

Arctic Space Strategy: The US and Norwegian Common Interest and Strategic Effort

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Abstract

The US and Norway are Arctic and space nations and members of the NATO alliance. The increased strategic significance of the Arctic due to the retreating ice presents challenges best solved by elevated space capabilities. Both nations will gain from greater cooperation regarding the Arctic as a region and space as a domain. Areas of collaboration should include space domain awareness; communication capacity; intelligence, surveillance, and reconnaissance; launch capability; and education, research, and technology development. An improved combined Arctic space strategy for both nations with an immediate focus on shared knowledge and understanding through education and liaising will increase cooperation and effectiveness at a low cost.

The Arctic region has historically been a remote, unfriendly area where only the most eager hunters, explorers, and scientists have shown any interest. Climate change and the following increased temperatures in the last 10 to 20 years have changed the Arctic's characteristics. The Arctic region is still a harsh environment not suitable for regular human settlement and operations. However, resources previously inaccessible are now readily available due to the melting ice. Formerly unusable sea lines of communication are now open and free of ice for extended periods of the year. Many nations see the opportunities the melting ice brings in the Arctic. China and Russia have declared their interests in the new possibilities regarding resources in the area and have increased their presence commercially and militarily. The Arctic has become an area of strategic competition and increased global strategic significance but lacks the basic infrastructure to be controlled and exploited safely and securely.

The Arctic's harsh environment and weather conditions limit the region's settlements and infrastructure. Space will play a unique role in pro-

viding the necessary means to control and secure operations in the Arctic for commercial, civil, and military activity for all stakeholders. As an Arctic nation, Norway has learned to live, function, and thrive in the region. The nation has played a significant strategic role for NATO due to its northern geography and proximity to the Russian Northern Fleet's operating area. As the most prominent member of the NATO alliance and an Arctic nation, the US has emphasized Norway's crucial geostrategic position. The increased activity and access to the Arctic region further increase Norway's global strategic importance. Norway should continue to have a key role in US Arctic strategy because the two nations have an equal interest in the region. Both nations have specific knowledge and technology to bring to the cooperation, and enhanced space capabilities will increase security to operate in the region for both.

This article first investigates what makes the Arctic an increasingly important area for many stakeholders and, more specifically, China's and Russia's interests. Next, it explores US, Norwegian, and NATO strategies for the Arctic and space while emphasizing coinciding focus areas. Finally, it examines areas for cooperation—some already in play and some for the future—and suggests focus areas for the US and Norwegian Arctic space strategies.

Significance of the Arctic

The Arctic is the cold and remote wasteland north of the 66.3° north latitude, commonly referred to as the Arctic Circle.¹ The United Nations Convention on the Law of the Sea defines the Arctic Five, the nations with an Arctic coastal area and an exclusive economic zone (EEZ) extending into the region.² They include Russia, Canada, Denmark (Greenland), Norway, and the US (Alaska).³ Iceland, Sweden, and Finland are also considered Arctic nations but do not have an Arctic coastal area. These eight nations constitute the members of the Arctic Council and have special interests in the Arctic.⁴ The region's considerable economic value in oil and gas resources, fisheries, and minerals make it of interest to many nations beyond the Arctic Council.⁵

These resources have long been unavailable for exploitation due to ice coverage, but their growing accessibility brought on by climate change is making the Arctic even more valuable. Surveys estimate that 13 percent of the world's undiscovered oil reserves and 30 percent of undiscovered gas reserves reside in the Arctic.⁶ Until recently, the Arctic's minerals, oil, and natural gas liquids have been inaccessible due to harsh conditions. However, the declining Arctic ice has opened up access to areas where

these resources are located, and more extensive sea areas for fisheries are now reachable.⁷ Also, the retreating ice opens up previously closed sea lines of communication.

The Northwest Passage and the Northern Sea Route are open for more extended periods, transporting merchandise from the Pacific to the Atlantic free from piracy activity and faster than the traditional routes through the Suez or Panama Canal.⁸ At the same time, the increasing availability of resources presents several problems.⁹ Although most disagreements regarding maritime boundaries have been resolved peacefully, a more “complicated disagreement involves the North Pole itself.”¹⁰ Canada, Denmark (Greenland), and Russia claim ownership of the Lomonosov Ridge, an underwater ridgeline that extends well into the central Arctic.¹¹ The issue is unsettled and a possible source of conflict—but it has been solely a diplomatic one.¹² Naturally, as Arctic nations, Russia and the US are interested in the Arctic region due to its resources and vital strategic points. The increased potential for economic gain and military-strategic advantage has made the Arctic an arena for strategic competition and has led to an increased military, civil, and commercial presence from both nations. In particular, Russia has “gradually reintroduced army, navy and air force elements into the region,” expanding its military footprint in the Arctic.¹³

