

Targeting Dual-Use Satellites

Lessons Learned from Terrestrial Warfare

JENNIFER A. CANNON

The United States, its Allies, partners, and other space powers are increasingly relying on dual-use satellites for national security and defense, raising questions about the implications for targeting such assets as part of current and future warfare. Three case studies of terrestrial attacks on dual-use targets extrapolate strategic, operational, and legal issues that could arise from attacks on dual-use satellites in space.

This article addresses a research gap in the studies of geopolitical and operational implications for intermingling commercial space capabilities and services with military operations and their derived effects. Other research has delved into the legal consequences of dual-use satellites—satellites that can serve both civil and military purposes—based on international treaties, space law, and international humanitarian law.¹ Instead, this article will focus on the operational and strategic impacts of spacefaring nations' increased development of dual-use satellites. Reviewing outer space treaties and international law, the research will consider examples of previous attacks on terrestrial dual-use targets to suggest possible implications of attacks on dual-use satellites.

This analysis includes three case studies: the 1999 attacks on Serbian targets by NATO during Operation Allied Force, the 2021 attack on the Al-Jalaa tower in Gaza by the Israeli Defense Forces, and the Russian Federation's current attacks against dual-use infrastructure in Ukraine. Each case study considers three independent variables—geopolitical/strategic implications of the strikes, operational consequences, and adherence to international humanitarian law—revealing consequences for using and striking dual-use satellites, especially as they relate to international humanitarian law, also called the law of armed conflict (LOAC).

Certainly, collateral damage—unintentional harm to civilians—from terrestrial attacks differs from collateral damage in outer space; accordingly the most recent attacks on satellites supporting the war in Ukraine can predict future impacts to noncombatants from such strikes. Although the strategic implications of strikes on dual-use targets might be similar in outer space and on land, the impacts on collateral damage and related concerns connected to international humanitarian law are largely unknown in the operational space domain.

Lieutenant Colonel Jennifer Cannon, USAF, holds a master of strategic intelligence from American Military University and is transitioning to a position at Aerospace Corporation as a civilian in August 2023.

1. Kenneth R. Rizer, "Bombing Dual-Use Targets: Legal, Ethical, and Doctrinal Perspectives," *Air & Space Power Journal* Chronicles, May 1, 2001, <https://www.airuniversity.af.edu/f>; Ross Brown, "Conflict on the Final Frontier: Deficiencies in the Law of Space Conflict below Armed Attack, and How to Remedy Them," *Georgetown Journal of International Law* 51, no. 1 (Fall 2019); and P.J. Blount, "Renovating Space: The Future of International Space Law," *Denver Journal of International Law and Policy* 40, no. 1 (January 2011).

Current Outer Space Dual-Use Capabilities and Policy

An increasing number of security organizations and space powers, including NATO, the United States, China, and the Russian Federation, accept that dual-use satellites are critical to national security. On February 15, 2023, 16 NATO countries, along with Sweden and Finland, announced an Alliance Persistent Surveillance from Space initiative that would integrate commercial and national space sensors to significantly improve NATO's intelligence, surveillance, and reconnaissance capabilities.² This integration of commercial and national sensing assets is a notable example of Allies using dual-use space capabilities for national and collective security. In this article, dual-use objects refers "to objects which qualify as a military objective under international humanitarian law, but which also simultaneously serve civilian functions."³

These technologies are not new. As one space policy expert explains, these "fundamental space technologies created by the military-industrial complexes of the Second World War and the Cold War committed space technology's original sin as a tool for warfare, intelligence gathering, and self-interested political-economic power."⁴ Using commercial or civil assets alongside national assets in space allows the developers to save resources by sharing time and space on costly launches and capabilities.

According to the 2021 *US Space Priorities Framework*, the United States "will leverage new commercial space capabilities and services to meet national security requirements and will deepen the integration of U.S. national security space capabilities and activities with those of [its] allies and partners."⁵ Although this verbiage does not specify the increased procurement of dual-use satellites or additional capabilities for existing ones, it suggests leveraging commercial capabilities for national security means is critical. For the US military, integrating military and commercial satellites into this hybrid construct is necessary for sufficient capacity and redundancy in times of crisis.⁶

Moreover, the recent examples of the employment of dual-use satellites in Ukrainian military efforts and the increase in funding of American, NATO, and partner commercial/military hybrid constellations reinforce the fact that US decisionmakers, strategists, and planners must understand the implications of using these satellites in future conflicts.

2. North Atlantic Treaty Organization (NATO), "16 Allies, Finland and Sweden Launch Largest Space Project in NATO's History," NATO (website), February 23, 2023, <https://www.nato.int/>.

3. Maurice Cotter, "Military Necessity, Proportionality and Dual-Use Objects at the ICTY: A Close Reading of the *Prlić et al.* Proceedings on the Destruction of the Old Bridge of Mostar," *Journal of Conflict and Security Law* 23, no. 2 (2018): 297, <https://doi.org/>.

4. Bleddyn Bowen, *Original Sin: Power, Technology, and War in Outer Space* (New York: Oxford University Press, 2023), 3.

