy," The Korea Herald (April 26, 2022), https://www.koreaherald.com/view.php?ud=20220426000882.

[37] U.S. Space Force "Space Force activates component field command for U.S. Forces Korea," (December 14, 2022) https://www.spaceforce.mil/News/Article/3249547/space-force-activates-component-field-command-for-us-forces-korea/; Brad Lendon, "US Space Force establishes first foreign command in South Korea as threat from North grows," CNN (December 14, 2022) https://www.cnn.com/2022/12/14/asia/us-space-force-new-command-korea-intl-hnk-ml/index.html#:~:text=US%20soldiers%20attend%20the%20activation,%2C%20in%20Pyeongtaek%2C%20South%20Korea.&text=The%20US%20military%20activated%20its,any%20threat%20in%20the%20region.;

[38] "Leaders' Joint Statement in Commemoration of the 70th Anniversary of the Alliance between the United States of America and the Republic of Korea," The White House (April 26, 2023) https://www.whitehouse.gov/briefing-room/statements-releases/2023/04/26/leaders-joint-statement-in-commemoration-of-the-70th-anniversary-of-the-alliance-between-the-united-states-of-america-and-the-republic-of-korea/#:~:text=Guided%20by%20our%20shared%20commitment,to%20build%20prosperity%20and%20security.

[39] See Figure 2.

[40] Lim Chang-won, "Some $2.8 billion earmarked for development of independent satellite-navigation system by 2035," Aju Business Daily (July 18, 2022) https://www.ajudaily.com/view/20220718145210991.

[41] Nathan Strout, "How 2 Space Norway satellites will help the Air Force in the Arctic," C4ISRNET, (July 5, 2019) https://www.c4isrnet.com/battlefield-tech/2019/07/05/how-2-space-norway-satellites-will-help-the-air-force-in-the-arctic/; U.S. Space Systems Command, "USSF's EPS-R Program on Schedule for Historic Polar Mission," (October 29, 2021) https://www.ssc.spaceforce.mil/Newsroom/Article-Display/Article/2827813/ussfs-eps-r-program-on-schedule-for-historic-polar-mission#:~:text=Hosting%20the%20EPS-R%20payload%20on%20the%20Norwegian%20Artic,years%20faster%20than%20a%20traditional%20satellite%20acquisition%20program.

[42] "Joint Statement by the United States of America And the Republic of Korea on Civil Global Navigation Satellite Systems Cooperation," (May 2021), GPS.gov. https://www.gps.gov/policy/cooperation/korea/2021-joint-statement/.

[43] "S. Korean ICT minister discusses technology alliance, partnership with U.S. tech, space officials," *Yonhap News Agency*, August 2, 2022, https://en.yna.co.kr/view/AEN20220802003900320.

[44] Park Si-soo, "U.S., South Korea agree to cooperate on space situational awareness for military purposes," SpaceNews (April 26, 2022). https://spacenews.com/u-s-south-korea-agree-to-cooperate-on-space-situational-awareness-for-military-purposes/

[45] Jacob Stokes and Joshua Fitt, "Peninsula Plus," Center for New American Security (March 2023), https://s3.us-east-1.amazonaws.com/files.cnas.org/documents/PeninsulaPlus_Final.pdf?mtime=20230315092611&focal=none.

[46] "Leaders' Joint Statement in Commemoration of the 70th Anniversary of the Alliance between the United States of America and the Republic of Korea," The White House (April 26, 2023) https://www.whitehouse.gov/briefing-room/statements-releases/2023/04/26/leaders-joint-statement-in-commemoration-of-the-70th-anniversary-of-the-alliance-between-the-united-states-of-america-and-the-republic-of-korea/#:~:text=Guided%20by%20our%20shared%20commitment,to%20build%20prosperity%20and%20security. "DoD Agrees to Share Space Data with South Korea," U.S. Strategic Command (September 5, 2014) https://www.stratcom.mil/Media/News/News-Article-View/Article/983783/dod-agrees-to-share-space-data-with-south-korea/.