Russia is the only nation in the Arctic Council that is not a NATO member or partner.¹⁴ Russia has the largest Arctic population, with more than 2 million citizens living north of the Arctic Circle.¹⁵ Russia also generates 22–30 percent of its gross national product (GNP) from the Arctic.¹⁶ Because of the melting ice and changing Arctic environment, Russia is “optimistic about the potential for Siberia and the Russian Far East” to significantly boost the nation’s economy.¹⁷ Energy projects and faster shipping between Asia and Europe because of the Northern Sea Route will increase the need for supporting ports and infrastructure. Building and maintaining this infrastructure will be a potentially positive economic revenue for the nation.¹⁸ The economic potential has intensified Russia’s interest in protecting its Arctic assets through a heightened military presence. Signs of this interest include Russia’s reopening of abandoned military installations and more “incursions by Russian aircraft and submarines into or close to other [nations’] Arctic spaces.”¹⁹ The planting of a Russian metal flag under the ice at the North Pole by a Russian submarine crew in 2007 shows that a greater military presence may have a secondary purpose.²⁰ President Putin has demonstrated a will to use illegal aggression and violate international law to seize territory in Europe.²¹ Russia may

intend to contest the economically and strategically important region and likely make claims for ownership and economic rights in the Arctic that extend beyond the 200-nautical-mile EEZ. Similarly, China has shown increased interest in the Arctic region.

An exciting aspect of the Arctic and strategic competition is China's claim to be a near-Arctic state.²² China's 2018 Arctic strategy outlines a "Polar Silk Road economic plan."²³ China sees the shorter distance from China to Europe through the Northern Route as a possible "economic boom."²⁴ It has also invested heavily in energy projects in Russia and does not hide its desire to access Arctic natural resources.²⁵ China's investments in ports, airports, research stations, and satellite ground stations are reasons to raise concerns about its intentions in the "autonomous territory" of the Arctic.²⁶ China is also developing a "constellation of twenty-four polar observation satellites."²⁷ The first satellite, launched in September 2019, has already delivered over 2,500 pictures covering the Arctic and Antarctic.²⁸ China's increased activity and interest in the Arctic confirms the Arctic as a new ground for strategic competition between Russia, China, and the US.

The Arctic has risen as a new arena for strategic competition and a region of increased interest for other stakeholders with economic motives. The unfortunate consequences of its environmental changes are a potential increase in natural resource exploitation and new transportation lines. This new paradigm affects commercial, civil, and military operations and has increased the strategic value of all Arctic and near-Arctic countries.

The corresponding threats to the area are significant. In fragile regions like the Arctic, an accident from oil drilling or shipping would have dire consequences. Continued environmental change might also impact the wildlife and fisheries in the area, and further research and surveillance are critical. A conflict in the area leading to the use of arms may have the same effects. The vast amount of international waters and disputed rights to resources may lead to conflicts between Arctic nations and other stakeholders claiming their rights to exploit the region. Increased activity has "fueled a demand for communication, navigation, and surveillance infrastructures."²⁹ In the 2013 *National Strategy for the Arctic Region*, President Barack Obama recognized the Arctic as "an amazing place" where climate changes represent emerging opportunities and "very real challenges."³⁰ These challenges are multifaceted, and many of them fall under the purview of the Department of Defense.

Arctic Strategies

US Arctic Strategy

Since the US bought Alaska from Russia in 1867, it has been an Arctic nation and is currently one of the Arctic Five and a member of the Arctic Council.³¹ In Alaska, permafrost dominates the northern third of the state, making regular settlements challenging.³² Less than 68,000 Americans live in the Arctic, and Alaska produces only 0.3 percent of the US GNP.³³ Mineral production in Alaska constitutes about four percent of US mineral production.³⁴ Nevertheless, the Arctic is vital to US geostrategic interests.³⁵ As the Arctic as a “geostrategic buffer is eroding” and strategic competition in the area is increasing, the US needs a comprehensive US military strategy for the region.³⁶

The DOD’s 2019 Arctic strategy expands on the complex security environment in the region. It recognizes the security threat emerging from increasing access to resources, an uncertain strategic environment, and the fragile but still enduring cooperation in the region.³⁷ The DOD established three main objectives for the Arctic: defend the homeland, compete when necessary to maintain favorable regional balances of power, and ensure common domains remain free and open.³⁸ The DOD acknowledges the Arctic as an increasingly vital region due to strategic competition and greater access to the region and its resources. This focus gives the Air and Space Forces a direction for an Arctic strategy.

The Department of the Air Force views the Arctic as “residing at the intersection between the U.S. homeland and two critical theaters, Indo-Pacific and Europe, [thus making] the Arctic . . . an increasingly vital region for U.S. national security interests.”³⁹ The Air Force’s *Arctic Strategy* also recognizes the “Arctic as a region of strategic opportunity for the Air and Space Forces, Joint Force, allies, and partners.”⁴⁰ The strategy builds around four lines of effort: maintaining vigilance through command, control, communications, intelligence, surveillance, and reconnaissance (C3ISR); projecting power through bases in Alaska and Greenland; cooperating with allies and Arctic partners; and finally, preparing through training, research, and development.⁴¹ Allied and partner cooperation is emphasized throughout the strategy. The strategy recognizes space as a solution for the challenges in the demanding Arctic operating environment. The Space Force must overcome the region’s unique orbital and electro-magnetic obstacles that negatively affect all communication and navigational signals.⁴²