5. The White House, *United States Space Priorities Framework* (Washington, DC: The White House, December 2021), 6, <https://www.whitehouse.gov/>.

6. John Goehring, "The Legality of Intermingling Military and Civilian Capabilities in Space," Lieber Institute – West Point, October 17, 2022, <https://lieber.westpoint.edu/>.

International Law

Treaties

The five primary UN treaties relating to outer space include the Outer Space Treaty (OST), the Rescue Agreement, the Liability Convention, the Registration Convention, and the Moon Treaty.⁷ Of these, the OST is the most relevant document related to the exploration, scientific use, and application of outer space for national security. Legal and policy scholars have dissected this document for academic, operational, strategic, and legal decisions related to offensive and defensive attacks in outer space, with one leading legal scholar noting it is the most comprehensive treaty applicable as a “quasi-constitution for space.”⁸

Article III of the treaty states that international law extends to outer space. Therefore, international humanitarian law should apply when considering states’ use of outer space for national security matters, although it is important to note that even the *Oslo Manual on Select Topics on the Law of Armed Conflict* has observed that “in the absence of sufficient state practice and *opinio juris*, the application or interpretation of LOAC in Outer Space may be subject to controversy.”⁹

Regarding weapons in outer space, Article IV of the Outer Space Treaty notes that states “undertake not to place in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction.”¹⁰ Since the OST entered into force, other types of weapons—directed energy, kinetic (antisatellite), electronic attack, cyber—that are not considered weapons of mass destruction have been put into orbit around Earth.¹¹ In the current strategic and technological environment, the OST cannot preclude state and nonstate actors from putting any weapons except weapons of mass destruction into orbit.

Article VI of the treaty is also relevant to attacks in outer space. It states that parties “shall bear international responsibility for national activities in outer space . . . whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth

7. United Nations Office for Outer Space Affairs (UNOOSA), “Space Law Treaties and Principles,” UNOOSA (website), n.d., <https://www.unoosa.org/>.

8. Bonny Birkeland, “Space: The Final Next Frontier Note,” *Minnesota Law Review* 3260 (2020): 2067.

9. Yoram Dinstein and Arne Willy Dahl, *Oslo Manual on Select Topics of the Law of Armed Conflict: Rules and Commentary* (Cham, Switzerland: Springer International Publishing, 2020), § 1, Rule 2, 3–4, <https://doi.org/>; and Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (Outer Space Treaty), opened for signature January 1967, UN RES 2222 (XXI).

10. Outer Space Treaty.

11. Department of Defense (DoD), *Defense Space Strategy Summary* (Washington, DC: DoD, June 2020), 4, <https://media.defense.gov/>.

in the present Treaty.”¹² One analysis maintains that Article VI considers commercial actors in space, pointing to language that says states are responsible for nongovernmental actors’ behaviors.¹³ This interpretation is critical when analyzing the implications of the United States and its partners’ increased desire to utilize dual-use satellites for national security.

Law of Armed Conflict/International Humanitarian Law

The United States, its Allies, and its partners treat the law of armed conflict—a collection of international treaties and customary international law—as a source of significant authority in military interventions and war.¹⁴ The American military applies LOAC based on international treaties, including the 1949 Geneva Conventions, customary international law, and domestic laws and regulations.¹⁵ Based on this set of treaties and customary laws, many states and organizations, including the United States and its Allies, have begun extrapolating laws applicable to outer space, recently named the US military’s newest warfighting domain.¹⁶ Notably, the *Oslo Manual* determines that LOAC rules prevail over the rules of the law of outer space, which are *lex generalis*, when states are parties to armed conflict.¹⁷

This article will discuss the three commonly accepted LOAC principles of military necessity, distinction, and proportionality. Military necessity refers to taking “measures which are actually necessary to accomplish a legitimate military purpose.”¹⁸ Next, the rule of distinction states that civilians and combatants must be distinguishable, and attacks must only be directed against combatants.¹⁹ Finally, the rule of proportionality prohibits an attacker from “launching an attack which may be expected to cause incidental loss of civilian life, damage to civilian objects, or a combination thereof, which would be excessive in relation to the . . . military advantage anticipated.”²⁰ For example, collateral damage may result when attacking dual-use targets. Actors that strike those targets must consider that their destruction “may be disproportionate to the expected military advantage.”²¹

12. Outer Space Treaty.

13. Blount, “Renovating Space,” 518.

14. Bryan Frederick and David E. Johnson, *The Continued Evolution of US Law of Armed Conflict Implementation: Implications for the US Military* (Santa Monica, CA: RAND Corporation, 2019), 1.

15. Frederick and Johnson, 2–3.

16. Everett C. Dolman, “Space is a Warfighting Domain,” *Æther: A Journal of Strategic Airpower & Spacepower* 1, no. 1 (Spring 2022), <https://www.airuniversity.af.edu/>.

17. Dinstein and Dahl, *Oslo Manual*, 5.

18. International Committee of the Red Cross (ICRC), “Military Necessity,” ICRC (website), n.d., <https://casebook.icrc.org/>.