[47] Clint Work, "U.S.-Japan-ROK Trilateral Cooperation," The National Bureau of Asian Research (August 1, 2022), https://www.nbr.org/publication/u-s-japan-rok-trilateral-cooperation-transforming-the-u-s-rok-alliance-through-a-trilateral-prism/.

[48] Robert S. Wilson, "Japan's Gradual Shift Toward Space Security," The Aerospace Corporation (May 20, 2020) https://csps.aerospace.org/papers/japans-gradual-shift-toward-space-security.

[49] U.S. Department of Defense, "U.S., Republic of Korea, and Japan Participate in Missile Defense Exercise in Hawaii (August 15, 2022).

[50] Timothy W. Martin and Peter Landers, "Japan and South Korea Leaders Meet One-on-One for the First Time Since 2019," The Wall Street Journal (September 22, 2022).

[51] Ahn Sung-mi, "Yoon calls for 'urgent' efforts to restore ties with Japan," *The Korea Herald*, March 28, 2023, https://www.koreaherald.com/view.php?ud=20220328000673.

[52] "Status of International Agreements relating to activities in outer space as at 1 January 2022," *Committee on the Peaceful Uses of Outer Space*, March 28, 2022, 8, https://www.unoosa.org/res/oosadoc/data/documents/2022/aac_105c_22022crp/aac_105c_22022crp_10_0_html/AAC105_C2_2022_CRP10E.pdf.

[53] "Draft Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects," *Ministry of Foreign Affairs of the People's Republic of China*, February 12, 2008, https://www.fmprc.gov.cn/mfa_eng/wjb_663304/zzjg_663340/jks_665232/kjfywj_665252/200802/t20080212_599554.html.

[54] Robert Wood, "Statement by Ambassador Wood: The Threats Posed by Russia and China to Security of the Outer Space Environment," *U.S. Mission to International Organizations in Geneva*, August 14, 2019, https://geneva.usmission.gov/2019/08/14/statement-by-ambassador-wood-the-threats-posed-by-russia-and-china-to-security-of-the-outer-space-environment/.

[55] United Nations, "Further practical measures for the prevention of an arms race in outer space," *United Nations Digital Library* (A/RES/74/34), December 12, 2019, https://digitallibrary.un.org/record/3839974?ln=en; and United Nations, "No first placement of weapons in outer space," *United Nations Digital Library* (A/RES/69/32), December 2, 2014, https://digitallibrary.un.org/record/820062?ln=en.

[56] United Nations, "No first placement of weapons in outer space," *United Nations Digital Library* (A/RES/77/42), December 7, 2022, https://digitallibrary.un.org/record/3996913?ln=en.

[57] Republic of Korea, "Republic of Korea's National Report on the UNGA Resolution A/RES/75/36," *United Nations Office for Disarmament Affairs*, May 3, 2021, https://front.un-arm.org/wp-content/uploads/2021/05/210503-National-Submission-Republic-of-Korea_75_36.pdf.

[58] Republic of Korea, "Republic of Korea's National Report on the UNGA Resolution A/RES/75/36," *United Nations Office for Disarmament Affairs*, May 3, 2021, https://front.un-arm.org/wp-content/uploads/2021/05/210503-National-Submission-Republic-of-Korea_75_36.pdf.

[59] Park Si-soo, "UK, South Korea join ASAT test ban, raising like-minded countries to seven," *SpaceNews* (October 5, 2022) https://spacenews.com/uk-south-korea-join-asat-test-ban-raising-like-minded-countries-to-seven/.

[60] Park Si-soo, "South Korea touts Artemis Accords as a way to settle international space issues," *SpaceNews*, August 19, 2021, https://spacenews.com/south-korea-touts-artemis-accords-as-a-way-to-settle-international-space-issues/.

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