Norway's Arctic Strategy

As one of the eight nations in the Arctic Council and one of the five nations with an Arctic coastline, Norway has extensive interests in the Arctic. Approximately 10 percent of its population—a greater proportion than any other Arctic country—or half a million Norwegians live north of the Arctic Circle.⁴³ Key industries in North Norway such as fisheries, aquaculture, and tourism depend on natural resources.⁴⁴ It is estimated that more than half of Norway's undiscovered oil resources are in the Arctic region.⁴⁵ The Norwegian political vision for North Norway and the Arctic region is economic, environmental, and social sustainability.⁴⁶ Arctic policy goals focus on international cooperation and international legal order to achieve peace, stability, predictability, value creation, and ecosystem-based management.⁴⁷ The five priority areas in the Arctic strategy are international cooperation, knowledge development, infrastructure, environmental protection and emergency preparedness, and business development.⁴⁸ These priorities are essential for the development in the Arctic region and coincide with US policy and strategy for the region. Due to the Gulf Stream, Norway is ice-free in the summer and has no permafrost. Without the Gulf Stream, the average temperature in Norway would be 10 to 15 degrees Celsius colder.⁴⁹ Although the latitude is similar to Alaska's, Norway's climate is friendlier to human activity.

NATO's Arctic Strategy

NATO also understands the Arctic's strategic importance, particularly in light of environmental changes, but has failed to develop an Arctic strategy that incorporates the Arctic's unique challenges. The rapidity of change “suggests the Arctic is likely to be one of the twenty-first century's most contested areas.”⁵⁰ The current strategic concept of NATO is “active engagement, modern defense.”⁵¹ Collective defense, crisis management, and cooperative security are core tasks, and deterrence “remains a core element” of NATO's strategy.⁵² In developing an Arctic strategy (excepting the operational plan), “NATO lags significantly behind” Russia and China.⁵³ An increased Russian military presence and Russia's enhanced weapons available for anti-access and area denial (A2/AD) in the gap from Greenland to Iceland to the United Kingdom (GIUK) and northbound represent a major strategic problem for some of the alliance's Arctic members.⁵⁴ Unfortunately, not all NATO nations, and not even all NATO Arctic nations, have the same viewpoint.⁵⁵ An intensified focus on the Arctic from the US and Norway may shift NATO's focus toward the

north. However, currently, there is no NATO Arctic strategy other than deterrence and cooperative security.

The Significance of Space as the Solution

The obvious solution to the unique infrastructure challenges in the Arctic is space.⁵⁶ Commercial satellite services can support the need for increased communications, surveillance, and understanding of events in the region while also increasing cooperation between nations and partners. The use of space assets and space-based infrastructure is not without challenges. However, by “optimizing existing and future space-based infrastructure, using low Earth, geosynchronous, and highly elliptical orbits, the United States can work cooperatively with other Arctic nations to build situational awareness, enhance operations, and strengthen a common rule-based order.”⁵⁷ Continued research and information sharing in a region formerly neglected due to the harsh environment should be the preferred measure to solve these issues.

Space Strategies

US Space Strategy

The 2020 *National Space Policy of the United States of America* declares that “the United States will continue to use space for the nation’s security and our allies,” continuing the high focus on allied cooperation, involvement, and protection from the US Arctic strategy.⁵⁸ Among the many goals of the policy, “lead, encourage, and expand international cooperation,” and “preserve and expand United States leadership . . . [working] with like-minded international and private partners” also confirm this focus on allied and partner cooperation.⁵⁹ The policy explicitly calls for assured access to space; enhanced positioning, navigation, and timing (PNT); and the development of space professionals as foundational activities.⁶⁰ Furthermore, the policy defines national security guidelines. In addition to recognizing space as a war-fighting domain, it emphasizes “robust space domain awareness of all activities in space with the ability to characterize and attribute potentially threatening behavior” as an essential tool.⁶¹ The policy focuses on “advanced technologies, capabilities, and concepts that anticipate and rapidly respond to changes in the threat environment and improve timeliness and quality of intelligence and data to support operations.” It also tries to “integrate cybersecurity into space operations and capabilities” and “collaborate with allies and partners actively engaging in space security and intelligence operations . . . for the exchange of relevant

space and space-related information.”⁶² Additionally, this policy instructs the secretary of defense (SecDef) to defend the US and its allies, protect freedom of navigation, defend space assets while supporting joint operations, and use space to deter conflict and defeat aggression. Other SecDef responsibilities include providing affordable and timely space access; developing rapid launch options; detecting threatening space behavior; conducting strategic space posture reviews; and developing, acquiring, and operating space intelligence capability to support joint operations.⁶³ Allied cooperation and defense are vital to accomplishing these tasks. Likewise, the 2020 *Defense Space Strategy* emphasizes allied cooperation.