19. ICRC, “Rule 1. The Principle of Distinction between Civilians and Combatants,” International Humanitarian Law (IHL) Databases, n.d., <https://ihl-databases.icrc.org/>.

20. ICRC, “Rule 14. Proportionality in Attack,” IHL Databases, n.d., <https://ihl-databases.icrc.org/>.

21. Human Rights Watch (HRW), *Off Target: The Conduct of the War and Civilian Casualties in Iraq* (New York: HRW, 2003), 42.

The US military applies international humanitarian law, now through the *Law of War Manual*, when deciding on rules of engagement, no matter the warfighting domain.²² The United States expects its Allies, partners, and adversaries to conform to the LOAC as well. The following section will explore three examples of strikes on dual-use structures to later analogize to the space domain.

Operation Allied Force

During the Kosovo War, Serbian leader Slobodan Milošević violated what one legal analyst refers to as “reverse distinction”—the corollary to the principle of distinction that “requires that military personnel and assets be effectively separated from their civilian counterpart to shield potential military targets from destruction.”²³ In fact, Milošević “conspicuously recruited thousands of civilians—many of them wearing bull’s-eye T-shirts—to assemble on and around potential US bombing aim-points in Belgrade.”²⁴

This willful placement of civilians—the practice of using human shields—on a legitimate military target is incompatible with treaties and customary international humanitarian law, as well as LOAC. Many of the dual-use facilities consisted of legal military targets such as command-and-control nodes, leadership, lines of communication, and petroleum facilities. They were meant to create Serbian civilian pressure on Milošević’s government to terminate the conflict with Kosovo.²⁵ Despite Milošević’s use of human shields, NATO’s bombing campaign against civil-military dual-use targets by NATO forces eventually persuaded him to settle with NATO and Kosovar leadership.

For the most part, the United States and its NATO Allies abided by international humanitarian law during Operation Allied Force. The Alliance did not strike many strategic and critical targets because of the concern about distinction and an understanding that hitting civilian infrastructure would erode support for the Allied effort.²⁶ In fact, target approval took so long that fighter and bomber aircraft destroyed targets faster than new targets could be approved.²⁷ Brigadier General Randall C. Gelwix, the director of the Combined Air Operations Center leading the air campaign in Operation Allied Force, stated, “We had a playbook of 900 plays, but were only allowed to use 50 of them.”²⁸

22. DoD, *Department of Defense Law of War Manual* (Washington, DC: DoD, updated December 2016), <https://dod.defense.gov/>.

23. David A. Koplow, “Reverse Distinction: A US Violation of the Law of Armed Conflict in Space,” *Harvard National Security Journal* 13, no. 25 (2022): 51, <https://doi.org/>; and Goehring, “Capabilities in Space.”

24. Koplow, 24.

25. Stephen T. Hosmer, *The Conflict over Kosovo: Why Milosevic Decided to Settle When He Did* (Santa Monica, CA: RAND Corporation, 2001), 66.

26. Headquarters, US Air Force (HAF), *The Air War over Serbia: Aerospace Power in Operation Allied Force* (United States Air Forces in Europe Studies and Analysis Directorate, 2000), 26.

27. HAF, 26.

28. HAF, 26.

The primary reason for the delay thus involved obtaining legal approval of targets, many of which were considered dual-use. Legal and political authorization during the operation required a myriad of considerations: “Is this a legitimate target [under international law]? How does it relate to our military goals? What role does it play in our opponent’s system of operations, and how will it affect him if it is destroyed? Can we constrain our intended damage to this target only?”²⁹ NATO planners were conscientious in planning targets and gaining their approval to create an environment where Milošević would “sue for terms” and bend to NATO’s desired humanitarian and geopolitical outcomes.³⁰

One strike on a dual-use target, a major bridge in southern Serbia, occurred on May 30, 1999, in Varvarin.³¹ In the time between NATO’s first and second bomb strikes on the bridge, civilians reportedly gathered to care for the wounded. Initial accounts indicated that after the second round of bombs hit, the number of casualties totaled nine killed and 28 wounded.³² This attack on the Varvarin Bridge was one of several examples of NATO aircrew destroying targets during the operation that resulted in civilian deaths due to collateral damage, including a missile attack on a bus and a bridge attack where a passenger train was destroyed.³³

Implications

An analysis of strikes on dual-use targets during Operation Allied Force reveals the geopolitical implications, operational implications, and adherence to international humanitarian law.

Geopolitics. First, the strategic impact of NATO bombings during Phase I of the operation included an adverse reaction from the Yugoslav people, who blamed NATO for turning off their electrical power after NATO airstrikes hit Serbian power facilities. Additionally, NATO’s restraint in taking care in choosing targets that adhered to international humanitarian law “may actually have encouraged a resurgence of Serb nationalism and popular defiance.”³⁴ After increased strikes on infrastructure and supply lines in April and May 1999, about 500 civilians were killed by collateral damage, and about 900

29. Andrew Bacevich and Eliot Cohen, *War Over Kosovo: Politics and Strategy in a Global Age* (New York: Columbia University Press, 2002), 7.

30. Bacevich and Cohen, 7.

31. Eric Schmitt, “Allied Air Strikes Kill 9 on Busy Bridge in Serbia,” *New York Times*, May 31, 1999, <https://archive.nytimes.com/>.

32. Schmitt, 6.

33. Philip Shenon, “NATO Admits Missile Hit Bus but Says Bridge Was a Legitimate Target,” *New York Times*, May 1, 1999, <https://archive.nytimes.com/>; and “A Long Litany of NATO Mistakes Hits a New Low,” *Irish Times*, May 10, 1999, <https://www.irishtimes.com/>.

34. Bacevich and Cohen, *War over Kosovo*, 10.

were injured.³⁵ These civilian casualties increased scrutiny on NATO forces, especially given the intent of Operation Allied Force was “humanitarian intervention.”

Operations. Next, and apart from the Varvarin Bridge example referenced above, the operational implications of generally refraining from engaging dual-use targets resulted in a more protracted conflict than the NATO military planners initially desired. The Serbs believed they could continue to work and live normally since they were not being harmed, encouraging Milošević “to believe that he could wait NATO out—that the allied consensus would weaken or that international pressure would force an end to the bombing without obliging him to make any concessions.”³⁶

LOAC. Finally, NATO forces adhered to international humanitarian law during planning, although tactical decisions may have caused unwanted civilian casualties and collateral damage. American and NATO military planners went to great lengths to ensure the planned targets were consistent with international humanitarian law. While preparing for Operation Allied Force, American and NATO military strategy architects based their plans on three key requirements: “minimize collateral damage, avoid all friendly losses, and preserve the Yugoslav civil infrastructure.”³⁷ These dictations ensured that war planners, operators, and tacticians minimized casualties among the Serb people and collateral damage to targeted areas, adhering to LOAC principles of military necessity, proportionality, and distinction.³⁸

Israel and the Associated Press Building in Gaza

On May 15, 2021, the Israeli Defense Forces (IDF) attacked the Al-Jalaa Tower in the Gaza Strip. This building was considered a dual-use facility because it housed legitimate military targets, media offices such as the Associated Press and Al Jazeera, and civilian residences.³⁹ During this and similar IDF attacks on dual-use buildings, the Israeli forces provide a warning “soft knock” or “knocking on the roof”—in the form of small munitions—before using full kinetic force.⁴⁰ These warnings allow civilians and military personnel to leave urban structures targeted by the Israeli Air Force to mitigate collateral damage resulting from kinetic strikes against these large, in-place legitimate military targets.

Although the Israeli Defense Forces limited civilian casualties by providing its standard advance warning, the political and media fallout from the strike in Gaza was enormous because of the number of civilian residences and noncombatant media personnel working

35. Bacevich and Cohen, 22.

36. Bacevich and Cohen, 10.

37. Bacevich and Cohen, 4.

38. HAF, *Air War over Serbia*, 5.

39. Michael Schmitt, “Targeting Dual-use Structures: An Alternative Interpretation,” Lieber Institute—West Point, June 28, 2021, <https://lieber.westpoint.edu/>.

40. Raphael Cohen et al., *From Cast Lead to Protective Edge: Lessons from Israel’s Wars in Gaza* (Santa Monica, CA: RAND Corporation, 2017), 45, 67, <https://doi.org/>.

in the building.⁴¹ In fact, the airstrike provided Hamas and its supporters the opportunity for a “PR terror attack.”⁴² Even after the IDF released data proving there was a weapon in the basement of the building that could disrupt Israel’s Iron Dome missile defense system, the public and Hamas had already won the public affairs campaign to smear Israel and the IDF. In this situation, there was little Israel could do to prevent a negative public relations outcome because of the dual-use nature of the targeted structure.

Implications

Geopolitics. The strategic implications of most Israeli attacks on Palestinian-held territory in the West Bank or Gaza are more significant than most similar strikes by different countries worldwide. This is due to the incredible scrutiny of Israeli strikes on Hamas and Palestinian Islamic Jihad in the urban, densely populated Gaza Strip, and of more limited strikes against these groups in the West Bank.⁴³ The 2021 attack on the Al-Jalaa building in Gaza was no different. According to Human Rights Watch, although no one was hurt in the building strike, it destroyed many families’ homes and businesses.⁴⁴ A former IDF general, speaking to one of Israel’s most prominent media outlets, stated that the attack on the Al-Jalaa Tower caused “more damage to Israel’s image than it provided operational benefit.”⁴⁵

Operations. While the strike destroyed Hamas’ intelligence assets, the IDF was slow to provide a more detailed explanation of exactly which assets and never provided evidence for its claims.⁴⁶ Based on open-source reporting, the IDF “claimed the tower was used by Hamas to set up equipment to block GPS signals to interfere with the military’s Iron Dome missile defense system.”⁴⁷ If the IDF hit the specified target, the airstrike on the Al-Jalaa building could have saved many Israeli lives by ensuring the Iron Dome system adequately protected Israeli citizens from Hamas rocket launches into Israeli territory.