The *Defense Space Strategy* defines the objectives of “maintain[ing] space superiority; provid[ing] space support to national, joint, and combined operations; and ensur[ing] space stability.”⁶⁴ The space strategy defines some lines of effort: “build a comprehensive military advantage in space; integrate military spacepower into national, joint, and combined operations; shape the strategic environment; [and] cooperate with allies, partners, industry, and other U.S. Government departments and agencies.”⁶⁵ Some specific objectives are to improve intelligence and command and control capabilities; develop capabilities to counter the hostile use of space; integrate allies into plans; and expand cooperative research, development, and acquisition with allies and partners.⁶⁶ As with much of US military strategy, the document focuses on strategic competition with China. But the strategy also recognizes Russia as a threat. As the Arctic nation with the most citizens north of the Arctic Circle, Russia is also a threat to US security in the Arctic region extending into space.⁶⁷

The *Department of the Air Force Arctic Strategy* notes that satellite communications and data links are major C3ISR improvements in the area while recognizing that space assets “reduce the need for a physical footprint in the demanding Arctic operation environment.”⁶⁸ Another high-focus topic in the strategy is “all-domain awareness” and the accompanying challenges of “unique orbital mechanics” and “electromagnetic obstacles” in the region.⁶⁹ The strategy also emphasizes allied cooperation, the development of new technology to “ensure access to and freedom to operate in space,” and the need to use space capabilities to “mitigate and predict environmental disturbances unique to the Arctic Region.”⁷⁰ Norway’s space strategy, like that of the US, emphasizes international cooperation.

Norway's Space Strategy

Although Norway is not a large nation in geographical terms or population, it is an essential and experienced space nation. Situated as it is in the High North, Norway is an Arctic nation. It is a technologically developed nation that emphasizes research and development in many space-related areas.⁷¹ Norway's space strategy, last updated in 2019, presents four goals for Norwegian space operations. These are promoting profitable businesses, growth, and employment; ensuring crucial needs for society and the population; ensuring adequate security for an essential space infrastructure; and securing Norwegian foreign policy, security, and defense policy activities and operations in space.⁷² Prioritizing the user's end needs leads to multisector solutions requiring cooperation between government agencies, commercial interests, and international entities.⁷³ International cooperation is a key focus area for environmental surveillance, security and preparedness, research and education, and military use of space.⁷⁴ Bilateral agreements and commercial cooperation will enhance the Norwegian military's capacities.⁷⁵

Norway's ambition to be the "NATO in the North" creates responsibilities to develop space-based services in the Arctic, an area of high strategic significance for Norway.⁷⁶ At the same time, Norway has ambitions of being independent in critical security sector services.⁷⁷ Due to its global dependence on space infrastructure, Norway's territory in the Arctic (e.g., Svalbard and Bjoernoeya) and Antarctic (e.g., Queen Maud's Land) increases its geostrategic significance.⁷⁸ As the Kongsberg Satellites Services' station SvalSat on Svalbard exemplifies, these areas are favorable for ground stations.⁷⁹ Norway will work in multilateral and bilateral processes to ensure Norwegian and allied security and freedom to use space.⁸⁰ Traditionally, the US and Norway have cooperated on space activities. One recent example is the Rimfax radar developed in Norway and carried by the *Perseverance* rover on Mars.⁸¹

The Norwegian Armed Forces Space Department was established in 2016 to integrate the space activities of Norway's armed forces in an operational domain.⁸² The department will strengthen the strategic development, coordination, and leadership of military space operations.⁸³ The new long-term plan for the armed forces through 2024 confirms the military focus on space operations. Maritime surveillance, communications, command and control, space domain awareness (SDA), and cooperation with allies and commercial actors are focus areas.⁸⁴ There is a broad understanding of space as a war-fighting domain and the need for including space in strategy development.⁸⁵ SDA is a capacity relevant for

NATO contribution and a prioritized national focus area and therefore aligns with NATO's strategy.⁸⁶

NATO's Space Strategy

NATO established space as a new operational domain in 2019 when alliance members adopted NATO's space policy.⁸⁷ In October 2020, the NATO Space Centre at Allied Air Command in Ramstein, Germany, was established. The center will coordinate allied space activities, support NATO missions and operations such as communications and satellite imagery, and protect allied space systems.⁸⁸ NATO will not put weapons in space but will procure all products from NATO allies.⁸⁹ The alliance will not become an autonomous space actor.⁹⁰ Some essential military space functions to be provided to NATO include SDA, satellite imagery, PNT, and communications.⁹¹ NATO's demand for space support aligns with US and Norwegian strategic focus areas regarding space assets and support in the Arctic.

Topics of Cooperation

The US and Norway may have different goals and motivations for their Arctic and space strategy efforts. These differences are natural since the US is a great power while Norway is a smaller nation with political and cultural ties to the US and Russia. Norway's neighbor brings strategic competition to Norway's doorstep, strengthening relations between Norway and the US. Although the two countries may have separate reasons for their interest in the Arctic and their strategy rationales may differ, their activities to achieve these goals often align. The coinciding lines of effort and focus areas for the two nations establish common grounds for cooperation.

First and foremost, cooperation is the common ground for the described policies and strategies, and it is the foundation for all other topics discussed in this article. Norway and the US have already established a unique cooperative relationship in some of these areas. Nevertheless, better cooperation and awareness of the potential advantages of joining forces may lead to even greater gains for both nations. Not limited to just the Arctic region, SDA is one of the most critical areas where both countries can cooperate. The following table summarizes lines of effort and strategies for the US, Norway, and NATO.