LOAC. In this case, opposing beliefs exist on whether Israel abided by international humanitarian law. Human Rights Watch, the Associated Press, and the Foreign Press Association argue there was insufficient evidence to prove the Al-Jalaa Tower was a

41. Zachary Keyser, “Israel Slammed for Strike on AP, Al Jazeera Gaza Offices in Attack on Hamas,” *Jerusalem Post*, May 16, 2021, <https://www.jpost.com/>.

42. *Jerusalem Post* Staff, “Gaza AP Building Strike was ‘Own-Goal’ for Israel – Ex-IDF General,” *Jerusalem Post*, October 25, 2021, <https://www.jpost.com/>.

43. Isabel Kerschner, “Israel Launches Biggest Air Attack on West Bank in Nearly Two Decades,” *New York Times*, July 7, 2023, <https://www.nytimes.com/>.

44. Human Rights Watch (HRW), “Gaza: Israel’s May Airstrikes on High-Rises,” HRW (website), August 23, 2021, <https://www.hrw.org/>.

45. Judah Ari Gross, “Former IDF General: Bombing AP Tower in Gaza in May Conflict Was an ‘Own Goal,’” *Times of Israel*, October 24, 2021, <https://www.timesofisrael.com/>.

46. Josef Federman, “‘Shocking and Horrifying’: Israel Destroys AP Office in Gaza,” Associated Press, May 15, 2021, <https://apnews.com/>.

47. Gross, “Former IDF General.”

legitimate military target; therefore, the Israeli strike was illegal.⁴⁸ On the other hand, the Israeli Defense Forces believed they targeted a legitimate military target and did so under international humanitarian law because the Hamas terror group was using the building. They warned building residents in advance—the so-called soft knock—giving them one hour to evacuate before the planned airstrike.⁴⁹

If Israel's allegation regarding Hamas' military use of the building is true, the terror group's employment of building residents as human shields—witting and unwitting—is consistent with previous group tactics, for example, the UN Relief and Works Agency's 2014 discovery of Hamas rockets stored in one of its Gaza Strip schools.⁵⁰

Overall, the negative strategic implications of striking a building that housed Western journalists and Palestinian civilians outweighed the strike's operational utility. The Israeli Defense Forces acknowledged they could have better explained to the public its reasons for targeting the Al-Jalaa building and will create better public affairs plans in the future for similar strikes.⁵¹

Russian Attacks on Ukrainian Dual-Use Infrastructure

On November 23, 2022, Russian forces executed coordinated missile attacks with cruise missiles and drones on Ukrainian infrastructure, including the state power grid and the water supply.⁵² In a single day, these attacks killed at least 12 civilians and injured more than 100 people around the Kyiv region.⁵³ Also, because of the strikes, at least two Ukrainian nuclear facilities were disconnected from the grid, increasing the electricity deficit in Ukraine. To date, the Russian attacks on Ukraine's infrastructure are ongoing. They have severely disrupted civilian lives and destroyed their property. Last fall in the span of about six weeks (October 10–November 25, 2022), at least 77 civilians were killed in attacks against infrastructure. As of mid-July 2023, at least 9,000 civilians have been killed since the beginning of Russian President Vladimir Putin's aggression against the country.⁵⁴

48. HRW, "Israel's May Airstrikes"; Federman, "Shocking and Horrifying"; and Keyser, "Strike on AP."

49. Gross, "Former IDF General."

50. Cohen et al., *Cast Lead*, 143.

51. Gross, "Former IDF General."

52. Thaisa Semanova, "Ukraine War Latest: 6 Million Still without Electricity after Russia's Nov. 23 Missile Attack," *Kyiv Independent*, November 26, 2022, <https://kyivindependent.com/>; and "For the Sake of Ukraine's People, Global Community' Russian Federation's Unjustified War Must Stop, Under-Secretary-General Tells Security Council," 9380th Meeting (PM), UN Meetings Coverage and Press Releases, UN (website), July 17, 2023, <https://press.un.org/>.

53. Office of the High Commissioner of Human Rights (OHCHR), "Ukraine: Attack on Civilians and Infrastructure," UN (website), October 11, 2022, <https://www.ohchr.org/>.

54. Semanova, "Ukraine War Latest"; and Unjustified War.

Implications

Geopolitics. When considering the overall strategic implications of these strikes, one should understand how they help or hurt Russia's standing in the international community and its geopolitical power. Although operationally Russia has had success with the attacks on potentially legal targets, much of the international community has denounced its actions. NATO Allies and partners continue to condemn Putin's illegal war against a sovereign Ukraine, and Ukraine is now considering seeking membership within the Alliance.⁵⁵ Although Russia initially gained territory after striking dual-use infrastructure in Ukraine, the strategic implications for Russia as a global power and influence are negative—the international community is increasingly viewing Russia as a pariah.

Operations. For Russian military forces, attacks on the power infrastructure have been operationally useful because they allowed them to maneuver in the cover of darkness, slowed Ukrainian defenses, and decreased fuel supplies crucial for Ukraine's logistics. These attacks allowed Russian forces not only to create immediate economic hardship and logistical problems for Ukrainian forces but also to apply psychological pressure on civilians who no longer had electrical power at home and work.⁵⁶ In the days and months that followed these intense attacks on Ukraine's power systems, Russia gained ground in the east of Ukraine to further its operational military objectives.⁵⁷

LOAC. When considering these attacks within the context of international humanitarian law, legal scholars suggest that some may be unlawful, but many may be legal.⁵⁸ The DoD *Law of War Manual* notes “electric power stations are generally recognized to be of sufficient importance to a State's capacity to meet its wartime needs of communication, transport, and industry so as usually to qualify as military objectives during armed conflicts.”⁵⁹ This is the US military's interpretation of LOAC, but other entities such as Human Rights Watch, the UN High Commissioner for Human Rights, and states including the United Kingdom believe these attacks are unacceptable and in violation of the law of war.⁶⁰

55. Jim Garamone, “Leaders Agree to Expedite Ukraine's NATO Membership,” DoD News, July 11, 2023, <https://www.defense.gov/>.

56. Andrian Prokip, “Russian Air Attacks on Ukraine's Power System,” *Kennan Institute* (blog), October 19, 2022, <https://www.wilsoncenter.org/>.

57. “Russia Attacks Ukrainian Power Grid and Gains Ground in the East,” Al Jazeera, February 10, 2023, <https://www.aljazeera.com/>.

58. Michael N. Schmitt, “Ukraine Symposium – Attacking Power Infrastructure under International Humanitarian Law,” Lieber Institute – West Point, October 20, 2022, <https://lieber.westpoint.edu/>.

59. DoD, *Law of War Manual*, 219.

60. HRW, “Ukraine: Russian Attacks on Energy Grid Threaten Civilians,” HRW, December 6, 2022, <https://www.hrw.org/>; OHCHR, “Ukraine”; and James Kariuki, “Russia's Systematic Attacks on Ukrainian Civilian Infrastructure Are Unacceptable, and Must End,” statement at the UN Security Council on Ukraine, November 23, 2022, <https://www.gov.uk/>.

Findings

The case studies above analyzed three independent variables related to strikes on dual-use terrestrial targets: geopolitical/strategic implications, operational implications, and adherence to international humanitarian law. Strategically, attacks on dual-use targets during Operation Allied Force, the Israeli-Palestinian conflicts in Gaza, and Russia's war against Ukraine have proven neutral or ineffective for the states' more significant geopolitical goals.

An analysis of the attacks in Serbia by the United States and NATO reveals geopolitical effects were minimal, although human rights organizations condemned the attacks when they resulted in the death or injury of civilians. In the case of the IDF attacks in Gaza, Israel experienced negative public affairs consequences because of the intense scrutiny by human rights organizations and news outlets. In addition, the strategic implications for Russia's actions in Ukraine have been negative, highlighted by the UN's condemnation of its attacks on civilian infrastructure and a lowering of Russia's international political standing.

Unlike the negative or neutral strategic outcomes, operationally, these dual-use target attacks successfully met military and security goals in all three cases; however, when considering adherence to international humanitarian law, these attacks show less clear results. In the cases of the NATO attacks against Serbian targets and in the case of the IDF attack against the Al-Jalaa building in Gaza, the attacker went to adequate lengths to ensure it was advised by military lawyers and minimized civilian casualties. And while there is no evidence Russian military commanders were well advised by their military lawyers, international law experts weighed in on the target selections and believed most aligned with international humanitarian law.

Despite Israel, NATO, and Russia forces executing attacks per the law of armed conflict, human rights organizations and international watchdogs argued there was more these militaries could have done to minimize collateral damage. Still, although the International Criminal Court has recently issued a warrant of arrest for Putin in the context of the war in Ukraine, no attackers have yet been found guilty in an international court for their strikes on the dual-use targets analyzed.⁶¹

Understanding the geopolitical and operational implications of these terrestrial dual-use target strikes can help to extrapolate the impact of similar strikes in outer space. Moreover, since the Outer Space Treaty extends international law, including the Charter of the United Nations, to outer space, the LOAC implications of terrestrial dual-use strikes may also be applicable to the newest operational domain.

61. International Criminal Court, "Situation in Ukraine: ICC Judges Issue Arrest Warrants against Vladimir Vladimirovich Putin and Maria Alekseyevna Lvova-Belova," press release, March 17, 2023, <https://www.icc-cpi.int/>.

Geopolitics

One implication of the increased intermingling of commercial space capabilities and services with military operations and derived effects, particularly when implementing military rules of engagement within LOAC, is the possibility of harming a state's international image. As with Israel's destruction of the Al-Jalaa building, striking or disabling dual-use satellites has the potential to begin a "naming and shaming" campaign against the aggressor. States or organizations like Human Rights Watch may choose to highlight the collateral damage inflicted on civilians by the disabling of these satellites, even if they were legal and valid military targets according to LOAC.