Table. Lines of effort and strategies

Lines of Effort	Strategies		
	United States	Norway	NATO
International, allied, and partner cooperation in both domains	<ul style="list-style-type: none"> • US space policy • Department of the Air Force Arctic strategy • Defense space strategy 	<ul style="list-style-type: none"> • Norway's Arctic strategy • Norway's space strategy • Norwegian armed forces long-term plan 	<ul style="list-style-type: none"> • NATO strategy
Space domain awareness	<ul style="list-style-type: none"> • US space policy • Defense space strategy 	<ul style="list-style-type: none"> • Norway's space strategy • Norwegian armed forces long-term plan 	<ul style="list-style-type: none"> • NATO space strategy
C3ISR in the Arctic	<ul style="list-style-type: none"> • Department of the Air Force Arctic strategy • Defense space strategy 	<ul style="list-style-type: none"> • Norway's Arctic strategy • Norwegian armed forces long-term plan 	<ul style="list-style-type: none"> • NATO strategy
Enhanced PNT	<ul style="list-style-type: none"> • National space policy • Department of the Air Force Arctic strategy 	<ul style="list-style-type: none"> • Norway's space strategy 	<ul style="list-style-type: none"> • NATO space strategy
Launch capability	<ul style="list-style-type: none"> • US space policy 	<ul style="list-style-type: none"> • Norway's space strategy 	
Exchange of knowledge, education, research, development, exercises, and training	<ul style="list-style-type: none"> • US space policy • Department of the Air Force Arctic strategy 	<ul style="list-style-type: none"> • Norway's Arctic strategy • Norwegian armed forces long-term plan 	

Space Domain Awareness

Space domain awareness is a primary strategic goal for the two nations and NATO. Norway's GLOBUS radars, located in Vardo in northeastern Norway, have provided space situational awareness for Norway, the US, and NATO since 2001.⁹² The system will be further improved after completion of the Globus III radar, a joint project of US Air Force Space Command and the Norwegian Intelligence Service.⁹³ The system is planned to be operational in 2022.⁹⁴ The radar site's primary missions are surveilling, tracking, and categorizing objects in space; surveilling Norwegian interest areas in the north; and collecting research and development information.⁹⁵

This cooperation and joint effort exemplify how Norway, a relatively small military space nation, can contribute to the space domain to benefit all NATO nations. Norway's geographic position and relatively mild climate make the operation possible within the Arctic region. With the Arctic becoming the new area of competition and congestion, Norway is positioned to become a critical player in the arena.⁹⁶ Like space domain awareness, communication is an essential area of cooperation.

Communications

Secure, reliable communication in the Arctic is vital for any operation—military, civilian, or commercial. Communication between units operating

in the Arctic area and back to their command organizations is essential for command and control. US and Norwegian armed forces need broadband network and voice capability. In a remote area like the Arctic, where “fiber optic infrastructure is scarce or nonexistent,” communication via satellites is the only viable solution.⁹⁷ An increased US presence and a sustained presence from Norwegian forces—all with the same communication, command, and control demands—make satellite communication a perfect example of another area of needed cooperation between nations and between government and civilian actors.

Communications services in the Arctic are provided mainly by satellites in geostationary Earth orbit (GEO), with a limited coverage above 75°–80° north.⁹⁸ Fixed users may have broadband service up to 80° north, but the very small aperture terminals (VSAT) only cover up to 75° north.⁹⁹ Iridium NEXT’s low Earth orbit (LEO) satellite constellation is the only mobile satellite service provider with proper coverage in the polar region.¹⁰⁰ Like Kepler and Argos, a few other companies provide LEO connectivity, but none provide near-real-time broadband service.¹⁰¹ Communications in the Arctic area need improving to meet the increased requirements for the allied military presence there.

The US and Norway are already working together to upgrade communications. They are involving government and commercial entities and combining international, cross-sector, and dual-use cooperation. For example, Inmarsat plans to launch two satellites in a highly elliptical orbit (HEO) in 2022.¹⁰² They will provide continuous high-speed mobile broadband coverage above 65° north and work in conjunction with Inmarsat’s 13 GEO satellites.¹⁰³ The Norwegian Defense Department will share the cost with the US Air Force and Inmarsat.¹⁰⁴ The satellites will be available for merchant fleets, fishing vessels, and other commercial actors and provide tactical and strategic communication for government customers.¹⁰⁵ They will improve broadband coverage for US and Norwegian military forces in the area but may not deliver a satisfactory amount of data transfer in the event of a conflict.

Norway’s ambition of being independent in providing critical services for security issues combined with its emphasis on international and bilateral agreements shows the desire for government- or allied-controlled assets. Although Inmarsat is a UK-based company, future commercial sales or changes in the company structures might threaten the Norwegian military forces’ access to the service or render null the possibility of secure and classified communications. China and Russia are investing in and buying European companies. Recently, a Russian-controlled company attempted

to buy a Norwegian Rolls Royce engine maker.¹⁰⁶ However, the Norwegian government has temporarily stopped the sale due to security issues.¹⁰⁷ To depend solely on a commercial actor reduces the service's reliability in times of crisis, making increased governmental cooperation even more critical.

A government controlled and operated tactical and strategic initiative is needed to cover the US's and Norway's increased demand for high-speed communications in the Arctic. The planned ViaSat Link 16-capable LEO satellite is an example of a system under US and Norwegian government control.¹⁰⁸ Bringing Link 16 from a line-of-sight to beyond-line-of-sight system would improve the situational awareness for all on the tactical, operational, and strategic levels of a conflict.¹⁰⁹ As an Arctic nation, Norway should invest in this constellation to ensure a speedy development to achieve timely and secure communications in the Arctic for all Norwegian and allied forces. Norway is well positioned for cooperation regarding up-link and downlink through already established capabilities and can bring this capability into the cooperative effort. Intelligence, surveillance, and reconnaissance (ISR) is another area of cooperation that should be emphasized and increased.

Intelligence, Surveillance, and Reconnaissance

Space is integral to ISR operations because it is the vehicle for the provision of any usable situational awareness in the Arctic region. The Arctic's properties—large, dark, and remote with inhospitable weather—make conducting ISR operations from space the preferred and most likely the only viable solution. As Norway's space strategy states, environmental surveillance is critical. Understanding the Arctic environment and determining how and when it will change is a precursor to avoiding potential conflict. Dual-use assets for environmental surveillance have a military potential as well.

Norway has a long history of maritime surveillance of the sea in the Norwegian area of interest. Through *NorSat-1* and *NorSat-2*, the Norwegian Coastal Administration uses the Automatic Identification System (AIS) that all ships above 300 gross tons have been required to have since 2010.¹¹⁰ The new *NorSat-3* enhances AIS surveillance with an experimental navigation radar detector (NRD).¹¹¹ The *NorSat* satellites are in sun-synchronous orbits and also have additional scientific purposes such as surveillance of solar radiation and space weather.¹¹² They thus provide cross-sectorial (commerce and defense sector) and dual-use (surveillance and scientific) capabilities. These satellites, combined with the coastal radars in Norway, are a vital surveillance source for Russian military ac-

tivity in the Barents area. Satellites in polar LEO orbit will help track ships in Norway's exclusive economic zone and detect ships operating in the Arctic region.

Norway is also developing new, exciting technological solutions that could improve ISR capabilities environmentally and militarily. At the Norwegian University of Science and Technology in Trondheim, a team of students and professors is working on a satellite with a hyperspectral camera, an intelligent onboard processing computer, and robotics.¹¹³ The onboard camera can be slewed and provides images of small areas of interest.¹¹⁴ The Norwegian company Kongsberg Satellite Service (KSAT) has contracted with the university to provide ground support that will enable the satellite to download images. Also, short revisit times due to its LEO orbit will allow the satellite to detect algae that is dangerous to salmon farming companies. The satellite's information can be transferred to "unmanned vehicles that can investigate the areas of interest further."¹¹⁵ This technology could be developed and proved helpful in detecting images other than underwater algae, particularly submarines. Norway is close to the Kola Peninsula and Kola Bay, the Russian Northern Fleet's home base.¹¹⁶ An ISR satellite combined with an unmanned aerial system deploying active sonar and confirming the satellite's findings will give the US, Norway, and NATO greater situational awareness. In addition to environmental surveillance, increased weather surveillance and forecasts are needed.

Any party with interest in the Arctic must consider the punishing weather conditions that can affect the safety of humans and machines. The US Space Force (USSF) is "considering future investments to improve weather monitoring in the Arctic."¹¹⁷ Climate change, not only in the Arctic, requires "more timely and more precise data."¹¹⁸ Norway's interest in research on environmental changes and improved weather forecasting aligns with the DOD and USSF's need for an updated weather satellite program, especially in the Arctic. By working cooperatively, the US and Norway stand to gain in everything from technology research to the employment of new space assets. Improved sensors reduce cost and improve capabilities. Polar weather satellites with an up-down link every 90 minutes via SvalSat—and distributed via high-speed broadband satellite—would make weather data available to many users, including commercial traffic and decision-makers in both countries.

Understanding the magnitude and speed of environmental changes in the Arctic is essential for resource conservation and situational awareness of potential strategic impacts. According to *SpaceNews*, a USSF spokes-

person confirmed that the Space Force “does not operate and is not developing capabilities specifically to monitor climate change.”¹¹⁹ Although continued work with NASA and the National Oceanic Atmospheric Administration (NOAA) should be a focus area, cooperation between the US and Norway on environmental surveillance will benefit the intelligence and research communities and departments of commerce (fish and oil industry). It will also improve security for both nations and their allies, especially NATO. Besides enhanced ISR, the Arctic region needs enhanced PNT accuracy.

Position, Navigation, and Timing

Greater activity in the Arctic demands a heightened military presence in areal and naval assets. Thus, fully developed and accurate navigation systems are required to avoid accidents and ensure accurate data for situational awareness and weapons deployment, if needed. The high angles from a satellite in a global navigation satellite system—such as the Global Positioning System or Galileo for the Arctic user—limit the user’s accuracy, especially in the vertical axis.¹²⁰ The satellite-based augmentation system (SBAS) is constrained by atmospheric and topography challenges.¹²¹

One solution is to launch SBAS satellites in polar highly elliptical or low Earth orbits.¹²² Another is to develop a medium Earth orbit constellation.¹²³ A dual-use system with future communications satellites used as SBAS assets represents the third option. Accurate, secure navigation and timing will be just as significant in the Arctic region as in the more populated areas between 65° south and 65° north as the number of cruise ships, commercial carriers, fishing vessels, oil rigs, and other commercial users increases. Therefore, it is in the interest of not only the US Space Force, DOD, and Norwegian Armed Forces to enhance PNT in the area but also that of the US Department of Commerce, Norwegian Department of Commerce and Fisheries, coast guards, and justice departments. The development of new technologies to enhance the accuracy of PNT in the region is, therefore, one area of future cooperation for the US and Norway. Launch capability is another important line of effort for both nations.