One difficulty with this type of campaign is that the aggressor must be known, which is more difficult to discern in the space warfighting domain than terrestrially. In space, even if one gathers intelligence from various sources, there will likely still be an incomplete picture of who and what was targeted.⁶² Also, one of the elements of LOAC, proportionality, must be considered when attacking a target. In the case of space objects, it is challenging to foresee civilian harm that results from kinetic or nonkinetic attacks on dual-use satellites.⁶³

Operations

The attacks on dual-use targets analyzed in this article achieved certain operational objectives. In these examples, NATO, Israel, and Russia destroyed important military targets relevant to their overall campaigns. Similarly, in a future conflict, destroying or disabling military space capabilities will be critical to gaining an advantage against an adversary, even if there is a successful naming-and-shaming campaign against the aggressor for its possible damage to civilian infrastructure.

In fact, the potential of the operational success of an attack on a dual-use satellite can be exemplified by Russia's nonkinetic attacks on the Viasat satellite internet network. In the opening days of Russia's war in Ukraine in February 2022, a Russian cyberattack took tens of thousands of Viasat modems offline.⁶⁴ Although there is no public data detailing the extent of the damage due to this attack, it is known that the modems had to be sent back to the factory to be replaced.⁶⁵ These communications were critical to Ukrainian first responders and military operations and most likely slowed down critical communications between Ukraine's leaders and military personnel during the invasion and into the following weeks.

62. P. J. Blount, "Targeting in Outer Space: Legal Aspects of Operational Military Actions in Space," *Harvard National Security Journal* (2012), <https://papers.ssrn.com/>.

63. Abdul Rehman Khan, "Space Wars: Dual-Use Satellites," *Rutgers Journal of Law and Public Policy* 14, no. 314 (Spring 2017): 5.

64. Elizabeth Howell, "Elon Musk Says Russia is Ramping Up Cyberattacks on SpaceX's Starlink Systems in Ukraine," *Space.com*, October 14, 2022, <https://www.space.com/>.

65. Howell.

Russia's actions prompted NATO and friendly state entities to reassess their collective sensing capabilities and organize to increase intelligence data-sharing. One example is SpaceX's Starlink network, which provided reliable, high-speed internet to Ukraine after the Russia Viasat attack disabled its military's ground-based internet connections.⁶⁶ Using these commercial satellites for Ukrainian military intelligence and communications underscores the importance of commercial satellite capabilities to warfighting. The high-resolution satellite imagery of commercial actors like Maxar and BlackSky and the communications capabilities of Starlink prove that militaries do not need government-specific satellites and capabilities to produce the data and insight necessary to fight and succeed in a conflict.⁶⁷

LOAC

In the terrestrial strikes against dual-use targets in the case studies, NATO and Israel went to great lengths to adhere to the law of armed conflict. Both actors ensured the targets they were striking were legal, and they abided by the principle of distinction by directing the attacks against military operations. In the case of Israel, human rights organizations and the media believed the attack on the Al-Jalaa Tower was unlawful because sources said Hamas had already moved its computers out of the building, altering the legality of the target.⁶⁸ Lastly, Russian military forces adhered to LOAC when striking Ukrainian dual-use infrastructure, although human rights organizations continue to argue that those strikes were unlawful because of the large number of civilian casualties. For all three case studies, implications of strikes on dual-use targets included negative media attention and intense scrutiny from international human rights organizations.

Although the law of armed conflict has been well studied, operationally used, and has precedents for use in the traditional warfighting domains, it has yet to be tested in the space domain. Also, since LOAC puts the protection of civilians at the center, and there are very few civilians in space, it is difficult to measure the extent to which civilians are affected by attacks on dual-use satellites. If, however, adversaries launched a massive cyber-attack on critical infrastructure satellites, the follow-on effects could be significant:

Televisions would go blank, mobile networks silent, and the internet would slow and then stop. Dependent on time stamps from GPS satellites, everything from stock markets to bank transactions to traffic lights and railroad switches would freeze. Airline pilots would lose contact with the ground, unsure of their position and without weather data to steer around storms. World leaders couldn't

66. Bec Shrimpton, "Starlink Satellite Support of Ukraine Shows Value of Government-Private Sector Cooperation," Australian Strategic Policy Institute (ASPI)-The Strategist, October 18, 2022, <https://www.aspistrategist.org.au/>.

67. Marisa Torrieri, "How Satellite Imagery Magnified Ukraine to the World," Via Satellite (website), October 24, 2022, <https://interactive.satellitetoday.com/>.

68. Adil Ahmad Haque, "The IDF's Unlawful Attack on Al Jalaa Tower," Just Security, May 27, 2021, <https://www.justsecurity.org/>.

communicate across continents. In the US military, pilots would lose contact with armed drones over the Middle East. Smart bombs would become dumb. Missiles would sit immobile in their silos. The US could lose early warning of nuclear attacks for parts of Earth.⁶⁹

In this worst-case scenario, there would be great harm to civilians in the terrestrial domains. Yet the second- and third-order effects of losing GPS satellites in a conflict that extends to outer space, for example, will remain largely unknown until these events occur, because analysts have yet to determine the total effects of such a strike.

The conflict in Ukraine also provided insight into Russia's beliefs about the law of armed conflict in outer space. At the UN General Assembly in 2022, the deputy director of the Russian Foreign Ministry's Department for Nonproliferation and Arms Control, Konstantin Vorontsov, stated, "If US satellites were used to aid Kyiv, they could be a legitimate target for a retaliatory strike."⁷⁰ This statement legitimizes Russia's attacks on dual-use satellites because, as Vorontsov argues, the satellites can be targeted in accordance with international law.

Recommendations

Based on the findings above, the United States, NATO, and other space powers must understand the strategic and operational consequences of strikes on dual-use satellites. If the target is legal in accordance with international humanitarian law, the geopolitical effects of these dual-use attacks would likely be minimal, but the potential collateral damage is still largely unknown. Also, although attacks on dual-use satellites might help near-term operational military goals, longer-term effects on the military operation may be both positive and negative. Additionally, responses to such attacks—as in the case of Starlink in Ukraine—may serve to increase the defender's resilience, nullifying those initial operational gains.

Considering geopolitical, operational, and LOAC outcomes from terrestrial attacks against dual-use targets and the certain increase in similar attacks against dual-use satellites as they proliferate and become more attractive military targets, states should consider more research on when it is appropriate to attribute an actor for disabling or destroying dual-use satellites that could cause harm to civilians or cause collateral damage. The most significant difficulty in enacting a naming and shaming campaign is attribution. As with the cyber domain, it may be challenging to know which actor is causing harm to assets

69. Jim Sciutto, "US Military Prepares for the Next Frontier: Space War," CNN Politics, November 29, 2016, <https://www.cnn.com/>.

70. Ann M. Simmons and Micah Maidenber, "Russia Says It Could Target US Commercial Satellites in Ukraine War," *Wall Street Journal*, October 27, 2022, <https://www.wsj.com/>.

in the space domain due to the physical distance from orbit and techniques that hide the attacker.⁷¹

Second, the Department of Defense should begin to measure the potential effects on civilian infrastructure when it chooses to intermingle military and commercial capabilities of satellites. Secretary of the Air Force Frank Kendall's first operational imperative involves greatly increasing the number of satellites in the US Space Force architecture, which may include adding military capabilities to commercial satellites.⁷² Because of this desired capability, the United States and its Allies must understand the potential collateral damage should an aggressor decide to extend a conflict into outer space and attack a dual-use satellite to gain operational advantage.

Finally, striking satellites in orbit does not only affect military capabilities or allow for terrestrial collateral damage. If they are kinetic, these attacks will also increase the amount of debris in orbits affecting the growing number of civil, military, and commercial assets in space. One only has to reflect on the November 2021 Russian antisatellite test to understand how one kinetic strike can interfere with and potentially degrade peaceful international efforts in space such as the International Space Station or cause satellites in orbit to use more fuel to maneuver away from the destructive debris.⁷³

Nations capable of creating this debris must also consider the second- and third-order effects of potentially causing orbits to be completely unusable for future satellite capabilities and how losing those capabilities will affect modern life on Earth.

Additionally, Russia and the United States have declared that the "destruction of a satellite should be considered an 'act of war.'" ⁷⁴ Using kinetic or nonkinetic weapons to destroy a satellite is likely to begin a conflict, increase orbital debris, and change the character of war. World leaders must seriously consider these ramifications before approving attacks on outer space assets.

Several other implications not studied in this article that should be explored in future research are the need for indemnification of commercial companies' assets used for national security, the state's protection and defense of commercial companies' dual-use satellites, strategic implications of intermingling commercial and nuclear command and control satellites, and the regulation of companies that provide military services on commercial assets by governing organizations. International humanitarian law experts should

71. Office of the Director of National Intelligence (ODNI), *Annual Threat Assessment of the U.S. Intelligence Community* (Washington, DC: ODNI, February 6, 2023), 8, 16, <https://www.dni.gov/>; and Niall Firth, "How to Fight a War in Space (and Get Away with It)," *MIT Technology Review* 122, no. 4 (July/August 2019), <https://www.technologyreview.com/>.

72. Charles Pope, "Kendall Highlights Space's Importance, Need to 'Transform' Operations and Thinking for the Domain," US Space Force (website), April 5, 2022, <https://www.spaceforce.mil/>.

73. Shannon Bugos, "Russian ASAT Test Creates Massive Debris," Arms Control Association, December 2021, <https://www.armscontrol.org/>.

74. Tim Martin, "Space Force Should Offer European Allies Protection from Anti-Satellite Attacks: Saltzman," Breaking Defense, July 17, 2023, <https://breakingdefense.com/>.

also continue exploring the threshold for using force in outer space, particularly since most known attacks are nonkinetic and include cyber, directed energy, and electronic warfare.

The growing militarization and weaponization of space, along with a critical reliance on dual-use satellites, necessitates a careful consideration of lessons learned from terrestrial strikes against analogous dual-use targets. Military and political decisionmakers must consider the implications for geopolitics, operations, and international humanitarian law before considering kinetic or nonkinetic attacks on targets in outer space. The key outcomes and effects from those terrestrial operations will help when planning for and conducting operations against similar objectives in space and will ensure states are adhering to international law. → ✨

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