Launch Capability

Available, credible launch capability is one of Norway’s national focus areas and a focus area in the US space policy. Andøya Space will establish a launch site for small satellites to polar orbit.¹²⁴ The first launch is planned for the first half of 2022.¹²⁵ The launch capability will be up to 1.5 metric

tons to polar LEO or sun-synchronous orbit, and the Rocket Factory and Isar Aerospace will supply the initial launch vehicles.¹²⁶ Inclination will be from 87.4 to 108 degrees, and the remote area of Andøya provides for significant impact and dispersion areas in the Norwegian Sea.¹²⁷ The Norwegian government owns a large part of the company, which will be under governmental control in case of a conflict. Norway's launch capability will potentially extend to its allies, both bilateral and NATO, in the Arctic region. Andøya Spaceport will supplement the US government's existing launch capabilities. In addition to upstream space operations in launch capabilities, Norway can also provide downstream capabilities worldwide.

With Norway's geographic placement and relatively mild climate compared to the latitude, building and operating ground radars for SDA in the polar region is easier and more friendly to human existence than in Alaska, Canada, or Greenland. The world's largest ground station is SvalSat, operated by KSAT.¹²⁸ Located on Svalbard, an island to the north of the Norwegian mainland, it is "ideally situated at a high enough latitude to see every polar-orbiting satellite from all 14 daily transits."¹²⁹ Because the Norwegian government owns 50 percent of KSAT through Space Norway, SvalSat represents a reliable asset in times of conflict.¹³⁰ KSAT has 25 ground stations located throughout the world, including the Norwegian mainland.¹³¹ A global network combined with a cybersecurity focus makes global downloading of payloads and uploading of software for satellite management possible from the company's offices in Tromsø in northern Norway.¹³² Stronger military cooperation with the civilian side of the operation, as described in the Norwegian government's space strategy, will further improve data and cybersecurity for a military-grade system.

Education, Research, and Development

Norway has a long history as a space nation. Kristian Birkeland, a Norwegian scientist, completed his famous terrella experiment in 1896 in which he made artificial Northern Lights, known as the aurora borealis. This achievement marked the beginning of modern space operations in Norway.¹³³ The Andøya Rocket Range launched its first scientific rocket in 1962 and has since launched over a thousand rockets. Norway has several institutions for space-related education, from satellite technology to space physics. In cooperation with the University of Oslo (UiO), the Norwegian military research institute Forsvarets forskningsinstitutt (FFI) developed the Rimfax radar for the *Perseverance* rover.¹³⁴ Norway is a member of the European Space Agency, and the Norwegian space industry consists of around 40 companies.¹³⁵ Several Norwegian companies

have further developed technology used offshore and in areas from medical science to space technology, and Norwegian technology and knowledge of space and space operations are world class.¹³⁶ Space is also a highlighted interest in the Norwegian national strategy.

Suggested Combined Arctic Space Strategy

A future US and Norwegian combined Arctic space strategy should focus on three primary efforts. The first is closing the Arctic infrastructure gap. The US and Norway need to recognize the increased strategic significance of the Arctic region. Its remoteness and harsh conditions underline the need for space operations to provide C3ISR to achieve security for both nations' interests. Gen John Raymond, chief of space operations for the USSF, states that the *Department of the Air Force Arctic Strategy* is "a really important strategy for space" as the US wants to "deter conflict from occurring both in space and through the Arctic."¹³⁷ As most US and Norwegian strategy documents indicate and some space and military experts argue, there is a need for cooperation between Arctic partners to "increase vigilance in this increasingly vital region."¹³⁸ Therefore, an Arctic space strategy must continue on this track. US and Norwegian armed forces should expand their cooperation to ensure cost sharing and shared benefits from education, research, development, and geographic position to close the gap in necessary infrastructure in the region.

Dual-use assets reduce government spending, and profitable commercial companies increase a nation's economic power. Commercial companies like SpaceX conduct technological developments to make space operations cheaper, better, and more available. The drawback of the commercial space industry is the lack of governmental control in a conflict. Therefore, allied governments must deal exclusively with companies from the involved nations and have transparent contracts and ownership control. China's One Belt, One Road initiative and Russian corporations' predatory buy-ups of European companies emphasize this point. Space capabilities controlled by companies from an adversary nation are not desirable in case of a conflict.

As a small nation with limited human resources available for a considerable and credible conventional force, Norway should continue its strategy of NATO contributions. C3ISR space assets are a sought-after capacity for NATO, especially in the Arctic area where Russia and China are increasing their presence. Therefore, Norway needs to continue developing its focus on technological development within space, cyber, and artificial intelligence. Technological development will bring new com-

mercial opportunities and be a backup industry for oil and gas production, rendering Norway's economy powerless and vulnerable. Norway's geographic position in the Arctic—with less harsh conditions than Canada, Alaska, or Greenland—makes it an indispensable choice for US bilateral collaboration and NATO partner cooperation. Its geographic position also makes Norway dependent on the Arctic region and therefore equally as interested as the US in Arctic security. With less access to livable areas in the Arctic region, the US will benefit from such cooperation. Continued closing of the infrastructure gap can and should be done in conjunction with allies and partners.

The second main effort is improved SDA in the polar area. Space as the solution for the US and Norwegian Arctic challenges is not exclusive to these nations. China and Russia have shown military and commercial interest in the region and have increased their space capability in polar orbits. Increased SDA is therefore as important as increased ISR capabilities. Since Chinese and Russian intentions in the Arctic are unknown, their objectives in space in the polar region are an area of concern for the US, Norway, and NATO allies. A robust and dependable SDA system in the polar region must therefore be another critical area of cooperation—and one that nations' strategy documents should emphasize. Nevertheless, the most important field of cooperation does not lie in technical solutions and assets but in the exchange and increase of knowledge and usage of the capabilities.

To that end, the third main effort is education and liaising. A strong, valuable, and lasting cooperation between nations rests on a shared understanding of the necessity and gains of cooperation. Since most US and Norwegian policy and strategy documents recognize the criticality of space and the Arctic, cooperation between the two nations is, as the documents also declare, wanted and necessary. This cooperation must start with a shared understanding of the requirements to operating in the region and domain. Being an Arctic nation, Norway brings Arctic know-how, and the US, being the most prominent space nation, brings space knowledge into the partnership. Consequently, the most significant cooperation between the nations should be sharing knowledge through education, liaising, research, and development.

The know-how of Arctic operations on the ground is also a valuable trade for USSF personnel. The USSF mission includes "providing space capabilities to the joint force."¹³⁹ Considering the Arctic region's increased strategic importance, understanding the Arctic warrior's needs and how to support them is knowledge that Norway has acquired as an Arctic nation.

The US Marine Corps has already been conducting winter training in Norway, although reduced from year round to a more evenly spaced deployment.¹⁴⁰ Understanding the challenges of operating in harsh weather—with limited (but improving) access to communication assets, the effects of radiation, and a limited PNT signal for accurate positioning and weapons delivery—is crucial for the supporting role of USSF. The US already has two students (USAF and USMC) at the multiservice Norwegian Staff Course.¹⁴¹ One recommendation is that USSF members attend this course to increase their understanding of the Arctic. Further, Norway should continue participating in professional military education (PME) like the Schriever Space Scholars to gain space knowledge.

Though Norway is a medium-sized space nation on the civilian-end commercial side, it can still improve its military space knowledge. The increased recognition of space's significance for society at large and military operations constitutes a change in Norwegian armed forces' thinking. New space technology, doctrine, and security threats develop quickly, and Norway cannot afford to lag in this vital field. Norwegian officers at the tactical, operational, and strategic levels need PME to cooperate with our allies that are further developing space power theory and application. The establishment of the US Space Force in 2019 puts the US in the lead of NATO space nations. The growing number of American and international students in the Schriever Space Scholars program shows the DOD and USSF's dedication to space-related PME. It will be valuable for Norwegian officers to continue to attend this course either as an addition to Air Force Command and Staff College (ACSC) attendance or alternating biannually between the Schriever program or the USSF staff course and ACSC. In addition to education, building common grounds for the domains necessitates sharing a strategic and operational understanding of space and the Arctic through liaisons and exchange officers.

A Norwegian liaison position is recommended at the US operational and strategic levels to enable sharing experience and knowledge and discussing Arctic issues regarding space power application and cooperation in the USSF and Norwegian armed forces. As discussed, education will increase Norway's knowledge and competence regarding space power while the USSF gains knowledge of the Arctic region and operations therein. The main focus should initially be on the operational level to understand the possible application of space power in the Arctic during military operations. The Norwegian armed forces require an increased focus on the need to include the space domain in planning. On the strategic level, understanding US goals increases the possibility of adapting

Norwegian space strategy to gain even more mutual benefits for both nations in all operations in the Arctic space domain.

Conclusion

Norway should continue to play an essential role in the US Arctic space strategy. The US and Norway are cooperating in many vital areas already, but the growing strategic significance of the Arctic also increases Norway's geostrategic importance. Norway is becoming increasingly relevant not only because of its status as an Arctic nation and alliance with NATO but also because of its space industry, knowledge, and advantages regarding satellite launch, downlink, and operations in any polar orbits. The US and Norwegian combined Arctic space strategy should focus on three primary efforts.

The first is closing the Arctic infrastructure gap. Cooperation regarding the increased need for C3ISR, improved PNT, and environmental surveillance to understand the changing climate and possibilities in the area is crucial for decision-making. Military intelligence and commercial surveillance will increase security and improve communications possibilities for emergency communication and coordination of emergency and disaster handling. The second main effort is improving SDA in the polar area. Understanding how China and Russia are using polar and sun-synchronous orbits is essential for maintaining the security of our space capability and determining Chinese and Russian intentions in the region. The third and most critical effort is fostering an exchange of educational opportunities and liaisons. Sharing knowledge about the Arctic and space requires minimal economic investment and will benefit both forces. A stronger focus on knowledge exchange and strategy development is a low-cost enhancement of the two nations' cooperation and a necessity for building further cooperation on a steady foundation. **ISSQ**

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